Revision der Spinnenfamilie Psechridae (Arachnida: Araneae): Biodiversitätsforschung und Phylogenie mithilfe morphologischer und molekularer Methoden

Dissertation

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Vorbemerkungen:

Die vorliegende Arbeit ist in Form einer publikationsbasierten Dissertation angelegt. Sie besteht aus den folgenden drei Publikationen, welche dem Ergebnisteil dieser zusammenfassenden Darstellung beigefügt sind:

Bayer, S. (2011): Revision of the pseudo-orbweavers of the genus *Fecenia* Simon, 1887 (Araneae, Psechridae), with emphasis on their pre-epigyne. *Zookeys* 153: 1–56.

Bayer, S. (2012): The lace-sheet-weavers—a long story (Araneae: Psechridae: *Psechrus*). *Zootaxa* 3379: 1–170.

Bayer, S. & Schönhofer, A. (2012): Phylogenetic relationships of the Psechridae with comments on the family group Lycosoidea (Arachnida: Araneae) as inferred from molecular data. *Invertebrate Systematics*, in press, ca. 35 pp.

Alle drei Publikationen sind in dieser Reihenfolge (also alphabetisch, dann chronologisch) beigefügt. Die vorliegende, in deutscher Sprache gehaltene Ausführung ist als Einführung in die Thematik sowie als zusätzliche Darstellung, welche die drei Einzelpublikationen im Lichte des Gesamtvorhabens bewertet und zusammenfasst, zu verstehen.

Gemäß Punkt (7) der Ausführungsbestimmungen für publikationsbasierte Dissertationen im Promotionsfach Biologie im Rahmen des Beschlussprotokolls der 26. Sitzung des Fachbereichsrates Biowissenschaften der Goethe-UNI, Frankfurt/Main vom 07.07.2008 liefere ich folgenden schriftlichen Beleg über meinen Beitrag zur Publikation Bayer und Schönhofer (2012):
Für ca. 10 Spinnen-Exemplare wurden die DNA-Extraktionen, die PCR’s sowie die nachfolgenden Aufreinigungen von mir durchgeführt. Die entsprechende Aufarbeitung der Gewebeproben der restlichen Exemplare (exklusive der Exemplare, deren Sequenzen aus der Gendatenbank [“GenBank“, NCBI] stammten) wurden bei der Firma SRD, Bad Homburg in Auftrag gegeben, da diese Bearbeitung ansonsten den zeitlichen Rahmen des vorliegenden Projektes gesprengt hätte (siehe Tab. 1 in Bayer und Schönhofer [2012]). Die Sequenzierungen (BigDye Terminator Cycle Sequencing Kit v. 3.1) wurden alle von SRD durchgeführt und mir danach in Form von durch das Sequenzierungs-Programm voreditierten Sequenz-Dateien per e-mail-Anhang zur Verfügung gestellt. Die Sequenzen wurden dann aufgearbeitet und editiert (Abgleich zwischen forward- und reverse-Sequenz, Test-Alignierungen mit bereits vollständig bearbeiteten Sequenzen, manuelle Bereinigung von System-„Fehlinterpretationen“, Kürzung auf jeweils untersuchten Abschnitt), aligniert, in verschiedene Dateiformate gebracht (z.B. NEXUS, FASTA) und die Neighbor Joining-Auswertung im Programm MEGA durchgeführt. Die meisten der Außengruppentaxa in Bayer und Schönhofer (2012), die aus der Gendatenbank („GenBank“, NCBI) stammten (insgesamt 33, siehe Tab. 2 in Bayer & Schönhofer 2012), wurden von mir recherchiert, nacheditiert und aligniert. Die Ergebnisse aus den verschiedenen Auswertungen (Maximum Likelihood, Bayesian analysis, Neighbor Joining) wurden mit Hilfe von verschiedenen Baumbearbeitungs-programmen in übersichtliche Form gebracht.
Die gesamte Literaturrecherche, die Verfassung der Einleitung und der weitaus größte Anteil der Diskussion wurden von mir beigesteuert. Auch die schriftliche

Darstellung der Abschnitte „Material and Methods“, „Results“ sowie „Abstract“ wurde im wesentlichen von mir durchgeführt.

1. EINLEITUNG

1.1 Vorstellung des Projektes

Zwischen 2003 und 2008 sammelte Dr. Peter Jäger in verschiedenen Forschungsreisen nach Laos (u.a.) Spinnen der Gattung *Psechrus* Thorell 1878. Keine davon konnte bereits bekannten Arten zugeordnet werden. Jäger (2007) beschrieb Formen aus den Regionen um Thakek zum einen sowie Luangprabang zum anderen jeweils als neue Arten, *P. khammouan* Jäger 2007 und *P. luangprabang* Jäger 2007. Da ihm noch eine beachtliche Menge von weiterem, unbekanntem Material aus vielen, verschiedenen Regionen Südostasiens vorlag, was zu einem erheblichen Teil freundlicherweise von Fachkollegen zur Verfügung gestellt wurde, schloss er daraus, dass die Diversität dieser Gattung deutlich größer sein muss als bis dato aufgrund von vorhandenen taxonomischen Publikationen angenommen (z.B. Levi 1982; Wang und Yin 2001). Im Vergleich zu anderen Spinnenfamilien waren die Psechriden bis zu jenem Zeitpunkt nur unzureichend revidiert. Levi (1982) fertigte zwar eine Revision der bislang bekannten Psechriden des gesamten tropisch asiatischen Verbreitungsgebietes an, untersuchte aber nur geringe Individuenzahlen von den einzelnen Arten und stellte nur in einigen Fällen intraspezifische Variabilität dar. Wang und Yin (2001) beschränkten sich bei ihrer Revision auf chinesische Vertreter dieser Familie und verzichteten gänzlich auf die Darstellung intraspezifischer Variabilität. Von 1982 bis 2009 wurden viele, weitere *Psechrus* Arten und auch eine Art aus der Gattung *Fecenia* Simon 1887 neu beschrieben (*Fecenia* ist die zweite der beiden Gattungen welche die Familie Psechridae bilden). Eine detaillierte Revision dieser Familie war also dringend nötig geworden. Aus diesem Grund, und weil die beiden Gattungen *Psechrus* (siehe Bayer 2012, Abb. 93a–b) und *Fecenia* (siehe Bayer 2011, Abb. 120) deutlich unterschiedliche Fangnetze herstellen, was großes Interesse bei mir weckte, habe ich die Revision dieser Familie als Promotionsthema ausgewählt. Diese unterschiedlichen Netzformen könnten möglicherweise ein Indiz dafür sein, dass beide Gattungen, entgegen der Auffassung bisheriger Autoren (z.B. Levi 1982; Wang und Yin 2001; Griswold 1993), doch nicht monophyletisch sind. Im Rahmen der Revision wurden die Typus-Exemplare der jeweiligen validen aber auch synonymisierten Arten bei den jeweiligen Museen angefordert oder bei Museumsbesuchen direkt vor Ort ausgeliehen. Während Museumsbesuchen in Paris, London und Wien musste ich feststellen, dass eine grosse Anzahl der dort vorhandenen *Psechrus*- sowie *Fecenia*-Exemplare fehlbestimmt waren, was den dringenden Bedarf einer grundlegenden Revision dieser Familie nur um so deutlicher machte. Als erstes, kleineres Teilprojekt dieser Revision wurden zunächst die restlichen, unbekannten *Psechrus*-Exemplare aus Laos neu beschrieben (Bayer und Jäger 2010). Die taxonomischen Revisionen von *Fecenia* (Bayer 2011) sowie von *Psechrus* (Bayer 2012) folgten.

Über die phylogenetisch-systematische Position der Psechriden wurden bislang unterschiedliche Auffassungen veröffentlicht. Thorell, der die Gattungen *Psechrus* (1878) und *Fecenia* (1881) (letztere damals noch unter dem präokkupierten Namen *Mezentia*) erstmals beschrieb, rechnete beide Gattungen zu den Amaurobiidae. Simon (1890) transferierte beide Gattungen in die neu aufgestellte Familie Psechridae und führte diese unter den Cribellatae, also der, nach seiner Ansicht, monophyletischen Gruppe von Spinnen, die Cribellum und Calamistrum (siehe Abschnitt 1.2) besitzen (Simon 1892). Petrunkevitch (1923, 1928, 1939) wiederum, der die Cribellatae als monophyletische Gruppe nicht anerkannte (eine Meinung, die auch heute von Arachnologen allgemein geteilt wird), sah eine nahe Verwandtschaft der Psechridae insbesondere zu den Agelenidae. Die meisten Autoren (Homann 1971; Levi 1982; Griswold 1993; Silva 2003; Griswold et al. 2005) platzierten die Psechriden in die Überfamilie Lycosoidea. Oben wurde bereits angemerkt, dass das Typenmaterial nahezu aller Arten der beiden Gattungen der Psechridae sowie umfangreiches Material aus vielen verschiedenen Regionen Südostasiens zur Verfügung stand. Ein beachtlicher Teil dieses Materials war frisch gesammelt und in unvergälltem Ethanol aufbewahrt, so dass es für DNA-Extraktionszwecke tauglich war. Mit molekularen Methoden wurde im Zusammenhang der vorliegenden Revision nicht nur versucht, die Stellung der Psechriden im System der Spinnen (Araneae) herauszufinden, sondern auch die phylogenetischen Beziehungen der beiden Gattungen innerhalb der Familie sowie der einzelnen Arten innerhalb der beiden Gattungen. Die vorliegende Studie über die Spinnenfamilie Psechridae stellt also ein sehr gutes Fallbeispiel dar, um herauszufinden, ob Ergebnisse aus morphologisch-taxonomischer Bearbeitung, welche eine fundierte Merkmalsanalyse beinhalten, durch Ergebnisse molekularer Methoden bestätigt werden können. Für die molekulare Bearbeitung wurden die Markergene COI und 28S rRNA für 26 *Psechrus* und 4 *Fecenia* Arten sowie ca. 50 Außengruppentaxa sequenziert und durch die phylogenetischen Auswertungsmethoden „Maximum Likelihood“ und „Bayesian Analysis“ analysiert. Zudem wurden einige Taxa inkludiert, welche in früheren Publikationen zu den Psechriden gezählt wurden, *Stiphidion* Simon 1902, *Tengella* Dahl 1901, *Themacrys* Simon 1906 und *Poaka* Forster & Wilton 1973. Weiterhin wurden die in den taxonomischen Arbeiten (Bayer 2011, 2012) aufgestellten Arthypothesen mit Hilfe der Sequenzanalyse der sogenannten „Barcoding“-Region des COI Gens getestet (Neighbor Joining, Bayesian Analysis). Vorläufige Ergebnisse aus dem vorliegenden Promotionsprojekt wurden bereits in Seminaren in den Forschungsinstituten der Naturkundemuseen in Paris (2009) und Wien (2009) sowie auf arachnologischen Kongressen in Siedlce (Polen, 2010) sowie Berlin (2010) in Form von Vorträgen vorgestellt. Auf dem diesjährigen arachnologischen Kongress in Ljubljana (Slowenien, 2012) wurden die Gesamtergebnisse des vorliegenden Projektes vorgestellt.

1.2 Einführung und allgemeine Charakteristika der Psechridae

Die Psechriden sind hauptsächlich im tropischen Asien verbreitet, und kommen von Indien und Sri Lanka im Westen bis hin zu den Solomonen vor, welche den östlichsten Teil des Gesamtverbreitungsgebietes darstellen. Im Süden liegt die Verbreitungsgrenze im nördlichsten, tropischen Teil von Queensland, Australien. Die Verbreitungsgebiete der Gattungen *Psechrus* und *Fecenia* sind fast identisch. Lediglich die Nordverbreitungsgrenze von *Fecenia* (bis etwa Höhe Nordgrenze Vietnam, ca. 23° N) reicht nicht ganz so weit wie die von *Psechrus* (bis etwa 34° N).
Als Vertreter der Unterordnung der araneomorphen Spinnen haben die Psechriden nach ventral gerichtete Cheliceren, deren Endklauen gegeneinander arbeiten (Abb. 1, 2b), und nur ein Paar Buchlungen (Abb. 1b).

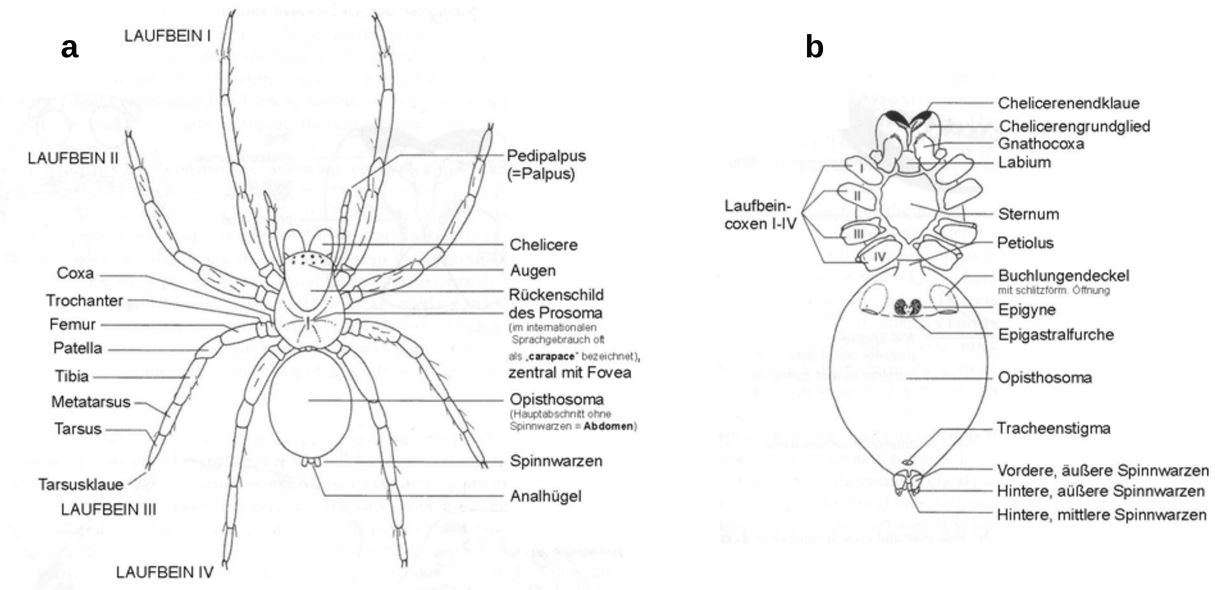

Abb. 1 Habitus einer araneomorphen Spinne (Weibchen), von dorsal (**a**) und ventral (**b**). Verändert nach Jocqué und Dippenaar-Schoeman (2006).

Die Psechriden sind recht schlank und langbeinig (Bayer 2011, Abb. 117, 119; Bayer 2012, Abb. 81c–d) und besitzen 8 Augen in zwei Reihen (Abb. 1a, 2a), die erste Reihe rekurv (Abb. 2a, anteriore Augenreihe) und die zweite entweder rekurv (*Psechrus*) oder gerade (*Fecenia*). Lateral an den Basen der Chelicerengrundglieder besitzen sie jeweils einen Condylus (Abb. 2c).

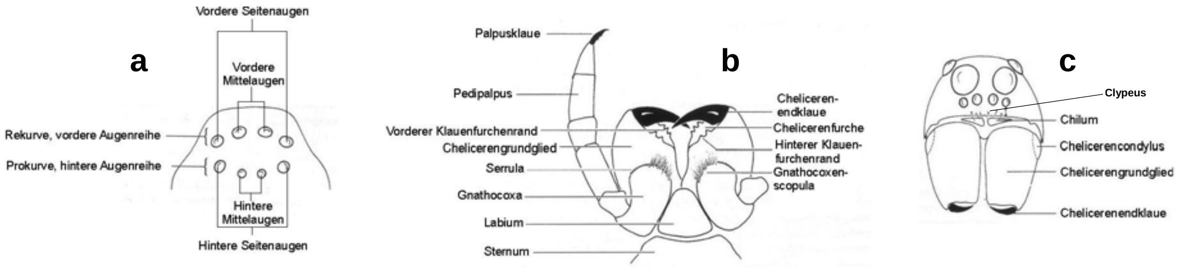

Abb. 2 Prosoma einer araneomorphen Spinne. **a** Augenregion, dorsal. **b** anteriorer Abschnitt, ventral. **c** Prosoma, frontal. Verändert nach Jocqué und Dippenaar-Schoeman (2006).

Beide Gattungen, *Psechrus* und *Fecenia*, stellen Fangnetze mit sogenannten cribellaten Fangfäden her. Das sind Fäden die von einigen Schlingen von Kräuselfäden umgeben sind, auf die dann eine dicke Schicht von Cribellumwolle aufgetragen wird. Diese Wolle besteht aus etlichen mikroskopisch kleinen Einzelfäden, die von mehreren hundert (bei einigen Spinnenarten sogar mehrere tausend) kleinen Spinnspulen des Spinnsiebes (Cribellums, Abb. 3a), hergestellt werden. Diese werden dann in Form von erstaunlich schnellen, rhythmischen Bewegungen durchgekämmt und jeweils mit einem der beiden Beine des vierten Beinpaares auf die jeweiligen Basisfangfäden aufgebracht. Beim Durchkämmen kommt der Kräuselkamm, das Calamistrum (Abb. 3b) zum Einsatz, welches sich dorso-retrolateral auf dem Metatarsus des vierten Beinpaares befindet. Cribellate Fangfäden sind außerordentlich adhäsiv und somit sehr effektiv, allerdings ist ihre Herstellung für die Spinne weitaus zeitaufwendiger als die von beispielsweise Klebefangfäden.

Abb. 3 Cribellum (**a**) und Calamistrum (**b**) von *Psechrus*. Verändert nach Jocqué und Dippenaar-Schoeman (2006).

Die folgende Kombination von Merkmalen ist laut Simon (1892) und Levi (1982) diagnostisch für Psechriden: Tarsen distal mit drei Klauen (die mittlere mit einem großen Zahn, die beiden äußeren mit vielen, schmalen Zähnen) und (zwei) Haarbüscheln (Abb. 4b); Nebenaugen mit rostförmigem Tapetum (Abb. 4a); Calamistrum aus mind. 3 Reihen von Borsten bestehend (Abb. 4c).

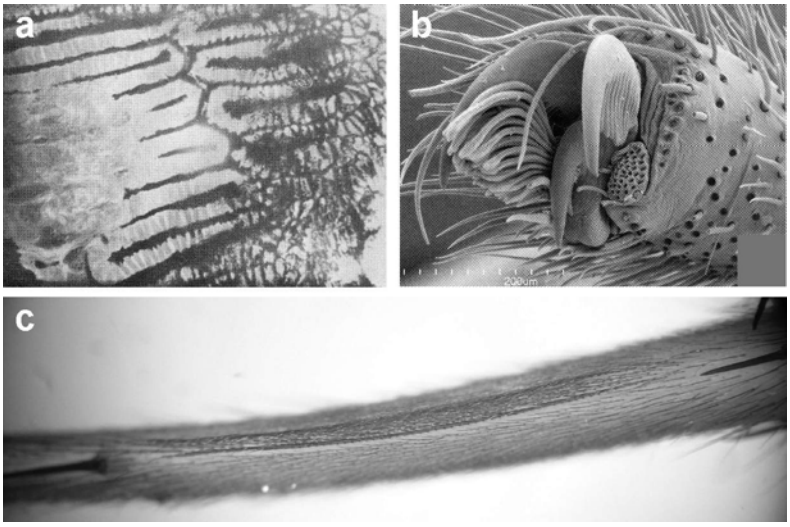

Abb. 4 Diagnostische Merkmale der Psechriden (hier *Psechrus*). **a** Rostförmiges Tapetum der Nebenaugen [aus Levi (1982)]. **b** Tarsusspitze von latero-distal: Drei Tarsalklauen und zwei apikale Haarbüschel (eines davon entfernt) [aus Griswold et al. (2005)]. **c** Calamistrum auf Metatarsus IV, hier aus 4–5 Reihen von Borsten bestehend.

Die wichtigsten Unterschiede zwischen *Psechrus* und *Fecenia* sind: 1) Die Augen und deren Anordnung: Die vorderen Mittelaugen stellen bei *Fecenia* die größten dar, bei *Psechrus* (mit) die kleinsten. Die hintere Augenreihe ist bei *Fecenia* gerade, bei *Psechrus* leicht rekurv. 2) Das Opisthosoma besitzt bei *Fecenia* ventral 2 helle Flecken auf dunklem Untergrund (Bayer 2011, Abb. 116) und bei *Psechrus* eine helle, dünne Medianlinie (Bayer 2012, Abb. 81c–g, 93a). 3) Der Clypeus, also der Prosoma-Abschnitt zwischen Vorderaugen und anteriorem Prosomarand, ist bei *Psechrus* deutlich höher als bei *Fecenia.* 4) Das vierte Beinpaar ist bei *Fecenia* stets kürzer als das zweite, bei *Psechrus* entweder etwas länger oder ca. gleich lang als das zweite. 5) Die Männchen von *Fecenia* besitzen Pedipalpen mit Apophysen an Patella, Tibia sowie am Bulbus (Bayer 2011, Abb. 53), welche bei *Psechrus* fehlen. 6) Die Weibchen von *Psechrus* besitzen Vulven mit sphärischen Spermathekenköpfen (‚spermathecal heads', Bayer 2012, Abb. 51b), welche in dieser Ausprägung bei den Weibchen von *Fecenia* fehlen.

Der augenfälligste Unterschied zwischen den beiden Gattungen bezieht sich jedoch nicht auf den Spinnenkörper, sondern auf das Fangnetz. *Psechrus* stellt, meist zwischen Geröll, Felsspalten, Baumwurzeln, Baumlöchern, Totholz oder unterhalb sandiger oder lehmiger Überhänge, meist in Wäldern, eine großflächige, leicht gewölbte, horizontale Gewebedecke her, die auf einer Seite in eine schmale Röhre mündet, welche in einem geschützten, dunklen Schlupfwinkel endet. Die Spinne bewegt sich außerordentlich schnell (mit dem Bauch nach oben), unterhalb dieser Gewebedecke (Bayer 2012, Abb. 93a–b). Man findet *Psechrus*-Netze aber mitunter auch synanthrop, z.B. in alten Schuppen oder dem Außenbereich von Gebäuden. Das Netz von *Fecenia*, was im Blattwerk von Bäumen oder Büschen ausgespannt wird, unterscheidet sich deutlich. Und zwar weben die Vertreter dieser Gattung ein vertikales Netz, was den Netzen der Radnetzspinnen (Araneidae) und deren Verwandten (z.B. Streckerspinnen, Tetragnathidae) bzw. denen der Kräuselradnetzspinnen (Uloboridae) stark ähnelt, aber deutlich unregelmäßiger ist (Bayer 2011, Abb. 120) und als konvergentes ’Radnetz’ aufzufassen ist, da *Fecenia* mit den vorgenannten Familien nicht näher verwandt ist (Coddington 1990). In Bayer (2011) wurde es daher als „pseudo–orbweb“ (Pseudo-Radnetz) bezeichnet. Ins Zentrum des Netzes wird stets ein eingerolltes Blatt integriert, welches als Schlupfwinkel für die Spinne dient, und welches sie nur zum Beutefang und zur Netzausbesserung verlässt. Des Nachts, in ihrer Hauptaktivitätszeit, sitzt sie dann in der Mündung des Blattes und streckt ihre Beine auf der Netzfläche aus. Wie oben bereits erwähnt, könnten diese deutlich unterschiedlichen Netzformen die Frage aufwerfen, ob die Psechridae, mit *Psechrus* und *Fecenia*, tatsächlich ein monophyletisches Taxon darstellen.

Über Beutefangverhalten beider Gattungen und Paarungsverhalten von *Fecenia* berichteten Robinson und Lubin (1979). Die Vertreter beider Gattungen ergreifen kleine Beutetiere mit den Cheliceren und zerren sie direkt in den Schlupfwinkel. Größere Beute wird zunächst durch einen Giftbiss attackiert und die Spinne zieht sich in den Schlupfwinkel zurück. Nach einigen Minuten kehrt sie zur (gelähmten) Beute zurück und spinnt sie mit wenigen Fäden ein, um sie besser (mit den Cheliceren) zum Schlupfwinkel transportieren zu können (Robinson und Lubin 1979). Dies ist bei *Fecenia* besonders wichtig, weil sich hier die Spinne vertikal im Netz bewegt und sich die Beute ansonsten u.U. leichter irgendwo verhaken und beim Loslassen aus den Cheliceren (also auch aus dem Netz) fallen könnte. *Psechrus* befindet sich zumindest mit dem vorderen Prosomabereich unterhalb der Beute, so dass die Wahrscheinlichkeit ohnehin geringer wäre, dass die Beute bei einem kurzfristigen Loslassen aus dem Netz herausfallen könnte. Ein sogenanntes „attack wrapping“, also ein schnelles, heftiges Einwickeln der Beute mit Unmengen von Fäden, direkt nach dem Giftbiss, so wie es bei den Araneiden (Radnetzspinnen) und den anderen o.g. Familien der Fall ist, kommt bei Psechriden nicht vor. *Fecenia* ernährt sich hauptsächlich von Nachtschwärmern und Motten, aber auch von anderen (nicht hartschaligen) Fluginsekten. Das Beutespektrum von *Psechrus* ist vielfältig. Manchmal sind es Orthopteren, manchmal Fluginsekten oder in seltenen Fällen auch andere Spinnen, die versehentlich auf die Netzdecke fallen. Selbst Ameisen werden nicht verschmäht (Robinson und Lubin 1979, eigene Beobachtungen).

Das Paarungsverhalten bei *Fecenia* ist von einer langen „Annäherungsphase“ des Männchens gekennzeichnet, indem es sich auf dem Schlupfwinkel des Netzes des Weibchens durch zarte Klopf- und Streichbewegungen (Bayer 2011, Abb. 121) bemerkbar macht, dies mit vielen Unterbrechungsphasen des Stillsitzens auf dem eingerollten Blatt. Die Paarung selbst findet im eingerollten Blatt oder im Bereich der Mündung desselben (fast ausschließlich nachts) statt, danach kann sich das Männchen noch einige Zeit zusammen mit dem Weibchen im Blatt aufhalten.

Für Artbestimmungen von einzelnen Vertretern der beiden Gattungen der Psechriden gilt, wie für die meisten anderen Spinnengruppen, dass artspezifische Merkmale meist in der Struktur der Kopulationsorgane zu finden sind. Alle Arten innerhalb der betrachteten Gattung oder Arten innerhalb von Artengruppen einer Gattung ähneln sich bezüglich des Habitus, der Färbung und Zeichnung sowie anderen somatischen Merkmalen meistens so stark, dass eine Artunterscheidung mit diesen Merkmalen allein nicht möglich ist. Stattdessen müssen die Kopulationsorgane sauber freipräpariert, detailliert untersucht und mit denen anderer Arten verglichen werden. Bei den Weibchen untersucht man zum einen die Epigyne, den äußeren Teil des sklerotisierten Kopulationsorgans, welche ventral im anterioren Drittel des Hinterleibes (Opisthosoma) zentral anterior der Epigastralfurche zu finden ist (Abb. 1b), und zum anderen die Vulva, den von außen nicht sichtbaren, dorsal der Epigastralfurche befindlichen Teil (siehe für *Psechrus* z.B. Bayer 2012, Abb. 2h; für *Fecenia* z.B. Bayer 2011, Abb. 83). Letztere besteht aus: 1) Den beiden, jeweils mit einer Einführöffnung beginnenden Einführgänge; 2) Den Spermatheken (Receptacula seminis), in denen die männlichen Samen lange Zeit gespeichert und am Leben erhalten werden können; 3) Den Befruchtungsgängen, durch welche die Spermien kurz vor der Befruchtung, welche unter Umständen erst lange Zeit nach der Begattung eintritt, hindurchwandern, um im Uterus die Eizellen zu befruchten. Bei den subadulten sowie prä-subadulten Weibchen erkennt man zentral anterior der Epigastralfurche bereits Vorläuferstrukturen der Epigyne, die jedoch deutlich kleiner, weniger strukturiert und noch nicht funktionsfähig sind, die ‚Prä-Epigyne' (Bayer 2011, Abb. 20, 58, 80, 81) bzw. die ‚Prä-Prä-Epigyne' (Bayer 2011, Abb. 22, 82). Bei Vertretern anderer Spinnenfamilien wurden z.T. auch bei juvenilen Weibchen aus noch jüngeren Stadien Epigynenvorläuferstrukturen entdeckt (Sierwald 1989). Bei *Pisaurina mira* (Walckenaer 1837) sogar schon beim fünften Stadium vor dem Adultstadium (Sierwald 1989). Eine solche Vorläuferstruktur würde man demnach als ‚5x Prä-Epigyne' bezeichnen. Bei den Männchen sind die Strukturen des Pedipalpus entscheidend, vor allem die des letzten Gliedes, des Cymbiums mit dem daran befindlichen Bulbus (genauer: Bulbus genitalis) (Bayer 2011, Abb. 8; Bayer 2012, Abb. 25b). Ein Penis fehlt bei Spinnen, bei ihnen dient der Pedipalpus samt Bulbus als Spermaübertragungsorgan (Foelix 1993). Die Spermien werden in Form eines Spermatropfens durch die Geschlechtsöffnung unterhalb der Epigastralfurche zunächst auf ein kleines Spermanetz abgegeben und hiernach durch den Embolus des Bulbus aufgesogen und innerhalb des Tegulums, also des sklerotisierten Hauptkörpers des Bulbus, in den dort befindlichen Samenschlauch eingelagert (Foelix 1993). Aus dem Tegulum entspringt nicht nur der Embolus, der ins weibliche Kopulationsorgan eindringende Teil, sondern auch der Konduktor, der Schutz- bzw. Führungsfunktion für den Embolus hat. Bei einigen Spinnentaxa (darunter *Fecenia*) befinden sich am Tegulum weiterhin eine bzw. bei einigen anderen Spinnenfamilien mehrere zusätzliche Apophysen oder Fortsätze anderer Art. Die Kopulationsorgane von artgleichen Männchen und Weibchen passen strukturell so zueinander, dass während der Kopulation eine stabile Position gewährleistet ist. Zumeist passen sie auch von den Dimensionen her zueinander. Besitzt z.B. ein Männchen einen langen Embolus, so weist das konspezifische Weibchen zumeist auch einen langen Einführgang in seiner Vulva auf.

1.3 Taxonomische Bearbeitung der Gattung *Psechrus* bis 2009

Bis zum Zeitpunkt meiner Doktorarbeit waren aus der Gattung *Psechrus* 22 valide Arten bekannt:

Psechrus	
Valide Arten:	**Synonyme:**
P. argentatus (Doleschall 1857)	*P. castaneus* Hogg 1914; *Uloborus flavolineatus* Rainbow 1898
P. borneo Levi 1982	
P. cebu Murphy 1986	
P. ghecuanus Thorell 1897	
P. himalayanus Simon 1906	
P. jinggangensis Wang & Yin 2001	
P. kenting Yoshida 2009	
P. khammouan Jäger 2007	
P. kinabalu Levi 1982	
P. kunmingensis Yin, Wang & Zhang 1985	
P. luangprabang Jäger 2007	
P. marsyandi Levi 1982,	
P. mulu Levi 1982	
P. rani Wang & Yin 2001	
P. senoculatus Yin, Wang & Zhang 1985	
P. sinensis Berland & Berland 1914	*P. guiyangensis* Yin, Wang & Zhang 1985
P. singaporensis Thorell 1894	*P. annulatus* Kulczyński 1908; *P. curvipalpis* Fage 1929; *P. libelti* Kulczyński 1908
P. taiwanensis Wang & Yin 2001	
P. tingpingensis Yin, Wang & Zhang 1985	
P. torvus (O. Pickard-Cambridge 1869)	*P. alticeps* Pocock 1899
P. triangulus Yang, Zhang, Zhu & Song 2003	
P. xinping Chen, Zhang, Song & Kim 2002	
Nomen dubium:	
P. mimus Chamberlin 1924	

Die folgenden tiefergreifenden taxonomischen und nomenklatorischen Handlungen wurden in der Gattung *Psechrus* vorgenommen: Lehtinen (1967) hat insgesamt 6 Synonymien vorgeschlagen, von denen jedoch nur eine einzige von den nachfolgenden Autoren akzeptiert wurde (*P. alticeps* = *P. torvus*). Fünf neue Synonymien wurden von Levi (1982) im Rahmen seiner Revision aufgestellt (*P. curvipalpis*, *P. annulatus*, *P. libelti* = *P. singaporensis*; *P. mimus* = *P. sinensis*; *P. castaneus* = *P. argentatus*). Nachfolgend haben verschiedene Autoren zwei weitere Synonymien vorgenommen und Wang und Yin (2001) haben *P. mimus* aus der Synonymie von *P. sinensis* herausgenommen und als *nomen dubium* aufgefasst, da es sich beim Holotypus um ein nach ihrer Meinung „nicht zu identifizierendes juveniles Weibchen" handelte. Auch wenn einige der Synonymien in Levi (1982) gerechtfertigt zu sein schienen, waren andere sehr fragwürdig, und zwar die von *P. annulatus* und *P. libelti* mit *P. singaporensis*. Levi (1982) fertigte von den Typusexemplaren dieser drei Arten Illustrationen der Kopulationsorgane an, welche deutliche Unterschiede aufwiesen, die er mit intraspezifischer Variabilität erklärte.

1.4 Taxonomische Bearbeitung der Gattung *Fecenia* bis 2009

Bis zum Zeitpunkt meiner Doktorarbeit waren aus der Gattung *Fecenia* 5 valide Arten bekannt:

Fecenia	
Valide Arten:	**Synonyme:**
F. cylindrata Thorell 1895	*F. hainanensis* Wang 1990
F. macilenta (Simon 1885)	*F. protensa* Thorell 1891
F. nicobarensis (Tikader 1977)	
F. ochracea (Doleschall 1859)	*F. angustata* (Thorell 1881); *F. buruana* Reimoser 1936; *F. cinerea* Hogg 1914; *F. maforensis* Simon 1906; *F. montana* Kulczyński 1910; *F. oblonga* Rainbow 1913
F. travancoria (Pocock 1899)	*F. sumatrana* Kulczyński 1908

Um die vorletzte Jahrhundertwende wurden eine Reihe von *Fecenia* Arten aus Neuguinea oder benachbarten, kleineren Inseln beschrieben: *F. angustata* (Thorell 1881), *F. maforensis* Simon 1906, *F. montana* Kulczyński 1910, *F. oblonga* Rainbow 1913, *F. cinerea* Hogg 1914 und *F. buruana* Reimoser 1936. Alle samt wurden von Lehtinen (1967) ohne nähere Erklärungen hierzu und zum Teil ohne Überprüfung von entsprechendem Typenmaterial mit *F. ochracea* synonymisiert. Mit den Arten *F. travancoria* und *F. sumatrana* Kulczyński 1908, welche Lehtinen (1967) mit *F. macilenta* synonymisierte, verhielt es sich genauso. Fakt ist, dass von *F. travancoria* und *F. sumatrana* bis 2009 jeweils nur Weibchen bekannt waren, von *F. macilenta* hingegen bis 1986 nur das Männchen. Das recht große Verbreitungsgebiet von *F. sumatrana* schließt dasjenige von *F. macilenta* mit ein. Levi (1982) synonymisierte *F. protensa* Thorell 1891, von welcher bis dato nur ein subadultes Weibchen (Holotypus) bekannt war, mit *F. macilenta* (betrachtete diese Synonymie jedoch selbst als zweifelhaft, Levi 1982, S. 136) und transferierte die Art *Psechrus nicobarensis* nach *Fecenia*. Murphy (1986) erkannte, dass die Synonymie von *F. travancoria* mit *F. macilenta* eine Fehlauffassung war, beschrieb erstmals das Weibchen von *F. macilenta* und synonymisierte folglich *F. sumatrana* mit *F. travancoria*. *Fecenia hainanensis* Wang 1990 wurde rund 10 Jahre nach ihrer Erstbeschreibung mit *F. cylindrata* synonymisiert (Wang und Yin 2001).

1.5 Phylogenie und systematische Position der Psechridae bis 2009

Bereits in 1.1 wurde ein Abriss der Auffassungen von verschiedenen Autoren bezüglich der Stellung der Psechriden im System der Araneae gegeben. Nachdem Simon (1890, 1892) die Familie Psechridae aufgestellt, ausführlich beschrieben und diagnostiziert hatte, wurden *Metafecenia* F. O. Pickard-Cambridge 1902 (= *Tengella* Dahl 1901), *Stiphidion* Simon 1902, *Themacrys* Simon 1906, *Matachia* Dalmas 1917, *Poaka* Forster & Wilton 1973 sowie einige weitere Gattungen neu beschrieben und den Psechriden zugerechnet. Dalmas (1917) unterteilte die Psechridae in vier Unterfamilien, die Psechrinae, Matachiinae, Themacryinae und Stiphidiinae. Einige Gattungen, welche zu diesem Zeitpunkt zu den Psechriden gerechnet wurden, wiesen die ursprünglich von Simon (1892) als diagnostisch für diese Familie angesehenen Merkmale, die drei Tarsalklauen inklusive distale Haarbüschel sowie das aus mindestens drei Reihen von Borsten bestehende Calamistrum, nicht oder nur zum Teil auf. Alle Gattungen mit Ausnahme von *Psechrus* und *Fecenia* wurden

später (Lehtinen 1967; Forster 1970; Forster und Wilton 1973; Griswold et al. 1999; Raven und Stumkat 2003) zu anderen Familien transferiert. Im Rahmen der vorliegenden Studie wurden zumindest einige dieser Gattungen (*Tengella*, *Themacrys*, *Stiphidion*, *Poaka*) inkludiert, um ihre systematische Position mit Hilfe molekularer Methoden zu überprüfen.
Wie bereits in 1.1 erwähnt, haben die meisten Autoren die Psechridae in die Überfamilie der Lycosoidea gestellt, deren entscheidendes, diagnostisches Merkmal die rostförmigen Tapeta der Seitenaugen darstellen. Ein Tapetum ist eine reflektierende Schicht aus kristallinen Ablagerungen in den Seitenaugen von Spinnen, welcher (möglicherweise) eine Art Restlichtverstärkerfunktion zur Erleichterung des nächtlichen Sehens zukommen könnte (Homann 1950). Nach Homann (1950) besitzen die Vertreter anderer Überfamilien andere Typen von Tapeta, z.B. kahnförmige oder solche mit primitivem Typus (also nicht abgeleitetem Typus: becherförmig, von vielen einzelnen Löchern für Sehnervendurchgänge durchbrochen). Homann (1950, 1971) war der erste Autor, welcher die Psechridae als dieser Überfamilie zugehörig auffasste. Seiner Ansicht folgten Levi (1982), Coddington und Levi (1991) und weitere Autoren. Später wurden auch morphologisch kladistische Ergebnisse veröffentlicht, welche die Monophylie der Lycosoidea und die Zugehörigkeit der Psechriden hierzu, unterstützten (Griswold 1993; Griswold et al. 1999, 2005; Raven und Stumkat 2005). Als weitere diagnostische Merkmale der Lycosoidea (plus Tengellidae und Zorocratidae) wurden von Griswold et al. (1999) das aus mehreren Reihen von Borsten bestehende Calamistrum sowie die Scopula dorsal auf dem Cymbium der Männchen (bei vielen Taxa reduziert) genannt. Fang et al. (2000) bestätigten die Zugehörigkeit der Psechriden zu den Lycosoidea erstmals mit molekularen Methoden, und zwar durch die Sequenzanalyse von Teilabschnitten der Gene 12S und 16S rRNA. Allerdings umfasste ihre Studie lediglich 8 Spinnenfamilien, 6 davon nur durch eine einzige Art und die Psechridae nur durch *Psechrus* vertreten, und war somit nur begrenzt repräsentativ.

1.6 Fragestellungen

Die Ziele der vorliegenden Dissertation können durch folgende Fragestellungen formuliert werden:

1) Welche taxonomischen Erkenntnisse ergibt die Revision der Gattung *Psechrus* (insbesondere vor dem Hintergrund der Diversität dieser Gattung in Laos und China (Jäger 2007; Wang und Yin 2001)) und welche Merkmale sind von taxonomischer Bedeutung?

2) Welche taxonomischen Erkenntnisse ergibt die Revision der Gattung *Fecenia* (insbesondere vor dem Hintergrund der vielen, in vorangegangenen taxonomischen Studien aufgestellten Synonymien) und welche Merkmale sind von taxonomischer Bedeutung?

3) Welche Stellung haben die Psechriden im System der Araneae, welche Verwandtschaftsbeziehungen haben *Psechrus* und *Fecenia* zueinander (man halte sich die verschiedenen Fangnetze vor Augen) und welche Stellung haben die Gattungen *Stiphidion*, *Tengella*, *Themacrys* und *Poaka* (ehemals Psechridae)?

4) Wie sind die Verwandtschaftsbeziehungen der einzelnen Arten innerhalb der Gattungen *Psechrus* und *Fecenia*?

5) Können die in den morphologisch taxonomischen Arbeiten aufgestellten Arthypothesen durch die Sequenzanalyse der 'barcoding'-Region des COI Genes bestätigt werden? Ist eine Bestimmung von Psechriden durch eben diese Methode möglich?

2. MATERIAL UND METHODEN

Die detaillierte Darstellung von Material und Methoden der vorliegenden Dissertation können den drei Einzelpublikationen entnommen werden (Bayer 2011, Bayer 2012; Bayer & Schönhofer 2012).
Zusammenfassend wurde wie folgt vorgegangen:
Das zu untersuchende Spinnenmaterial wurde zum Teil auf Forschungsreisen von Herrn Dr. Jäger und mir in Laos und Thailand 2009 gesammelt, zum Teil von Fachkollegen zur Verfügung gestellt (z.T. frisches Material) und der größte Teil wurde von Naturkundemuseen, weltweit, ausgeliehen. Frisch gesammelte Spinnen, die noch nicht adult waren, wurden im Labor, soweit möglich, bis zur Reife gehältert. Hierbei wurden bei Weibchen aus den Exuvien des subadulten Stadiums die Prä-Epigyne entnommen und zusammen mit dem entsprechenden adulten Exemplar aufbewahrt. Das Material wurde in 70% EtOH konserviert. Von frisch gesammeltem Material sowie Material aus Museumskollektionen, welche Vergällungsmittel benutzen, die sich nicht oder weniger negativ auf die Beschaffenheit der DNA im konservierten Gewebe auswirken (z.B. Isopropanol), wurden jeweils ein oder zwei Beine (je nach Größe des Tieres) entnommen und in 96% unvergällten EtOH überführt. Diese wurden dann zur DNA-Extraktion eingesetzt.
Für die morphologisch taxonomischen Untersuchungen wurden die Spinnen nach der Bestimmung präpariert (insbesondere die strukturellen Merkmale der Kopulationsorgane; die Epigyne/Vulva der Weibchen musste in den meisten Fällen herausgetrennt, freipräpariert und in Milchsäure aufgehellt werden). Danach wurden Zeichnungen von den für die Unterscheidung zu anderen Arten wichtigen Organen/Strukturen (v.a. der Kopulationsorgane, aber auch Palpenfemur der Männchen oder Chelicerenfurche etc.) angefertigt. Letztlich wurden die Tiere vermessen, morphologische Charakteristika aufgenommen (z.B. Anzahl von Stacheln an Gliedern von Extremitäten, Chelicerenbezahnung) und u.U. Fotos gemacht. Das Hauptaugenmerk bei den morphologischen Untersuchungen lag bei den adulten Tieren sowie den sub- und prä-subadulten Weibchen.

Für die molekulargenetischen Untersuchungen wurde aus den Spinnenbeinen (96% EtOH, unvergällt, siehe oben) zunächst mit Hilfe der CTAB Methode (siehe Bayer & Schönhofer 2012) DNA extrahiert und danach ein Test-Gel-Elektrophorese-Lauf sowie eine Mengenbestimmung durchgeführt. Die meisten Extraktionen wurden bei der Firma SRD in Auftrag gegeben, weil dies sonst den Zeitrahmen der Dissertation gesprengt hätte.
Ebenso wurden die meisten Amplifikationen (PCR-Ansatz, Primer, Cycling-Einstellungen, Aufreinigung siehe Bayer & Schönhofer 2012) der beiden untersuchten DNA Fragmente (28S rRNA, Fragment von ca. 750 Basenpaaren, und COI, 648 Basenpaar-Fragment) von SRD durchgeführt.

Die Sequenzierungen (jeweils mit forward und reverse-Primer) wurden alle von SRD durchgeführt.
Mit Hilfe des Programms BioEdit (Hall 1999 [Bayer & Schönhofer 2012]) wurden die Sequenzen manuell editiert, dies im Zusammenhang mit vorläufigen Alignments. Sobald alle Sequenzen editiert zur Verfügung standen, wurden finale Alignments angefertigt (Details siehe Bayer & Schönhofer 2012).
Nach der Berechnung des am besten passenden Substitutionsmodells für alle drei Datensätze (kombinierte Sequenzen von 28S und COI sowie 28S- und COI-Datensätze jeweils isoliert) wurden diese jeweils mit den Algorithmen „Bayesian Analysis“ und „Maximum Likelihood“ (ML) ausgewertet (siehe Bayer und Schönhofer 2012).
Der COI-Datensatz (isoliert) wurde zusätzlich per „Neighbor Joining“-Methode ausgewertet (siehe Bayer und Schönhofer 2012). Die ML Analyse wurde für diesen Datensatz ausgespart.

Die von den jeweiligen phylogenetischen Auswertungsprogrammen (siehe Bayer und Schönhofer 2012) erstellten Stammbäume wurden mit dem Bildverarbeitungsprogramm ‚Inkscape’ sowie den Stammbaumbearbeitungsprogrammen ‚TreeView’ und ‚MEGA 4.1b’ (Tamura et al. 2007) in übersichtliche Form gebracht und ergänzende Beschriftungen angebracht.

3. ERGEBNISSE

Die Ergebnisse samt illustrativer und graphischer Darstellung können den Einzelpublikationen (Bayer 2011, 2012; Bayer und Schönhofer 2012) entnommen werden und sind hier grob zusammengefasst dargestellt.

Im Zuge der Revision der Gattung *Psechrus* wurden ca. 1020 Exemplare untersucht. Zwei Synonyme von *Psechrus singaporensis* wurden als valide Arten erkannt (Bayer 2012), und zwar *P. annulatus* und *P. libelti*. Die Art *P. xinping* wurde mit *P. tingpingensis* synonymisiert. Alle 23 bislang bekannten Arten wurden eingehend beschrieben, charakterisiert, eindeutig diagnostiziert (und damit fehlerhafte oder unzureichende Diagnosen aus früherer Literatur korrigiert bzw. ergänzt) und illustriert, Informationen über Verbreitung gegeben und, abhängig von der Menge des untersuchten Materials einer bestimmten Art, auch intraspezifische Variabilität dargestellt. Auf die gleiche Art und Weise wurden auch drei neue Arten aus Laos (Bayer und Jäger 2010) sowie 20 neue Arten aus dem gesamten tropisch-asiatischen Verbreitungsgebiet (Bayer 2012) beschrieben. Für die nunmehr 46 Arten wurde ein Bestimmungsschlüssel erarbeitet. Zudem wurden 8 verschiedene Artengruppen aufgestellt, deren Vertreter hauptsächlich durch die Struktur ihrer Kopulationsorgane charakterisiert sind. In diesem Zusammenhang konnten aber auch einige somatische Merkmale erkannt werden, welche, in Kombination, zu einem gewissen Grad eine Unterscheidung der Artengruppen zuließen, z. B. die dorsale Bestachelung der Tibia des vierten Beinpaares, die (laterale) Zeichnung des Prosomas, Sternums und ventralen Opisthosomas (Stärke und Struktur der hellen Medianlinie) sowie die Beinlänge in Relation zum Prosoma.
Die Arten wurden demnach in folgende Gruppen eingeteilt:
***argentatus*-Gruppe:** *Psechrus argentatus*, *P. libelti.*
***mulu*-Gruppe:** *P. mulu*, *P. borneo*, *P. ulcus* Bayer 2012, *P. kinabalu.*
***annulatus*-Gruppe:** *P. annulatus*, *P. aluco* Bayer 2012, *P. decollatus* Bayer 2012.
***singaporensis*-Gruppe:** *P. singaporensis*, *P. elachys* Bayer 2012, *P. norops* Bayer 2012, *P. arcuatus* Bayer 2012.
***ancoralis*-Gruppe:** *P. ancoralis* Bayer & Jäger 2010, *P. rani*, *P. laos* Bayer 2012, *P. antraeus* Bayer & Jäger 2010, *P. khammouan*, *P. steineri* Bayer & Jäger 2010.
***himalayanus*-Gruppe:** *P. himalayanus*, *P. marsyandi*, *P. inflatus* Bayer 2012, *P. ghecuanus*, *P. pakawini* Bayer 2012, *P. luangprabang*, *P. demiror* Bayer 2012, *P. jaegeri* Bayer 2012, *P. vivax* Bayer 2012.
***sinensis*-Gruppe:** *P. sinensis*, *P. triangulus*, *P. tingpingensis*, *P. obtectus* Bayer 2012, *P. fuscai* Bayer 2012, *P. kunmingensis*, *P. jinggangensis*, *P. senoculatus*, *P. kenting*, *P. taiwanensis*, *P. clavis* Bayer 2012.
***torvus*-Gruppe:** *P. torvus*, *P. hartmanni* Bayer 2012, *P. zygon* Bayer 2012, *P. tauricornis* Bayer 2012.
Arten, die keiner dieser Gruppen zugeteilt werden konnten (Stellung unklar):
P. crepido Bayer 2012, *P. schwendingeri* Bayer 2012, *P. cebu.*

Weiterhin wurde die Prä-Epigyne der subadulten *Psechrus* Weibchen, die in bisheriger Literatur zumeist völlig unbeachtet blieb, erstmals als taxonomisch relevantes Merkmal eingeführt und für 43% der Arten illustrativ dargestellt. Eine Unterscheidung subadulter Weibchen dieser Arten anhand ihrer Prä-Epigyne ist demnach möglich.

In der Revision der Gattung *Fecenia* (Bayer 2011) wurden ca. 270 Exemplare untersucht und alle bekannten Arten in gleichem Maße, wie oben für *Psechrus* beschrieben, dargestellt. *Fecenia protensa*, welche bis dato mit *F. macilenta* synonymisiert war, wurde als eigenständige Spezies erkannt. Zudem wurden *F. nicobarensis* und *F. sumatrana* (letztere ist, entgegen der Auffassung von Murphy [1986], kein Synonym von *F. travancoria*) in die Synonymie von *F. protensa* gestellt. Alle derzeit als Synonyme von *F. ochracea* geführten nominellen Arten wurden auch in Bayer (2011) als solche bestätigt. Die große taxonomische Bedeutung der Prä-Epigynen der subadulten Weibchen von *Fecenia* wurde in dieser Publikation (Bayer 2011) herausgestellt und dieses Merkmal erstmals in der arachnologischen Forschung in den Arten-Bestimmungsschlüssel integriert. In seltenen Fällen kann es dazu kommen, dass die Prä-Epigyne eines subadulten Weibchens in ihrer Merkmalsausprägung gegenüber denen der restlichen subadulten Weibchen einer Art recht deutlich abweicht. Es wurden Überlegungen angestellt, die solche Abweichungen möglicherweise erklären könnten (siehe auch Abschnitt 4.2).
Durch modifizierte Diagnosen und viele begleitende Illustrationen ist es nunmehr möglich, *Fecenia* Arten klar voneinander abzugrenzen.

Für die molekulargenetische Untersuchung (Bayer & Schönhofer 2012) wurden drei verschiedene Sequenz-Datensätze mit den phylogenetischen Auswertungsmethoden „Bayesian Analysis“ (BA), „Maximum Likelihood“ (ML) und „Neighbor Joining“ (NJ, als Distanzverfahren [ohne Optimalitätskriterium]) analysiert und insgesamt 6 verschiedene Stammbäume erstellt, die zur Klärung unterschiedlicher Fragestellungen (siehe unten) herangezogen wurden. In einem ersten Datensatz waren 82 28S rRNA Sequenzen von 73 Spinnenarten enthalten. Davon gehörten 24 Arten zu *Psechrus* und 4 zu *Fecenia*. Ein weiterer Datensatz enthielt 65 Sequenzen von 28S und COI jeweils zusammengefügt (kombiniert) für 66 Arten, wovon 22 *Psechrus* und 4 *Fecenia* angehörten. Diese beiden Datensätze wurden jeweils mit BA und ML ausgewertet und eigneten sich besonders für die Untersuchung der Verwandtschaftsverhältnisse auf höherem Niveau (Familien, Gattungen, Artengruppen). Ein letzter Datensatz enthielt 103 COI Sequenzen von 42 Arten (davon 24 *Psechrus* und 4 *Fecenia*). Dieser war die Grundlage für die molekulare Überprüfung der in den morphologischen Arbeiten aufgestellten Arthypothesen und wurde durch NJ und BA ausgewertet.
Aus den beiden Stammbäumen basierend auf dem 28S-Datensatz (Abb. 1–2 in Bayer und Schönhofer 2012) sowie den beiden basierend auf dem kombinierten Datensatz (Abb. 3–4 in Bayer und Schönhofer 2012) ging hervor, dass die Gattungen *Psechrus* und *Fecenia* jeweils gut unterstützte Monophyla darstellten (sprich Bootstrap-Wert ≥ 70%; Posterior Probability aus BA ≥ 95%), welche beide Teil des Monophylums der Lycosoidea waren, wozu weiterhin die Lycosidae, Pisauridae, Zoropsidae, Oxyopidae, Tengellidae, Zorocratidae sowie die Thomisidae gehörten. Keiner der 4 Stammbäume wies die Psechriden (*Psechrus* und *Fecenia*) als monophyletisch aus. In allen vier Bäumen jedoch waren die Knoten, welche diese beiden Gattungen und jeweils andere Taxa verknüpften, ohne zuverlässige statistische Unterstützung. Die Gattungen *Stiphidion*, *Poaka*, *Themacrys* und *Tengella*, welche in früherer Literatur den Psechriden zugerechnet wurden, erwiesen sich aufgrund der vorliegenden, molekularen Ergebnisse als mit den Psechriden lediglich entfernt verwandt. Nur eine Gattung davon, *Tengella*, gehörte nach den vorliegenden Untersuchungen zu den Lycosoidea. Die Vertreter der unterschiedlichen Artengruppen von *Psechrus* (wie in Bayer 2012 aufgestellt) bildeten grundsätzlich jeweils gut unterstützte Monophyla. Die *himalayanus*-Gruppe

wurde jedoch in den 28S-Bäumen (Abb. 1–2 in Bayer und Schönhofer 2012) beider Auswertungsmethoden als Polyphylum zusammen mit Vertretern der *ancoralis*-Gruppe, und in den Bäumen des kombinierten Datensatzes (Abb. 3–4) als Paraphylum ausgewiesen. Hier tauchte in einem Ast die monophyletische *ancoralis*-Gruppe als Schwestergruppe zu einigen Vertretern der *himalayanus*-Gruppe auf. Die restlichen Vertreter der *himalayanus*-Gruppe wiederum bildeten eine Schwestergruppe zu dem oben genannten Ast (Bayer und Schönhofer 2012, Abb. 3–4). Die phylogenetische Position der Art *Psechrus crepido* variierte in den verschiedenen Stammbäumen. In allen Stammbäumen waren die Knoten, welche diese Art mit anderen *Psechrus*-Arten oder Artengruppen verband, nicht verlässlich unterstützt. Eine basale Verzweigung innerhalb der Gattung *Psechrus* trennte die Artengruppen mit nördlicher und westlicher Verbreitung von denen, die im südöstlichen Abschnitt des Gesamtverbreitungsgebietes vorkommen. In der Gattung *Fecenia* bildeten die Arten *F. protensa* und *F. travancoria* ein Monophylum, *F. cylindrata* und *F. ochracea* ein zweites.

Nach den Stammbäumen, die auf dem COI-Datensatz basierten (Abb. 5–6 in Bayer und Schönhofer 2012), wurden die jeweils verschiedenen Individuen aller Arten von *Psechrus* als auch von *Fecenia* als Monophyla erkannt. Einzelne Individuen einer Art zeigten untereinander grundsätzlich kurze Sequenzdistanzen (Sequenzabweichungen) und waren somit durch kurze Äste miteinander verbunden. Höchste intraspezifische Distanzen waren 4,5% bei *Psechrus* (von einer Ausnahme abgesehen, siehe Abschnitt 4.3 E) und 5,3% bei *Fecenia*. Zumeist aber waren sie deutlich geringer. Die Distanzen zwischen verschiedenen Arten, jedoch, waren mit durchschnittlich 10% deutlich größer. Dies wurde durch die generell deutlich längeren Äste, die verschiedene Arten miteinander verbanden, im Phylogramm auf den ersten Blick deutlich (Abb. 6 in Bayer und Schönhofer 2012).

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Revision of the pseudo-orbweavers of the genus *Fecenia* Simon, 1887 (Araneae, Psechridae), with emphasis on their pre-epigyne

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Abstract

The present paper provides a taxonomic revision of the genus *Fecenia* with emphasis on the characteristics of the pre-epigynes which are integrated for the first time into an identification key. As a result, one species is revalidated, *F. protensa* Thorell, 1891, **stat. n.**, and two new junior synonyms for *F. protensa* are recognised: *F. sumatrana* Kulczyński, 1908, **syn. n.** and *F. nicobarensis* (Tikader, 1977), **syn. n**. New records are reported: *F. ochracea* (Doleschall, 1859) from Malaysian Borneo, *F. macilenta* (Simon, 1885) from Sumatra, Indonesia, *F. protensa* from Thailand and Malaysia, *F. travancoria* Pocock, 1899 from Sri Lanka and Thailand, and *F. cylindrata* Thorell, 1895 from Thailand and Laos. Additional information on the biology of *Fecenia* is provided and the validity of characters for identifying *Fecenia* species is discussed.

Keywords

Taxonomy, copulatory organs, spination, distribution, South-East Asia, pseudo-orbweb, enrolled leaf, predatory behaviour, mating behaviour, moult, identification key

Introduction

Representatives of the spider genus *Fecenia* are distributed from southern India to the Solomon Islands. They are not known beyond the latitudes of 25°N and 15°S. To date (Platnick 2011) this genus comprises five valid species. *Fecenia* species possess relatively long and prograde legs. The first two pairs are directed anteriorly whereas the third and fourth leg pairs are directed posteriorly. *Fecenia* species have a flat carapace and a slender body shape (Thorell 1881). Their chelicerae are short and strong and bear a distinct condyle latero-proximally (Levi 1982). Adults build a vertical web, which is similar to the typical orbwebs of (most) Araneidae and related families like Tetragnathidae, respectively. Thus representatives of *Fecenia* are here called 'pseudo-orbweavers'. Simon (1892) described their web as more irregular than the webs of Araneidae. Furthermore he stated that it contains an enrolled leaf as a retreat in the centre. Despite this somewhat similar web style, *Fecenia* is not closely related to the Araneidae and does not belong to the Orbiculariae either (Coddington 1990). Together with *Psechrus* Thorell, 1878, this genus belongs to the Psechridae Simon, 1890 (Simon 1892; Lehtinen 1967; Levi 1982; Griswold 1993; Griswold et al. 2005; Platnick 2011). Previously the pseudo-orbweavers were revised twice. Levi (1982) provided a worldwide revision and Wang and Yin (2001) covered Chinese representatives. In the study of Lehtinen (1967) several *Fecenia* species were synonymised. Levi (1982) matched a female of a different species with the male of *F. macilenta* (Simon, 1885). Murphy (1986) recognised this mistake and described the female of *F. macilenta* for the first time. At present, further taxonomic ambiguities still persist. Some of these were caused by descriptions of new species using subadult females (which only possess pre-epigynes) as type specimens.

Pre-epigynes do not occur in all entelegyne spiders, but seem to be common within the families supposed to be related to Psechridae (Griswold 1993; Griswold et al. 1999, 2005), e.g. Pisauridae, Lycosidae, Stiphidiidae, Zoropsidae and Ctenidae. Up to now pre-epigynes were mostly disregarded in arachnological studies. There are some first descriptions where pre-epigynes had been erroneously regarded as epigynes (e.g. *Psechrus mimus* Chamberlin, 1924, *Heteropoda shillongensis* Sethi and Tikader, 1988, *Psechrus ghecuanus* Thorell, 1897). A study on *Agelena labyrinthica* (Clerck, 1757) noted the presence of a primordial copulatory organ in females (Strand 1906). Jäger and Ono (2000), Jäger (2008) as well as Jäger and Bayer (2009) illustrated pre-epigynes of a few particular species of *Olios* Walckenaer, 1837 and *Heteropoda* Latreille, 1804 respectively. Several differently developed primordial copulatory organs in different stages of immature females of *Cupiennius salei* (Keyserling, 1877) were documented in Lachmuth et al. (1985). In Psechridae pre-epigynes were illustrated for the first time by Levi (1982). However, he studied only a few species in this regard. Moreover, in the case of *Psechrus himalayanus* Simon, 1906, he regarded a pre-epigyne as an adult epigyne. This led to misunderstandings in species determination and characterisation. As an ongoing revision shows (Bayer unpubl. data), Griswold (1993) examined a subadult female of *P. marsyandi* Levi, 1982, identified as *P. himalayanus*, as the female representative of the genus *Psechrus* in his study on the phylogeny of Lycosoidea. Wang and Yin (2001) showed the pre-epigyne of one species, *Psechrus rani* Wang and Yin, 2001, and compared it with features of the conspecific adult female. A fairly complete investigation on the pisaurid genus *Thalassius* Simon, 1885 was carried out by Sierwald (1987) where most species concerned were characterised by their pre-epigyne II (penultimate instars) and some even by their pre-epigyne I (antepenultimate instars). An even more detailed study on American Pisauridae described changes in the development of pre-epigynes of different stages via very detailed illustrations (Sierwald 1989). Nevertheless, no study to date has examined variation within pre-epigynes of penultimate instar females within a species, nor has there been any attempt to integrate the pre-epigyne and pre-vulva- features into an identification key. In this context, the intention of this paper is to provide a thorough taxonomic revision of *Fecenia* including some remarks on their biology and above all the character states of pre-epigynes.

Material and methods

Part of the spider material was collected by hand during an expedition in Thailand and Laos from October-December 2009. Further material was obtained from colleagues, who collected specimens in different regions of SE Asia. Most of the material examined in the present study was borrowed from several natural history museums, which are listed below. Examinations and illustrations were made using a Leica MZ 165 C stereomicroscope with a drawing mirror. Photos of living spiders were taken with a Canon EOS 500D (equipped with a Sigma 105 macro lens and a Canon ringlite). Photos of preserved spiders and copulatory organs were taken with a Sony DSC W70 compact camera via the ocular of the stereomicroscope. The material was preserved in 70% denatured ethanol. Female copulatory organs were cleared from surrounding hairs and dissected. The opaque tissue surrounding the vulva was removed. Vulvae were cleared in 96% DL-lactic acid ($C_3H_6O_3$). As the cuticle surrounding the epigyne may curl and structures may get shifted in the course of applying lactic acid, this method could not be applied to every specimen. In males, hairs along the margin of the cymbium were removed to give a clear view of the bulb structures.

All measurements are in millimetres (mm). Leg formula (from longest to shortest leg) and leg spination pattern follow those in Bayer and Jäger (2010). In leg/palp spination the femur, patella, tibia and metatarsus (tarsus in palp) are listed in exactly this sequence. First, all spines on the prolateral surface of the respective limb article are counted and listed, then the ones on the dorsal, then retrolateral and finally the ventral surface. Thus the resulting number is generally one of 4-digits. Some limb articles, e.g. the femur and patella, always lack ventral spines, so here the number is of 3-digits. If a spination pattern from a certain limb article differs between the left and right sides, the pattern for the right article is listed in parenthesis behind, without a blank. Palp and leg lengths are listed as: total (femur, patella, tibia, metatarsus, tarsus).

Abbreviations used in the text: ALE – Anterior lateral eye. AME – Anterior median eye. AML – Anterior margin of lateral lobe. AS – Anterior part of median septum. bEA – Basal embolus apophysis. BL – Borderline between SSI and TSI. C – Conductor. CA – Cymbium alveolus. CO – Copulatory opening. DRTA – Dorso–retrolateral tibial apophysis. E – Embolus. EF – Epigynal field. EM – Epigynal muscle sigilla. FD – Fertilisation duct. juv. – Juvenile (convention in the present work: juveniles are immature specimens of instars where no sex determination is possible, otherwise called juvenile male or juvenile female). LL – Lateral lobe. MA – Median apophysis. MP – Membranous process of tegulum. PLE – Posterior lateral eye. PME – Posterior median eye. PS – Posterior part of median septum. p.s.a. – Pre-subadult. RPA – Retrolateral patellar apophysis. RTA – Retrolateral tibial apophysis. s.a. – Subadult. SB – Serial individual numbers of Psechridae examined by the author. SH – Spermathecal head. SO – Slit sense organ. SSI – Strongly sclerotised section of internal duct system. T – Tegulum. TR – Transverse edge/ridge of median septum. TSI – Transparent section of internal duct system. VPA – Ventral patellar apophysis.

Terminology of structures belonging to the copulatory organs is given as follows:

The female epigyne consists of two slits, which separate the lateral lobes (LL) from the median septum. The latter is folded transversely, resulting in a transverse edge or ridge (TR) (Fig. 79). Consequently, an anterior part of the septum (AS) and a posterior part (PS) can be distinguished (Fig. 79). Anteriorly, each of the LL exhibits a more or less sclerotised margin (anterior margin of lateral lobe, AML). The entire epigyne is surrounded by an epigynal field (EF), which is a sclerotised area. It is not as intensively sclerotised as the median septum or the LL and is distinguished from the adjacent areas of the ventral opisthosoma by a darker colour. The following structures certainly do not belong to the epigyne, but they may be of additional taxonomic information, so they are illustrated and described here, too. Namely the two muscle sigilla (epigynal muscle sigilla, EM) in front of EF (sometimes they are integrated into the epigynal field) and the slit sense organs (SO) near the epigyne (Fig. 79). The vulva consists of an internal duct system (more precisely a folded slit system, cf. Sierwald 1987). It is divided into an initial, rather transparent section (TSI), a strongly sclerotised section (SSI) and the fertilisation duct (FD) (Fig. 83). The border line (BL) between TSI and SSI is clearly visible (Fig. 83). The initial section of SSI features a wide area with pores leading to associated glands. As this area is presumably homologous to the spermathecal head in *Psechrus* (for location of the spermathecal head see Wang and Yin 2001 or Bayer and Jäger 2010) the term spermathecal head (SH) is used here for *Fecenia* too, despite its different shape (Fig. 83). Griswold (1993: p. 21) even denominated the entire SSI as "head of spermatheca", which is not followed here. In *Fecenia* it is very difficult to locate the receptaculum. It is not clear where the functional copulatory duct actually ends. Moreover, nobody has ever observed how far a *Fecenia* embolus penetrates within the internal duct system or where the sperm are finally stored.

Apart from structures of a male palp that are well known in arachnology, e.g. conductor, sperm duct or RTA, the *Fecenia* palp shows a retrolateral patellar apophysis (RPA), a ventral patellar apophysis (VPA) and a membranous process (MP) close to the embolus base (Fig. 8). In one species, *F. macilenta*, an additional large apophysis arises dorso-retrolaterally from the tibia (dorso-retrolateral tibial apophysis, DRTA, Fig. 53). Presently it cannot be clarified whether this apophysis is just the dorsal branch of an extended RTA or an additional apophysis. In either case, the DRTA can be regarded as an autapomorphy of this species.

Symbols/styles used in the illustrations: Regular solid lines indicate edges/margins/rims of structures as recognised in the respective view; Weak solid lines indicate edges of fine structures, e.g. membranous structures, or wrinkles in the area of the epigyne; Dashed lines indicate inner walls of ducts and/or slits; Dotted lines (wide) indicate structures shining through the cuticule (e.g. parts of vulva shining through epigynal cuticula). Dotted lines (fine) indicate clear colour differences (e.g. border of epigynal field). In schematic illustrations showing the course of the internal duct system the spermathecal head area is marked with several "T" marks, the copulatory opening with a circle and the end of the fertilisation duct in the direction of the uterus externus with an arrow (see e.g. Fig. 3). When a copulatory opening comprises an elongated slit/area, the circle is put at the central position of that slit/area. Arising points and/or directions of tegular appendages in males are described as clock-positions of the left palp in ventral view. This refers also to directions of some structures of the female vulva. As a convention in this latter case: In every species only the right vulva half is considered.

Museum collections (with curators): AMS – Australian Museum, Sydney (G. Milledge). CAS – California Academy of Sciences, San Francisco (C. E. Griswold, A. Carmichael). HBI – Hunan Biological Research Institute, Hunan Normal University, Changsha (X. J. Peng, L. Ping). IRSN – Institut Royal des Sciences Naturelles de Belgique, Brussels (L. Baert, B. Goddeeris). MCSN – Museo Civico di Storia Naturale, Genoa (M. Tavano). MCZ – Harvard University, Museum of Comparative Zoology, Cambridge, Massachusetts (G. Giribet, L. Leibensperger). MHNG – Muséum d'histoire naturelle, Geneva, Switzerland (P. Schwendinger). MIZ – Museum and Institute of Zoology, Warszawa (D. Mierzwa). MNHN – Muséum National de Histoire Naturelle, Paris (C. Rollard, E. Leguin). NHM – Natural History Museum, London (J. Beccaloni). NHMW – Naturhistorisches Museum Wien, Vienna (J. Gruber, C. Hörweg). NRS – Naturhistoriska Riksmuseet, Stockholm (G. Lindberg). NZSI – Zoological Survey of India, National Zoological Collection, Calcutta. RMNH – Nationaal Natuurhistorisch Museum Naturalis, Leiden, Netherlands (J. Miller, I. J. Smit). SJPC – Sunil Jose Private Collection, Kottayam, India (S. Jose). SMF – Senckenberg Museum, Frankfurt am Main, Germany (P. Jäger, J. Altmann). USNM – National Museum of Natural History, Washington D.C. (J. Coddington). ZMA – Zoologisch Museum Amsterdam (B. Brugge). ZMB – Museum für Naturkunde, Berlin (J. Dunlop, B. Nitsche). ZMH – Zoologisches Institut und Zoologisches Museum, Hamburg (H. Dastych). ZMUC – Zoological Museum of the University of Copenhagen (N. Scharff).

In the species descriptions the spider material is listed as follows: localities are listed from North to South, then from West to East; countries, provinces and towns/villages are listed as far as possible by their presently valid names.

Results

Characteristics of pre-epigynes

Distinction of pre-epigyne from adult epigyne. Pre-epigynes are considerably smaller than epigynes. If there is no adult female available to compare the size of the epigyne with that of the pre-epigyne of a subadult female the slit sense organs (SO) and epigynal muscle sigillae (EM) in front of the pre-epigyne can help. The distance between the SO from left to right side is about twice as long as the width of a pre-epigyne, but only slightly longer than the width of an adult epigyne. Furthermore, the pre-epigyne is only slightly longer than one EM. The adult epigyne, in contrast, is at least twice as long as EM. Moreover, the pre-epigyne exhibits either no epigynal field or the latter does not reach SO and/or EM.

Ontogeny of the epigyne. Pre-epigynes from four pseudo-orbweaver species were examined and found to exhibit apparently species-specific characteristics. Basic structures of adult epigynes can be recognised as primordial structures in the pre-epigynes. The following general ontogenetic process apparently leads from the primordial to the adult female copulatory organ: The anterior part of median septum (AS) and the anterior margins of lateral lobes (AML) extend strongly anterio-laterally.

In the subadult female of *F. protensa* Thorell, 1891 the transverse ridge/edge of the median septum (TR) is clearly recognisable as a broad "W"-shaped edge (Fig. 69). In addition to the changes that happen from the subadult to adult stage described above, the median section of TR becomes strongly notched, together with a distinct median folding of AS. The result is the characteristic adult epigyne (Figs 55, 64, 108).

In *F. cylindrata* Thorell, 1895, AML run at more or less a right angle anteriorly and face each other. This can be recognised overall in pre-subadult, subadult and adult females (Figs 79–82). A clearly developed TR is only present in subadult females and adults. In pre-subadult females the TR is at best only slightly indicated (dotted line in Fig. 82).

In *F. ochracea* (Doleschall, 1859), it is easy to identify corresponding structures of subadult females and adults, because the pre-epigyne (Figs 20–21) already strongly resembles the adult one (Fig. 19). TR is present in subadult females. As on both sides TR is strongly curved anteriorly the characteristic broad-"nose-like" AS, like in adults (Fig. 19), is already recognisable. By contrast, in pre-subadult females TR is at best very weakly developed (Fig. 22).

In *F. travancoria* Pocock, 1899, the situation is very similar to that in *F. protensa*, although its pre-epigyne (Fig. 74) slightly differs from that of *F. protensa* (Figs 58, 69) (see respective species descriptions).

Different developmental stages of pre-epigynes. Epigynes of adult females within the same species are similarly shaped (this is the reason why they can serve as an identification tool). In general this applies to the pre-epigynes, too. Yet, in one out of fifteen subadult females of *F. cylindrata* the pre-epigyne was larger and somewhat differently shaped (Fig. 80) than generally (Figs 81, 94). It gives the impression that it may be further developed than the others. This phenomenon of a differing character state of the pre-epigyne does not mean that identification via the pre-epigyne is not possible. Because if the respective pre-epigyne is interpreted accurately, it is noticeable that it tends to fall along a developmental continuum together with the "regularly" shaped pre-epigynes, the pre-pre-epigynes of p.s.a. ♀♀ and the adult epigynes (Figs 79–82). The s.a. ♀ of *F. cylindrata* illustrated in Fig. 80 is already more similar to the adult (Fig. 79). Its pre-vulva already exhibits a clear division into a transparent section of internal duct system (TSI) and a strongly sclerotised one (SSI) (Fig. 86). Hence, it is clearly recognised as *F. cylindrata*.

In summary, pre-epigynes are easily distinguished from adult epigynes and apparently exhibit species-specific characters (note that one species pair *F. protensa*/*F. travancoria* is difficult to distinguish, but this is not surprising as it applies to the adults too; see respective species descriptions). In rare cases, in *F. cylindrata* pre-epigynes of particular subadult females may differ from the general type. But by the means of an accurate interpretation of those pre-epigynes the respective subadult females can be recognised as *F. cylindrata*, anyway. So, in *Fecenia* the pre-epigynes can be used as an identification tool. Here they are integrated in an identification key for the first time.

Taxonomy

Psechridae Simon, 1890

In combination, the following characters are diagnostic for Psechridae: cribellum and calamistrum present; claw tufts distally on the 3-clawed tarsi; rectangular calamistrum comprising at least 3 rows of setae; indirect eyes with grate shaped tapetum (Simon 1892; Homann 1950; Lehtinen 1967; Levi 1982; Griswold et al. 2005).

Key to genera

1 AME smaller than or as large as other eyes; opisthosoma ventrally mostly with white or beige median line; clypeus at least twice as high as diameter of AME; legs II and IV almost equal in length; build horizontal, dome-shaped sheet webs .... ***Psechrus***

– AME larger than all other eyes; opisthosoma ventrally mostly with pair of white or beige patches, never with light median line; clypeus not or just slightly higher than diameter of AME; leg IV shorter than leg II; adults build vertical pseudo-orbwebs .... ***Fecenia***

Fecenia Simon, 1887

http://species-id.net/wiki/Fecenia

Mezentia Thorell 1881: 203 (Type species: *Mezentia angustata* Thorell, 1881); Simon 1885: 451.

Fecenia Simon 1887: 194 (homonym recognised, *Mezentia* Stål, 1878 [Orthoptera], replacement name established); Simon 1890: 80; Simon 1892: 226; Lehtinen 1967: 234, 383 (syn. of type species *F. angustata* with *F. ochracea*); Levi 1982: 131; Coddington 1990: 7; Murphy and Murphy 2000: 264; Griswold et al. 2005: 38.

Diagnosis. *Fecenia* species differ from *Psechrus* in the following characters: AME larger than all other eyes (in *Psechrus*, AME smaller or at most as large as other eyes); ventral side of opisthosoma centrally with pair of two white or beige patches, never with light median line like in *Psechrus*; clypeus flatter than in *Psechrus*, not or just slightly higher than diameter of AME, hence cephalic part of carapace rather flat; leg IV always shorter than leg II (in *Psechrus*, leg IV slightly longer or as long as leg II); in contrast to *Psechrus*, males with RTA, RPA, VPA and MA; females with clearly divided median septum of epigyne, vulva always lacking spherical spermathecal heads (in *Psechrus* females, median septum simple and spherical spermathecal heads generally present).

Description. Medium sized to large Psechridae, body length in males: 7.2–13.2 mm; females: 7.7–20.2 mm. Cephalic part of carapace not distinctly narrower than broadest (thoracic) section. Anterior eye row recurved, posterior row straight (or at least almost straight). Chelicerae strong, shorter than in *Psechrus*, basal article at most 2.5 times longer than broad. Cheliceral furrow with three promarginal and four retromarginal teeth. Basal article of chelicerae ventrally with long field of short, transverse striae. Ventral surface of former distally with semicircular lobe with long, curved hairs (Fig. 6). Labium slightly longer than broad (Fig. 5). Gnathocoxae ca. twice as long as broad, distal section slightly broader than basal one (Fig. 5). Serrula with ca. 130–170 (size-dependant) very small, dark, apically blunt teeth, very densely arranged. Sternum slightly longer than broad, with pointed posterior ending and broad-angled (160°) anterior ending (Fig. 4). Pedipalp in females with single claw (Fig. 51) containing 8–12 teeth. Legs extremely long in males (metatarsus I ca. three times longer than carapace (Fig. 117), relatively long in females (metatarsus I ca. 1.5–2 times longer than carapace, Fig. 119). Leg formula 1243. Coxae of legs I, II broader than III, IV. Calamistrum dorso-retrolaterally on metatarsus IV consisting of 3–4 rows of setae (inner rows irregular). Spination of palp and legs: Highly variable within each species. Therefore, no species-specific and no common genus-specific spination pattern could be found. Consequently the spination will only be listed for the primary type specimen in the species descriptions. At the following positions spines are always absent: All patellae, dorsal surface of all tibiae and all metatarsi. Palpal femur spination varies from 000, 010, 110, 120, 130, which are the most common ones, to 141. Palpal patella, tibia and tarsus mostly without spines, if present, then very small, the most common patterns in this case are: patella 110, tibia 0100, tarsus 1004. Femora of legs I and II with even more variable spination, e.g. 100, 110, 210, 300, 310, 312, 320, 401, 412, 501, or 613. The most common one is 310. The same for those of legs III and IV, but here the number of spines is lower on average, most common is 010. The tibial spination pattern in *Fecenia* includes a characteristic aspect: Legs I and II: retrolateral spines absent; legs III and IV: prolateral ones absent. At each opposite side the number of spines varies from 0 to 4, with legs I and II mostly having one to two spines more than III and IV. Ventrally at tibiae I and II there are mostly 6, at tibiae III and IV mostly 4 spines (paired spines at all tibiae). The spination of metatarsi is more conservative: I–II 2015, III 1025 or 1015, IV 1015 (ventrally the four proximal spines are paired). But there are exceptions, too. Colouration: Chelicerae, carapace and sternum yellowish brown to dark brown. In rare cases specimens exhibiting a darker carapace margin and a median longitudinal band. Sternum unicoloured. Legs from yellowish brown or light brown to brown, may be annulated. Tibiae I and II in some cases darker than other limbs/legs. Femora at distal third often with dark, annulated patches. Opisthosoma dorsally greyish-brown with yellowish patches. Heart region with darker lanceolate patch with light centre (Fig. 119). Distal half of opisthosoma dorsally with two converging rows of dark brown spots. Lateral surface of opisthosoma is covered with 3–4 larger yellowish patches running diagonally. Opisthosoma ventrally dark brown to black, centrally with a pair of white to beige patches (Figs 116, 118), which differ intraspecifically in size and shape. In some cases those patches are fused, in extremely rare cases absent. Additionally, with white to beige transverse patch in front of spinnerets/cribellum (Fig. 116). The whole body is covered with grey hairs (Fig. 116). Spinnerets are relatively short and conical, except for median ones, which are distinctly smaller, slender and cylindrical. Bipartite character clearly visible in posterior spinnerets. Copulatory organs: Male palp with almost round tegulum (T). Embolus (E) filiform, arising in prolateral half of tegulum (T) and at least twice as long as conductor (C). The latter membranous, mostly arising centrally on upper half of T (Fig. 8) and mostly shorter than median apophysis (MA). T next to E-base (Fig. 8) with membranous process (MP). MA relatively large with general retrolateral direction (e.g. Fig. 89). Cymbium distinctly broader than palpal tibia and patella (e.g. Fig. 62). RTA differently shaped among the particular species, DRTA only present in *F. macilenta* (Simon, 1885) (Figs 53–54). VPA often slightly bent anteriorly (e.g. Fig. 87). RPA mostly small and inconspicuous. Palpal femur modifications, e.g. ventral bulge as present in some *Psechrus* species, absent in all *Fecenia* species. Scopula dorsally on cymbium present in the same form in all *Fecenia* species (Figs 99–101), but less distinct than in most *Psechrus* species. Female epigyne generally broader than long, with folded median septum (e.g. Fig. 55). Anterior part of median septum (AS) larger than posterior part (PS). Anterior margins of lateral lobes (AML) iin some species strongly sclerotised (Fig. 108). Vulva simple, with internal duct system divided in three sections: Transversal section (TSI), strongly sclerotised section (SSI) and fertilisation duct (FD) (Fig. 83). Borderline (BL) between TSI and SSI clearly recognisable and often of taxonomic importance.

Biological notes. The pseudo-orbweavers are found in shrubs and trees, and also in the canopy (Deeleman, pers. comm.). *Fecenia* suspends its vertical pseudo-orbweb (Fig. 120) in the vegetation, mostly between twigs. The web possesses an enrolled leaf at the hub serving as a retreat. This is true for adults and later instar juveniles of all *Fecenia* species. Earlier instars build an elongate cone-shaped tube as a retreat, which is disguised with small prey remains and soil- and leaf-particles. The very early instars do not even build a pseudo-orbweb, but a rather conical or dome-shaped web with the retreat at the top of the cone. This web can be found in the herb layer too (Robinson and Lubin 1979). The pseudo-orbweb (Fig. 120) is more irregular than the webs of araneids and related families building orb-webs. In *Fecenia* there is no regular spiral of capturing thread(s) as in araneids etc. In *Fecenia*, one cannot speak of a real spiral as the distance between the threads and their orientation differs. The irregularity applies to the radii too. In many cases they are not continuous.

Predatory behaviour was observed in the lab using several *F. cylindrata* and *F. protensa* specimens. In each case the spider was transferred to a large cylindrical glass (30 cm high, diameter 20 cm) with a leaf, already partly enrolled, placed at the bottom. The next day the leaf was suspended by threads in the middle of the glass, a day later it was already fixed at the top. The pseudo-orbweb was completed another day later. After placing a house fly into the lower area of the web it took a few seconds until the spider stretched its two forelegs out of the retreat, and after ca. 1 minute it came out. The fly was grabbed with the chelicerae and immediately dragged into the retreat. A few centimetres before the leaf entrance the spider turned and crawled backwards into the retreat. In the case of larger prey items like crickets, the spider was extremely shy and careful. It took two or three attempts of coming out of the leaf and escaping back into it, sometimes interrupted by 5–15 minutes within the retreat. During the last attempt the cricket was bitten for about 7 minutes at the capturing site of the web before it was dragged to the retreat. Binding behaviour, as described in Robinson and Lubin (1979), was observed after providing an even larger cricket. But in addition to their observations I could recognise that *Fecenia* took threads out of the web, too, in order to bind its prey. An attack-wrapping behaviour like in Araneidae does not exist.

Robinson and Lubin (1979) observed the mating behaviour of a male *F. ochracea* (however in their publication identified as *Fecenia* sp.) approaching the female retreat, which I corroborate observing (raised) *F. cylindrata* from Champasak Province, Laos (males SB 509, 510 and females SB 486–487, 511, 514, see list in description of *F. cylindrata*, additional material examined). These were maintained in cylindrical glasses (see above) and fed on house flies and crickets. A few days after one male's final moult its web was reduced to a few frame threads. In two corners of that thread-framework sperm webs were found (Fig. 123). The bulb filling procedure was not observed. A female was transferred into a terrarium (30 cm high, diameter 20 cm) and offered a small "cone" of transparent film as retreat, which was accepted and later on integrated in the new web. In the respective trial the male was placed into the female's terrarium. After a while it approached the retreat from the top of the terrarium by roping down onto it. There it tapped and stroked the retreat carefully (Fig. 121). Later on it moved to the margin of the opening of the leaf retreat and repeated this behaviour. After some more repeats it stayed there motionless. Unfortunately, neither the moment of entering the retreat nor the copulation itself could be observed. The next day the male was sitting within the leaf retreat, together with the female (Fig. 122). In another trial a raised *F. protensa* male from Flores (SB 196, see description of *F. protensa*, list of additional material examined) was transferred to a terrarium with an already adult conspecific female from Bali. The behaviour was the same as described above, but in this case the next day saw the male half digested lying at the bottom underneath the retreat, which means it had been attacked and killed by the female. In one further trial a *F. protensa* male was put into the terrarium of a *F. cylindrata* female. The approaching behaviour upon the leaf was executed up to the point when the male reached the leaf opening. Here he turned and disappeared to an upper corner of the terrarium and stayed there motionless for more than one day.

Key to species:

1 Male (that of *F. travancoria* unknown) **2**
– Female (subadult one of *F. macilenta* unknown) **5**
2 DRTA absent, MA prominent, in some species massive **3**
– Prominent DRTA (Figs 53–54) present, MA slender and rather inconspicuous (Fig. 53) .... ***macilenta***
3 RTA short, at most ½ the width of palpal tibia, MA shorter than width of T ... **4**
– RTA at least as long as width of palpal tibia, MA large and massive, at least as long as width of T (Fig. 10) .... ***ochracea***
4 RTA knobbed, almost as broad as long, E without bEA, VPA arising proximally on patella (Figs 60–61) .... ***protensa***
– RTA rather slender, longer than broad, E with distinct, pointed bEA (Fig. 89), VPA arising centrally (Figs 87–88) .... ***cylindrata***
5 AML distinctly visible, AS with similar colour as surrounding parts of epigyne **6**
– AML hardly visible, posterior half of AS distinctly darker than surrounding parts of epigyne (Figs 48, 114) .... ***macilenta***
6 AML converging anteriorly and surrounding epigynal pit partly, pre-epigyne with TR running completely from left to right AML, in pre-vulva distance between centres of pre-receptacula > 3 x diameter of one pre-receptaculum **7**
– AML diverging anteriorly (Fig. 1), in pre-epigyne gaps between TR and AML (Figs 20–21), in pre-vulva distance between centres of pre-receptacula < 3 x diameter of one pre-receptaculum (Figs 23–24) .... ***ochracea***
7 AS with longitudinal folding, the latter mostly anteriorly pointed (e.g. Figs 55, 76), TR with distinct notch, pre-epigyne with double curved TR, the latter broadly W-shaped (Fig. 69), in general appearance pre-epigyne looking crown-shaped, pre-receptaculum bulbous/spherical (Figs 67–68) **8**
– AS flat (at least anteriorly), without longitudinal folding (Fig. 79), TR without notch, pre-epigyne with continuous TR (Fig. 81), the latter slightly curved, pre-receptaculum with lateral extension (Fig. 85) .... ***cylindrata***
8 In vulva BL running almost longitudinal (Fig. 77), lateral prongs of the "crown" in pre-epigyne narrow (Fig. 74) .... ***travancoria***
– In vulva BL running +/- transversal (Fig. 56), lateral prongs of the "crown" in pre-epigyne not distinctly narrow (Figs 58, 69) .... ***protensa***

Fecenia ochracea (Doleschall, 1859)

http://species-id.net/wiki/Fecenia_ochracea
Figs 1–47, 96, 102–104, 118

Tegenaria ochracea Doleschall, 1859: 50, pl. 8, fig. 8 (Description of ♀), [Holotype ♀ (SB 94) from INDONESIA: Maluku Prov.: Ambon Isl.; C. L. Doleschall leg. 1855–1858; NHMW 12·389, examined]; Thorell 1878: 302 (sub *Tegenaria* [?]); Thorell 1881: 694 (sub *T.* [?]).

Mezentia angustata Thorell, 1881: 204 (Description of ♀), [Holotype ♀ (SB 460) from INDONESIA: Maluku Utara Prov.: Ternate Isl. next to Halmahera; Prof. O. Beccari leg. 1872–1877; MCSN, examined]; Simon 1885: 451.

Mezentia ochracea—Simon 1885: 451 (Transfer from *Tegenaria*).

Fecenia ochracea—Simon 1887: 194 (Formal transfer from *Mezentia*, preoccupied by Stål, 1878 in Orthoptera, replacement name *Fecenia*); Simon 1892: 226; Simon 1906: 287, fig. 1B (Illustration of ♀); Kulczyński 1908: 570; Reimoser 1936: 407; Lehtinen 1967: 234; Levi 1982: 133, figs 68–79, 90 (Illustration of ♂ and ♀♀); Murphy 1986: 65; Griswold 1993: 7; Murphy and Murphy 2000: plate 21, fig. 5 (Photo of ♀); Song et al. 2002: 373 (listed as fauna element of Singapore; doubtful!, to date no records from Singapore).

Fecenia angustata—Simon 1887: 194 (Formal transfer from *Mezentia*); Simon 1892: 226; Pocock 1900: 212; Kulczyński 1908: 570; Petrunkevitch 1928: 90; Reimoser 1936: 407; Chrysanthus 1967: 102, figs 55–57, 60–64 (Description of ♂, illustration of ♂ and ♀♀); Lehtinen 1967: 234 (Synonymy).

Fecenia maforensis Simon, 1906: 287, fig. 1A (Description of ♀), [Holotype ♀ (SB 464) from INDONESIA: Irian Jaya Barat Prov.: Numfor Isl., formerly Mafor; A. Raffray leg.; MNHN AR185, examined]; Kulczyński 1908: 570; Strand 1915: 191 (Description of ♀); Reimoser 1936: 407; Chrysanthus 1967: 104, fig. 65 (Illustration of ♀); Lehtinen 1967: 234 (Synonymy).

Fecenia montana Kulczyński, 1910: 389, pl. 17, fig. 1 (Description of ♀), [Holotype ♀ (SB 461) from PAPUA NEW GUINEA: East New Britain Prov.: Baining Mountains; K. Rechinger leg. 1906; NHMW 12·388, examined], Reimoser 1936: 407, Lehtinen 1967: 234 (Synonymy).

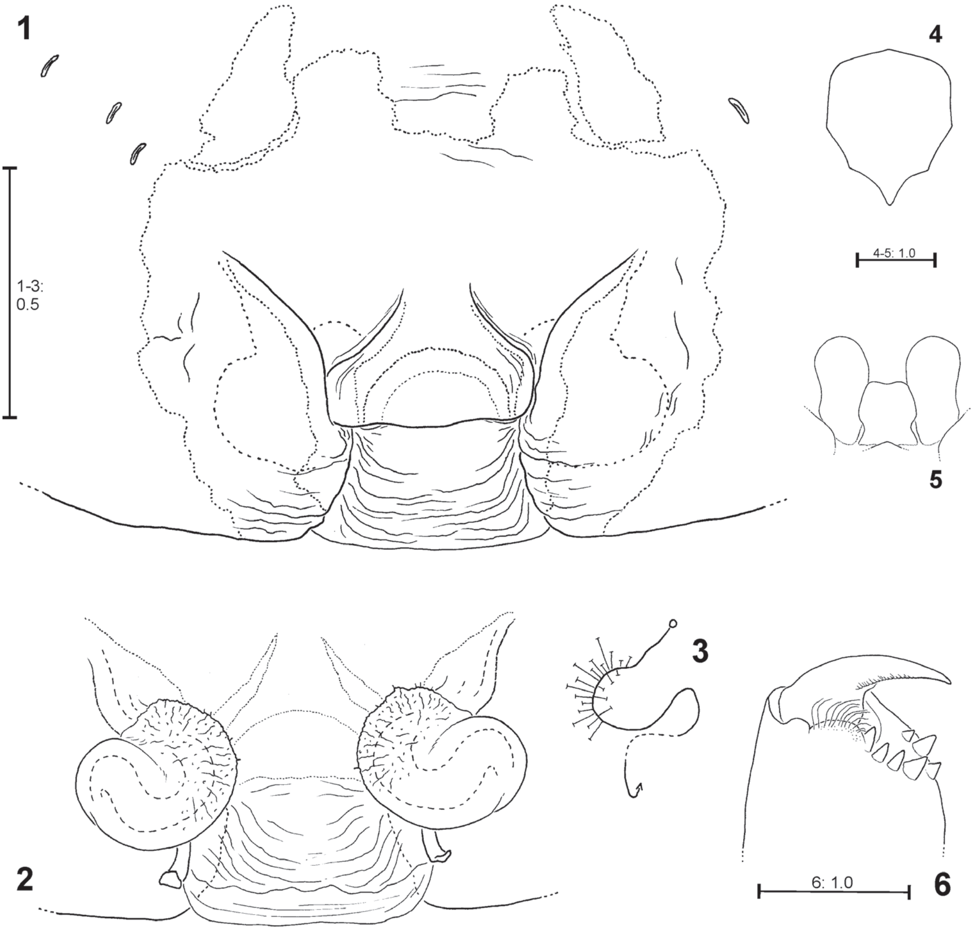
Fecenia oblonga Rainbow, 1913: 7, fig. 5 (Description of ♀), [Holotype ♀ from SOLOMON ISLANDS: Western Prov., Shortland Island Group, Island of Howla; W. W. Froggatt leg. ca. 1900; AMS, lost (Milledge, AMS, pers. comm.), thus not examined]; Reimoser 1936: 407; Lehtinen 1967: 234 (Synonymy).

Fecenia cinerea Hogg, 1914: 56 (Description of ♀), [Holotype ♀ (SB 404) from INDONESIA: Papua Prov.: Possibly near Mount Utakwa; A.F.R. Wollaston leg. 1912–1913 (Wollaston Expedition in Dutch New Guinea); NHM 1921·3·24·9, examined]; Hogg 1915: 437, fig. 23 (Illustration of ♀); Reimoser 1936: 407; Lehtinen 1967: 234 (Synonymy).

Fecenia buruana Reimoser, 1936: 406, fig. 1 (Description of ♂ ♀), [Lectotype ♀ (SB 418), paralectotype ♂ (SB 417) by designation of Levi (1982: 134), both from

INDONESIA: Maluku Prov.: Buru Isl., station 1; L.J. Toxopeus leg. 1921; ZMA, examined]; Chrysanthus 1967: 104, figs 66–67 (Illustration of ♂ and ♀); Lehtinen 1967: 234 (Synonymy).

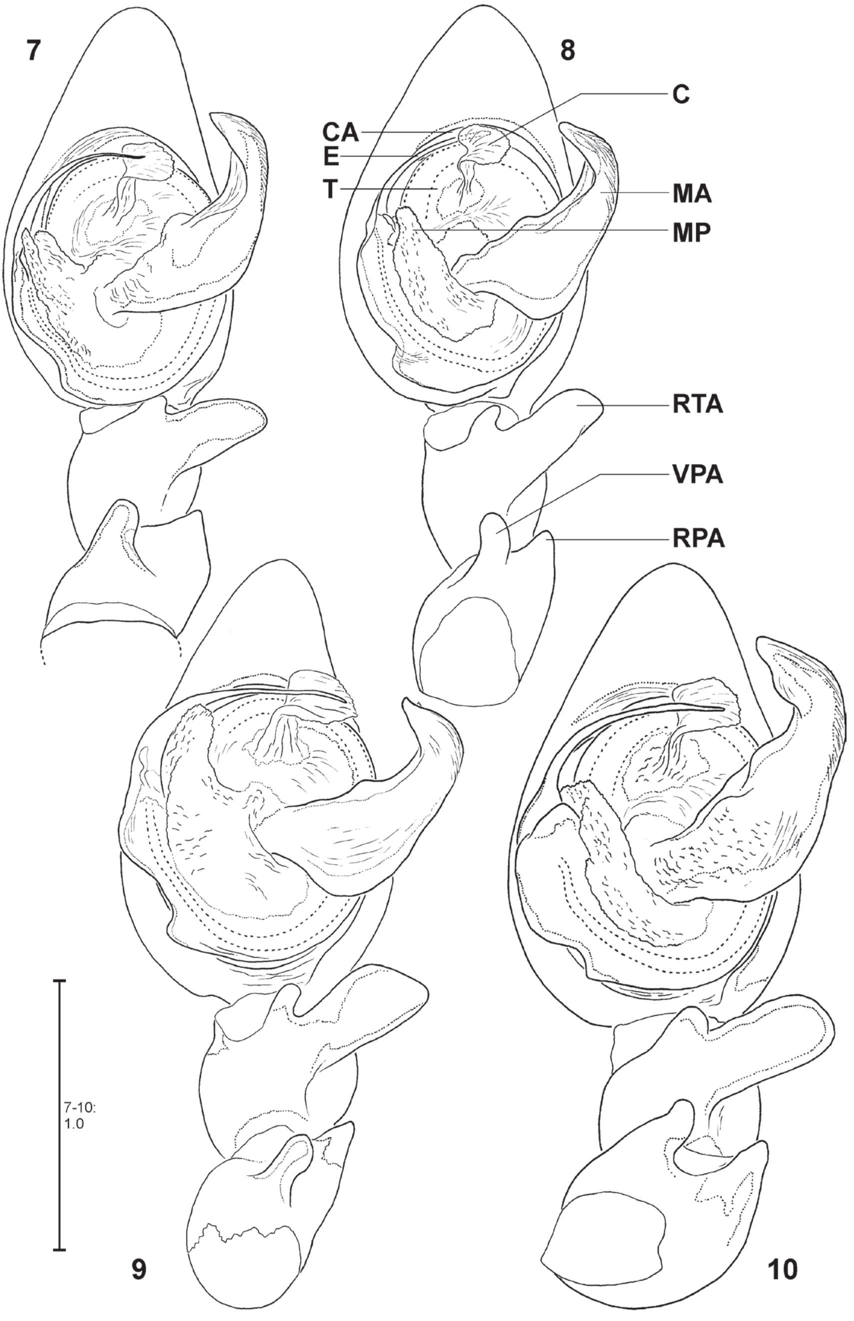
Note on the holotype of *Tegenaria ochracea*. The first description of Doleschall (1859) lacks any remarks concerning deposition of the type specimen. Generally, material recorded by naturalists of the "Natuurkundige Vereeniging in Nederlandsch Indie" has been deposited either in RMNH or in ZMA. Lehtinen (1967) stated that the type deposition was unknown (to him). Levi (1982) mentioned a personal communication from Van der Hammen, the curator of the arachnid collection in RMNH at that time, who stated that the type was lost. At present, the colleagues of the arachnid collection of RMNH still cannot find any type material of *Tegenaria ochracea* there (K. van Dorp and J. Miller, RMNH, pers. comm.). In the arachnid collection of ZMA there is also



Figures 1–6. *Fecenia ochracea*, ♀ holotype (SB 94) from Ambon, Indonesia **1** Epigyne, ventral view **2** Vulva, dorsal view **3** Schematic course of internal duct system, dorsal view **4** Sternum, ventral view **5** Labium and gnathocoxae, ventral view. **6** Right chelicere, ventral view.

no type specimen of *Tegenaria ochracea* (B. Brugge, pers. comm.). During a stay at the natural history museum in Vienna in April 2009 I recognised a syntype specimen of *Psechrus argentatus* (Doleschall, 1857). Both Lehtinen (1967) and Levi (1982) believed that the syntypes of this species had been lost. However, for this latter species found on Ambon, too, and recorded and described by the same author just two years before, it is evident that at least a part of the original syntype series was once deposited in RMNH (Van Hasselt 1877). After consulting Jürgen Gruber and Verena Stagl (both NHMW) I learned that Doleschall sent only a part of his spider- and insect material collected on Ambon to the museum in Leiden; a large part of the material was sent to the museum in Vienna (Stagl 1999). In the spider collection of NHMW I found a *Fecenia* female (SB 94), which was labelled "*Fecenia* - Insel Ambon" (oldest label). According to Gruber (pers. comm.) the handwriting is that of E. Reimoser, the curator of NHMW from 1923–1940. It is well known that Reimoser often discarded old labels and substituted them with new ones (Gruber pers. comm.). It is most likely that in this case the same had happened. Assuming that the handwriting on the original label from Doleschall was unclear, it is likely that Reimoser discarded that label, determined the female as *Fecenia* and just added the locality on the new label. Anyway, it is evident that before 1950 nobody other than Doleschall sent spider material from the island Ambon to the natural history museum in Vienna (Gruber pers. comm.). Hence, the female SB 94 (see synonymy list above) can be considered the holotype of *Tegenaria ochracea*.

Additional material examined. (4 ♂♂, 73 ♀♀, 4 s.a. ♂♂, 7 s.a. ♀♀, 2 p.s.a. ♀♀, 11 juvenile specimens)**. PHILIPPINES:** Luzon: Laguna Prov.: Los Baños; Baker leg.; 1 ♀ (SB 153), MCZ 82529. **MALAYSIA: Borneo: Sabah Prov.:** Kinabalu N.P., Poring Hot Springs, 5°02'N, 116°42'E, 600–700 m, primary forest; A. Floren leg. 03.III.1996 by canopy fogging "ridge"; 1 ♀ (SB 518), Deeleman Coll. in RMNH. **INDONESIA: Sumatra: Nanggroe Aceh Darussalam Prov.:** Ketambe, Gunung Leuser N.P., 3°51' N, 97°37' E, ca. 1300 m, primary forest, from leaves; S. Djojosudharmo leg. 03.V.1986; 1 ♀ (SB 127), Deeleman Coll. in RMNH. **Halmahera: Maluku Utara Prov.:** Jailolo Distr., Kampung Pasir Putih, 0°53'N, 127°41'E; A.C. Messer, P.M. Taylor leg. 1981; 1 ♂ (SB 187), USNM. **Maluku Utara Prov.:** Ternate Isl.; A. Raffray leg.; 1 s.a. ♂ (SB 465), MNHN. **Maluku Prov.:** Buru Isl., station 1; L. J. Toxopeus leg. 1921; 1 ♀ (SB 419), ZMA. Ceram Isl.; 6 ♀♀ (SB 470–473, 475–476), 1 s.a. ♂ (SB 467), 1 s.a. ♀ (SB 469), 1 juv. (SB 468), MNHN AR193. Ambon Isl.; 1 ♀ (SB 474), MNHN AR193. Aru Isls; 1 s.a. ♀ (SB 80), Roewer Coll. 1819 in SMF. **Irian Jaya Barat Prov.:** Manokwari, Dorey; A. Raffray leg.; 1 ♀ (SB 466), MNHN. **Papua Prov.:** Sentani; leg. IV. 1903; 1 ♀ (SB 661), MIZ. Mindiptana; B. Monulf leg. 1958-1965; 3 ♀♀ (SB 96-98) Coll.-No. 8474, 1 ♂ (SB 95), 1 ♀ (SB 442) Coll.-No. 8476, all RMNH. Merauke; B. Monulf leg. 1956-1957; 16 ♀♀ (SB 426-441) Coll.-No. 8475, 8 ♀♀ (SB 443-447, 450, 452-453), 1 s.a. ♂ (SB 444) Coll.-No. 8477, 4 ♀♀ (SB 99-102) Coll.-No. 8478, all RMNH. **Java: Jawa Barat Prov.:** Gunung Gedeh N.P., Cibodas Nature Reserve, 6°44'S, 107°00'E, 1450 m; S. Djojosudharmo leg. 06.XII.1986; 1 ♂ (SB 120), Deeleman Coll. in RMNH. **PAPUA NEW GUINEA: West Sepik Prov.:** Aitape, Seleo; 1 ♀ (SB 662), MIZ. **Morobe Prov.:** Wau, 7°20'S, 146°43'E; M. Robinson leg. 10–15.IV.1977, 5 ♀♀

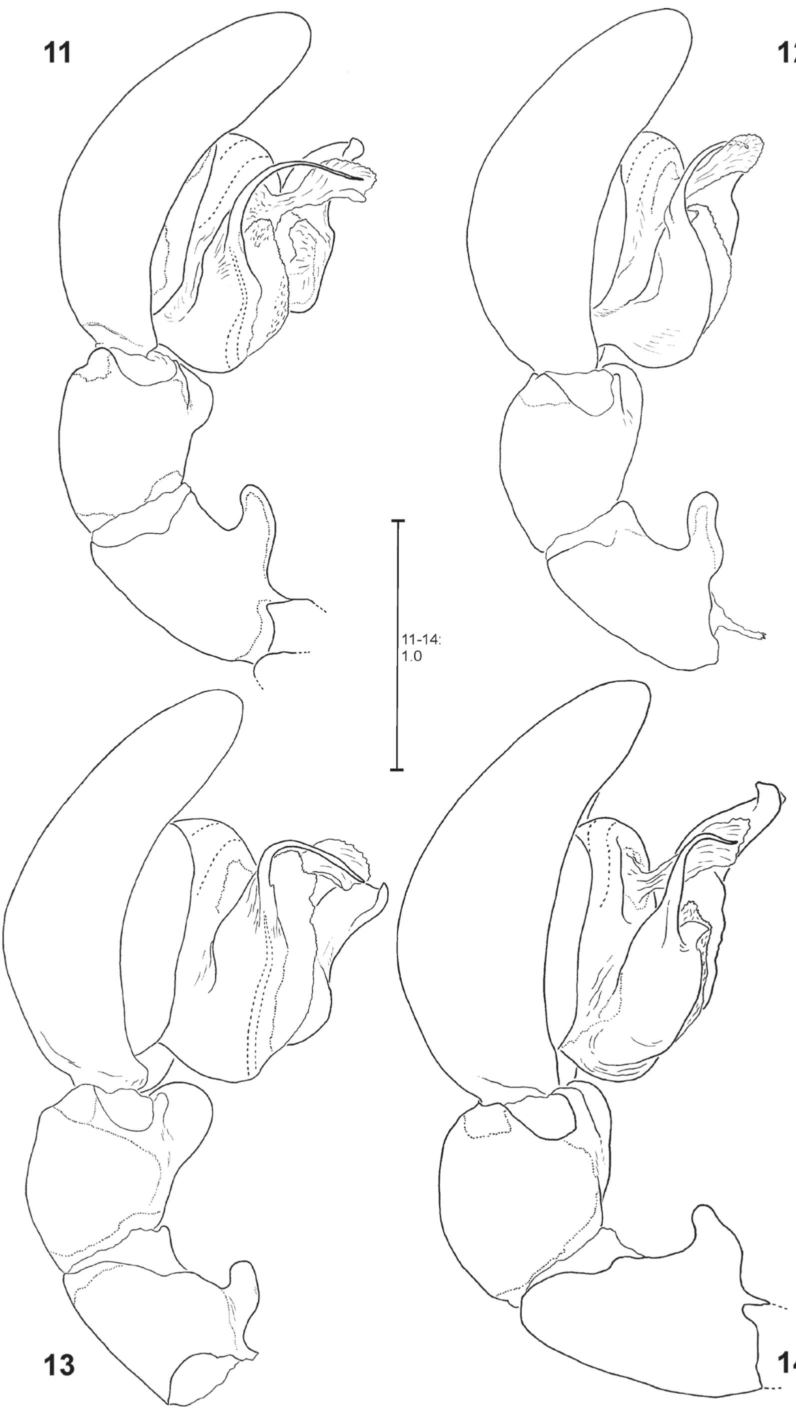


Figures 7–10. *Fecenia ochracea*, left ♂ palp, ventral view **7** SB 120 from Java, Indonesia **8** Paralectotype of *F. buruana* (SB 417) from Buru, Indonesia **9** SB 95 from Mindiptana, Indonesia **10** SB 180 from Wau, Papua New Guinea. Remark on Fig. 8 Embolus slipped behind conductor. C = Conductor; CA = Cymbium alveolus; E = Embolus; MA = Median apophysis; MP = Membranous process of tegulum; RPA = Retrolateral patellar apophysis; RTA = Retrolateral tibial apophysis; T = Tegulum; VPA = Ventral patellar apophysis.

(SB 163–166, 484), 2 juvs (SB 482–483); H. Levi, Y. Lubin, M. Robinson leg. 07.–12. III.1979, MCZ 82521, 5 ♀♀ (SB 156–157, 162, 479–480), 1 s.a. ♀ (SB158), MCZ 82533, J.E. Carico leg. 22.–29.VI.1982, 2 ♀♀ (SB 154–155), 1 p.s.a. ♀ (SB 478), 1 juv. (SB 477), MCZ 82531. Wau; 7°20'S, 146°43'E; J.E. Carico leg. 05.–06.VII.1982; 1 ♂ (SB 180), USNM. Wau, Ecology Center; E.I. Schlinger leg. 17.II.1978; ♀ (SB 947), CAS 9032225. **East New Britain Prov.:** "Putie Bucht", South coast; Dr G. Ducker leg. 05.-19.II.1909, Hamburg Südsee Exp., No. 300; 1 s.a. ♀ (SB 896), ZMH. Jacquinot Bay, ca. 5°34'S, 151°26'E; Dr G. Duncker leg. 19.-20.XII.1908, Hamburg Südsee Exp., No. 261; 2 ♀♀ (SB 892-893), ZMH. Keravat, 4°21'S, 152°07'E, 300 m, lowland tropical rain forest; I. Agnarsson leg. 03.–07.IV.2009; 1 s.a. ♀ (SB 540), 1 juv. (SB 541), SMF. Keravat, Laes; Y.D. Lubin leg. 01.VII.1980; 1 ♀ (SB 167), MCZ 82525. Kokopo, Ralum, ca. 4°20'S, 152°15'E, ca. 50 m; F. Dahl leg. 12.X.1896; 1 ♀ (SB 801), 1 s.a. ♀ (SB 794), 4 juvs (SB 795–800), ZMB 15472, 19244–19248. "Dörper Spitze, S.O. Bucht": Dr G. Duncker leg. 14.V.1909, Hamburg Südsee Exp., No. 534; 2 ♀♀ (SB 894-895), ZMH. **New Ireland Prov.:** New Ireland, Lemkamin; Nocna Dan Exp. 1961-1962; 1 ♀ (SB 887), ZMUC 5728. Feni Isls, Ambitle Isl. (Anir); E. Wolf leg. 04.V.1909; 1 ♀ (SB 86), SMF 2769/1. **Papua New Guinea [no other locality data]:** L. Biro leg.; 1 ♀ (SB 668), 1 p.s.a. ♀ (SB 669), 2 juvs (SB 670-671), MIZ 46/51U. **SOLOMON ISLANDS:** New Georgia Group; J.F. P. leg. 1965; 1 s.a. ♀ (SB 392), NHM. Auki; W.M. Mann leg. 1916; 3 ♀♀ (SB 159–161), MCZ 82524.

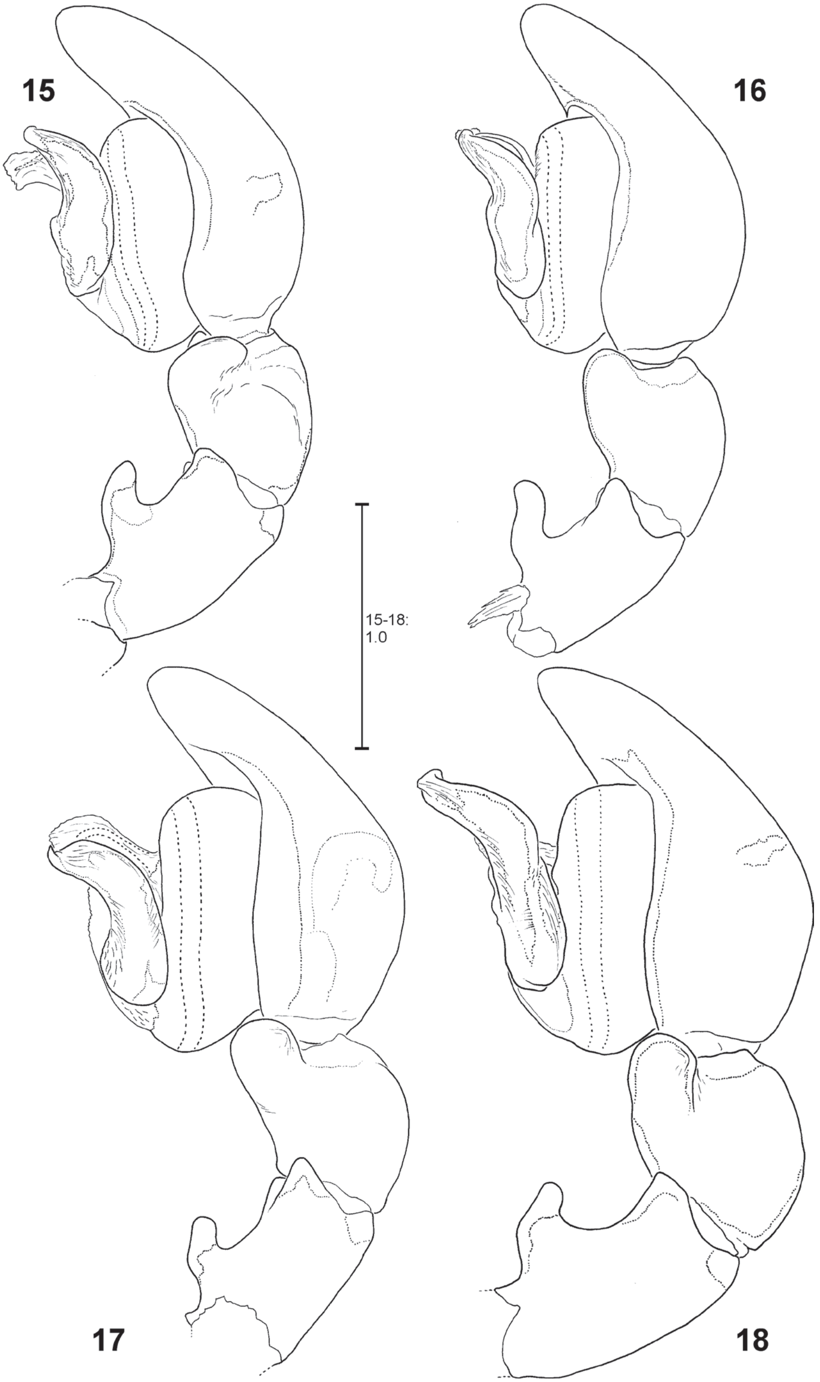
Diagnosis. Distinguished from other *Fecenia* species by the epigyne with diverging anterior margins of lateral lobes (AML) (Fig. 1). Males differ from all other *Fecenia* species by RTA at least as long as width of palpal tibia, MA large and massive, at least as long as width of tegulum (T) (Fig. 8).

Description. MALE: Body and eye measurements. Carapace length 4.2–4.7, carapace width 2.8–3.4, anterior width of carapace 1.7–2.1, opisthosoma length 4.8–7.1, opisthosoma width 2.0–3.3. Eyes: AME 0.28–0.33, ALE 0.20–0.23, PME 0.20–0.23, PLE 0.20–0.22, AME–AME 0.17–0.28, AME–ALE 0.06–0.13, PME–PME 0.22–0.28, PME–PLE 0.28–0.42, AME–PME 0.14–0.17, ALE–PLE 0.11–0.17, clypeus height at AME 0.28–0.42, at ALE 0.21–0.34. Measurements of palp and legs. Palp 5.2–6.1 [2.0–2.4, 0.8–1.1, 0.7–0.8, 1.3–1.8], I 46.6–55.9 [12.6–15.6, 1.9–2.2, 12.3–15.5, 13.4–16.9, 5.2–5.7], II 21.7–26.8 [5.8–6.7, 1.5–1.8, 6.0–7.6, 6.0–7.0, 2.4–3.0], III 12.1–14.2 [3.4–4.1, 1.1–1.4, 3.0–3.6, 3.1, 1.4–1.7], IV 20.6–24.0 [5.4–6.8, 1.4, 5.4–6.5, 6.2–6.5, 2.2–2.6]. Leg formula: 1243. Copulatory organ: Ventral patellar apophysis (VPA) arising in basal third of palpal patella (Figs 11–18), retrolateral patellar apophysis (RPA) mostly inconspicuous (Figs 9, 17). RTA distally not or just slightly broader than basally (Fig. 10). MA ventrally in basal third with distinct bulge (Figs 8–9, 96). Distal part of MA bent prolaterally. General direction of MA 1:00 or 1:30-o'clock. Embolus (E) arising in ca. 9-o'clock-position on T, at most as long as width of T (Figs 7–10, 96). T with corner-like lobe ventrally in prolateral half, T slightly longer than broad. MP with differing lengths (Figs 7–10, 96). Conductor (C) small, arising centrally in upper third of T.



Figures 11–14. *Fecenia ochracea*, left ♂ palp, prolateral view **11** SB 120 from Java, Indonesia **12** Paralectotype of *F. buruana* (SB 417) from Buru, Indonesia **13** SB 95 from Mindiptana, Indonesia **14** SB 180 from Wau, Papua New Guinea.

FEMALE (Measurements of holotype (SB 94) first, those of other specimens given as ranges in parentheses; Holotype misses both legs I as well as all limbs of legs IV from tibia on): Body and eye measurements. Carapace length 6.4 (3.2–6.9), carapace width 4.2 (2.2–4.3), anterior width of carapace 3.0 (1.7–3.1), opisthosoma length 9.1 (4.5–9.3), opisthosoma width 4.8 (2.2–5.2). Eyes: AME 0.33 (0.20–0.33), ALE 0.23 (0.15–0.23), PME 0.23 (0.15–0.23), PLE 0.25 (0.15–0.25), AME–AME 0.29 (0.22–0.29), AME–ALE 0.17 (0.09–0.17), PME–PME 0.36 (0.24–0.36), PME–PLE 0.48 (0.33–0.48), AME–PME 0.30 (0.15–0.30), ALE–PLE 0.24 (0.14–0.24), clypeus height at AME 0.44 (0.27–0.44), at ALE 0.42 (0.20–0.42). Measurements of palp and legs. Palp 6.3 (3.5–6.7) [2.2 (1.3–2.4), 1.1 (0.5–1.1), 1.2 (0.7–1.3), 1.8 (1.0–2.0)], I 17.2–40.7 [4.6–10.8, 1.3–2.9, 4.7.7–11.3, 4.5–11.4, 2.1–4.3], II 23.5 (10.8–24.5) [6.4 (3.0–6.6), 2.2 (1.1–2.2), 6.4 (2.9–6.8), 5.9 (2.50–6.2), 2.6 (1.3–2.7)], III 13.6 (6.6–14.6) [4.0 (1.9–4.3), 1.6 (0.8–1.7), 3.3 (1.5–3.5), 3.2 (1.5–3.4), 1.5 (0.9–1.7)], IV 10.0–21.4 [5.7 (2.7–5.8), 2.0 (1.0–2.1), 2.6–5.8, 2.5–5.3, 1.2–2.4]. Leg formula: 1243. Palpal claw with 10 (8–11) teeth. Spination (holotype from Ambon [except for leg I as well as tibia and metatarsus of leg IV, which are lost in holotype: spination of SB 474 from Ambon is listed instead]). Palp: 110, 000, 0000, 0000; legs: femur I 533(423), II 313, III 213, IV 111; patella I–IV 000; tibia I 3008, II 3006, III 0025, IV 2024; metatarsus I 2025, II 2025, III 1025, IV 1026. Copulatory organ: Anterior part of median septum (AS) of epigyne broad-“nose-like”, slightly broader than its posterior part (PS). Lateral lobes massive (Fig. 1, 102). Epigynal muscle sigillae (EM) mostly integrated in epigynal field (EF). Slit sense organs (SO) mostly outside EF. Vulva with relatively short and narrow transparent section of internal duct system (TSI). Strongly sclerotised section (SSI) compact, duct with two curves (Figs 2–3), apex of first one directed posterio-medially, of second anterio-laterally. Primordial copulatory organs: Pre-epigyne: Already strongly resembling the adult epigyne (Figs 20–21, 104). All major structures present in adult epigyne are recognizable in the pre-epigyne, too (of course much smaller). Epigynal field not or only poorly developed, EM far outside epigynal field (Fig. 21). Pre-pre-epigyne (antepenultimate instar): AML far shorter than in pre-epigyne and transversal ridge/edge of median septum (TR) hardly recognisable (Fig. 22, fine dotted line). Pre-vulva: Pre-receptacula bulbous/spherical and relatively close to each other. Distance between centres of pre-receptacula less than 3 times of diameter of one pre-receptaculum (Figs 23–24). Colouration: Male and female: As described for *Fecenia* in general, but white to beige patch in front of spinnerets may be rather unclear (Fig. 118), smaller or even absent. In one (SB 98, from Mindiptana, Eastern Papua Province, Indonesia) out of 103 specimens the light patches ventrally on opisthosoma are absent. Variation of copulatory organs: Among male specimens examined, cymbium differing at most slightly in length (Figs 11–18). In some specimens MA may be more massive (Fig. 10) or T slightly broader (Figs 9–10) than in others. Shape of prolatero-ventral lobe variable (Figs 7–10, 96). One specimen differing slightly more from the paralectotype of *F. buruana* (Figs 8, 12, 16) from Buru island (which is the closest male record to the type locality, Ambon) than the others. This is SB 95 from Mindiptana, Eastern

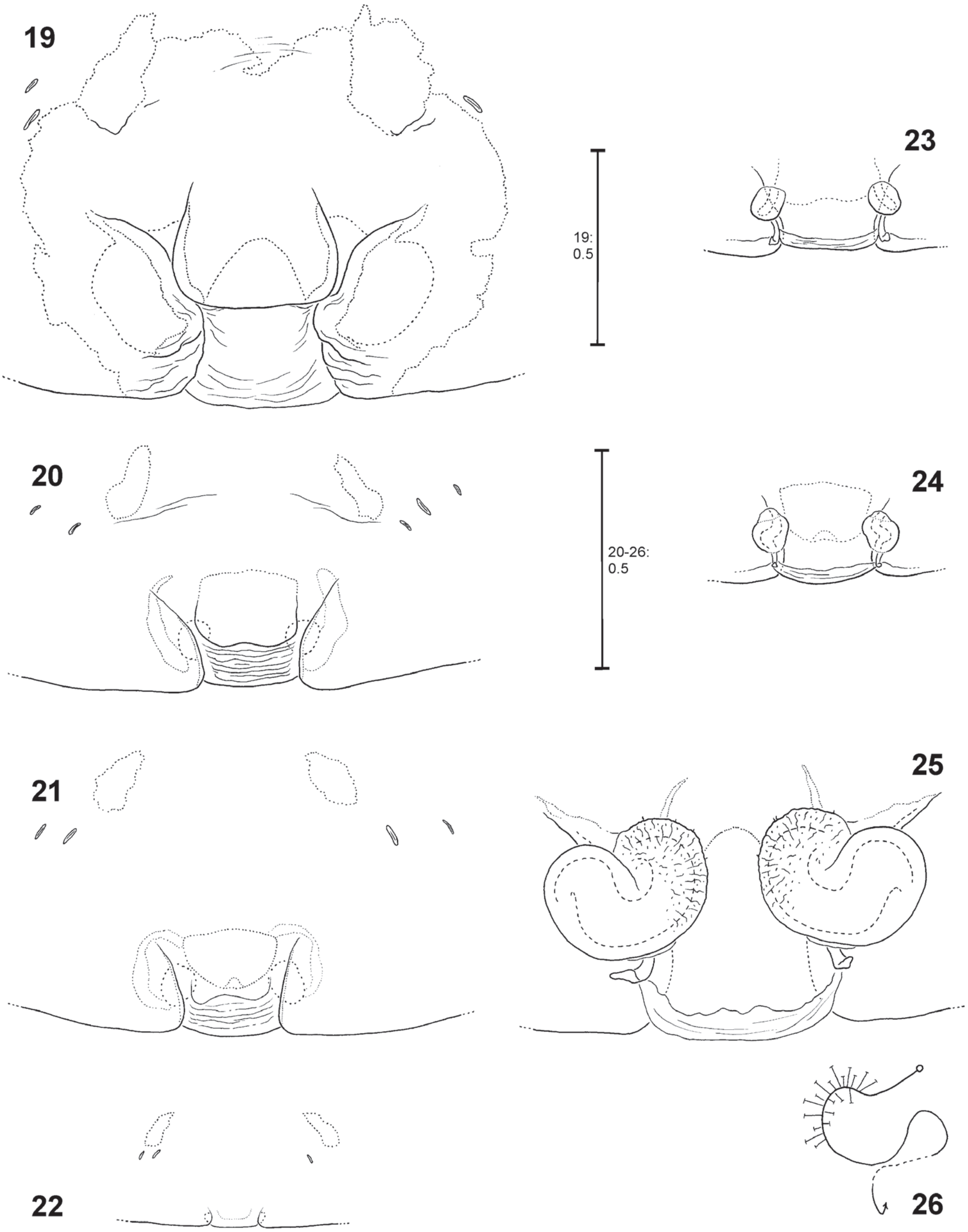


Figures 15–18. *Fecenia ochracea*, left ♂ palp, retrolateral view **15** SB 120 from Java, Indonesia **16** Paralectotype of *F. buruana* (SB 417) from Buru, Indonesia. **17** SB 95 from Mindiptana, Indonesia **18** SB 180 from Wau, Papua New Guinea.

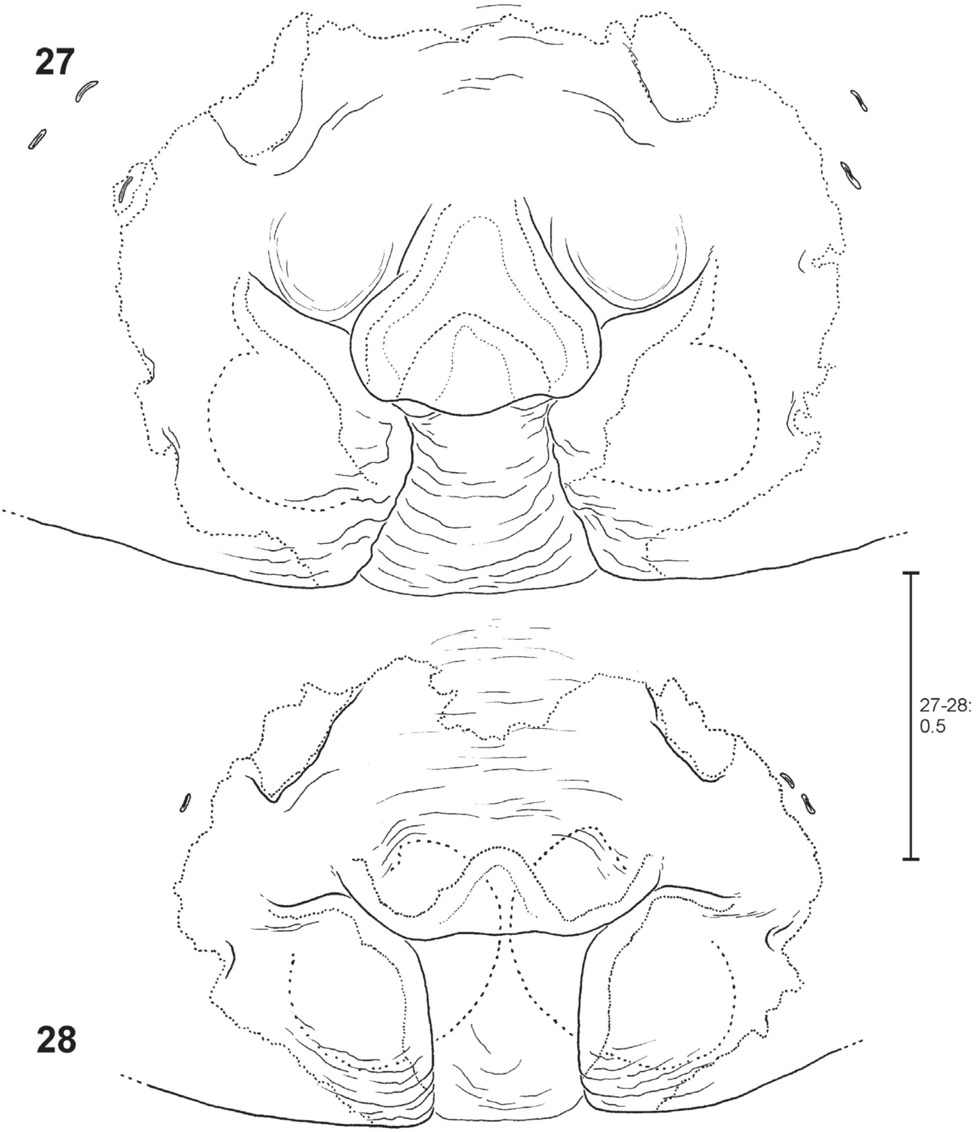
Papua Province of Indonesia: MA directed to 2:30-o'clock position (Fig. 9), embolus (E) slightly longer than in the other males examined, RTA broadest distally (Fig. 9). Additionally, T protruding a bit more out of cymbium (Fig. 13) than in the other specimens. In females intraspecific variation is higher. The shape of AS (Figs 1, 19, 27–33, 102) as well as the course of AML are highly variable. Number of SO varying among specimens without geographical dependence. Vulvae of the specimens examined show less variation than epigynes. The initial part of SSI may be slightly more prominent (Fig. 38). Further on, the position of SSI seems slightly shifted in some specimens (Figs 25, 34). Pre-epigynes also differing in shape of AS and in course of AML (Figs 20–21). Based on almost 80 females examined, all the variation described so far is neither geographically fixed, nor are there distinct forms of variants which recur here and there. In some cases females from exactly the same recording site show clear differences. And on the other hand females which are recorded in different localities, partly hundreds of km away from each other, look strikingly similar. Anyway, the following 'form of females' has to be discussed separately (see remark below).

Remarks. The vulvae of the holotype of *F. cinerea* (SB 404) (Fig. 40) and the specimens recorded from Mindiptana, Eastern Papua Province of Indonesia (SB 96–98, 442) (SB 98 illustrated in Fig. 44) differ from all other females examined. The duct of SSI is somewhat longer, especially the second curve (Figs 40, 44). Consequently, the course of the internal duct system of these specimens (Figs 41, 45) differs from the remaining *F. ochracea* females (Figs 3, 35, 37, 39, 43, 47). However, the vulvae of the holotype of *F. cinerea* (SB 404) and female SB 98 do not correspond completely. In SB 404 the second curve of SSI protrudes more strongly in a lateral direction. In one specimen (SB 97, not illustrated) from Mindiptana the second curve of SSI is a bit shorter than in the others from this locality. The epigynes of SB 96-98, 404 and 442 differ in shape (SB 404: Fig. 28; SB 98: Fig. 32; others not illustrated). According to the differences in the shape of the vulvae (see above) it may be justified to revalidate *F. cinerea* Hogg, 1914. However, the difference is little (second curve of SSI slightly longer than in *F. ochracea*) and thus does not provide evidence for a clear species delimitation; especially considering that in one specimen from Mindiptana the second curve is again slightly shorter. In addition, if the females from Mindiptana should be regarded as *F. cinerea*, then the male (SB 95, Figs 9, 13, 17), which was recorded from exactly the same locality, should be placed here, too. However, as discussed above, the palp structures of this male only slightly differ from the ones of other *F. ochracea* males (though these differences are worth mentioning as intraspecific variation). Moreover, no males have been recorded from the type locality of *F. cinerea* so far. Consequently, I refrain from changing the taxonomic status of *F. cinerea*. More material from the type locality of *F. cinerea*, especially males may enlighten this "problematic case".

Disribution. Philippines, Malaysia [Borneo], Indonesia [Sumatra, Borneo, Moluccas, West Papua, Java], Papua New Guinea, Solomon Islands, Australia [Northern Queensland].



Figures 19–26. *Fecenia ochracea*, ♀ copulatory organ/primordial copulatory organ **19, 25–26** Holotype ♀ of *F. montana* (SB 461) from East New Britain **20, 23** s.a. ♀ SB 540 from East New Britain **21, 24** s.a. ♀ SB 158 from Wau, Papua New Guinea **22** p.s.a. ♀ SB 669 from New Guinea **19** Epigyne, ventral view **20–21** Pre-epigyne, ventral view **22** Pre-pre-epigyne, ventral view **23–24** Pre-vulva, dorsal view **25** Vulva, dorsal view **26** Course of internal duct system.



Figures 27–28. *Fecenia ochracea*, ♀ epigyne, ventral view **27** Holotype of *F. maforensis* (SB 464) from Northwestern Irian Jaya, Indonesia **28** Holotype of *F. cinerea* (SB 404) from Southern Papua Prov., Indonesia.

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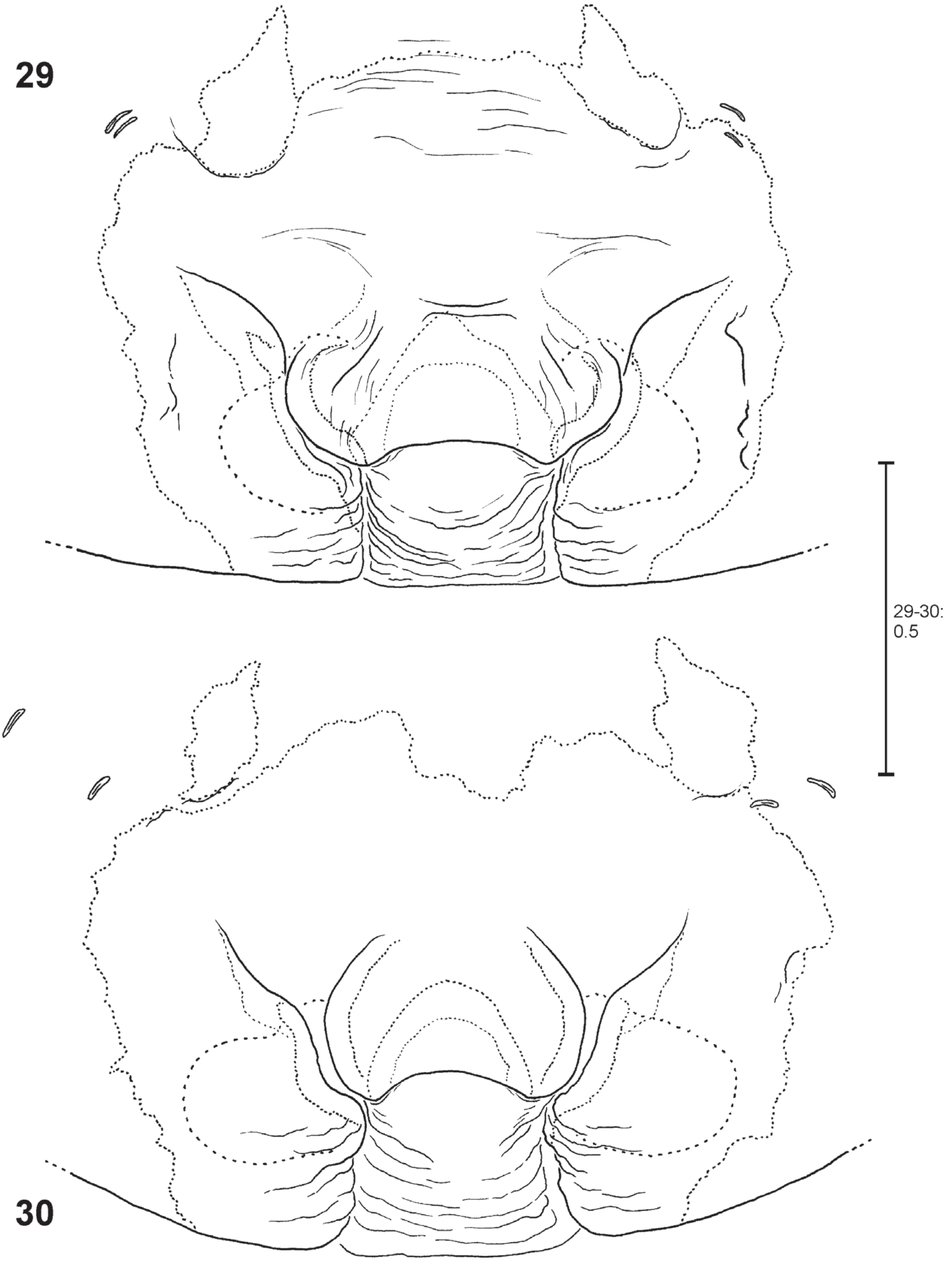

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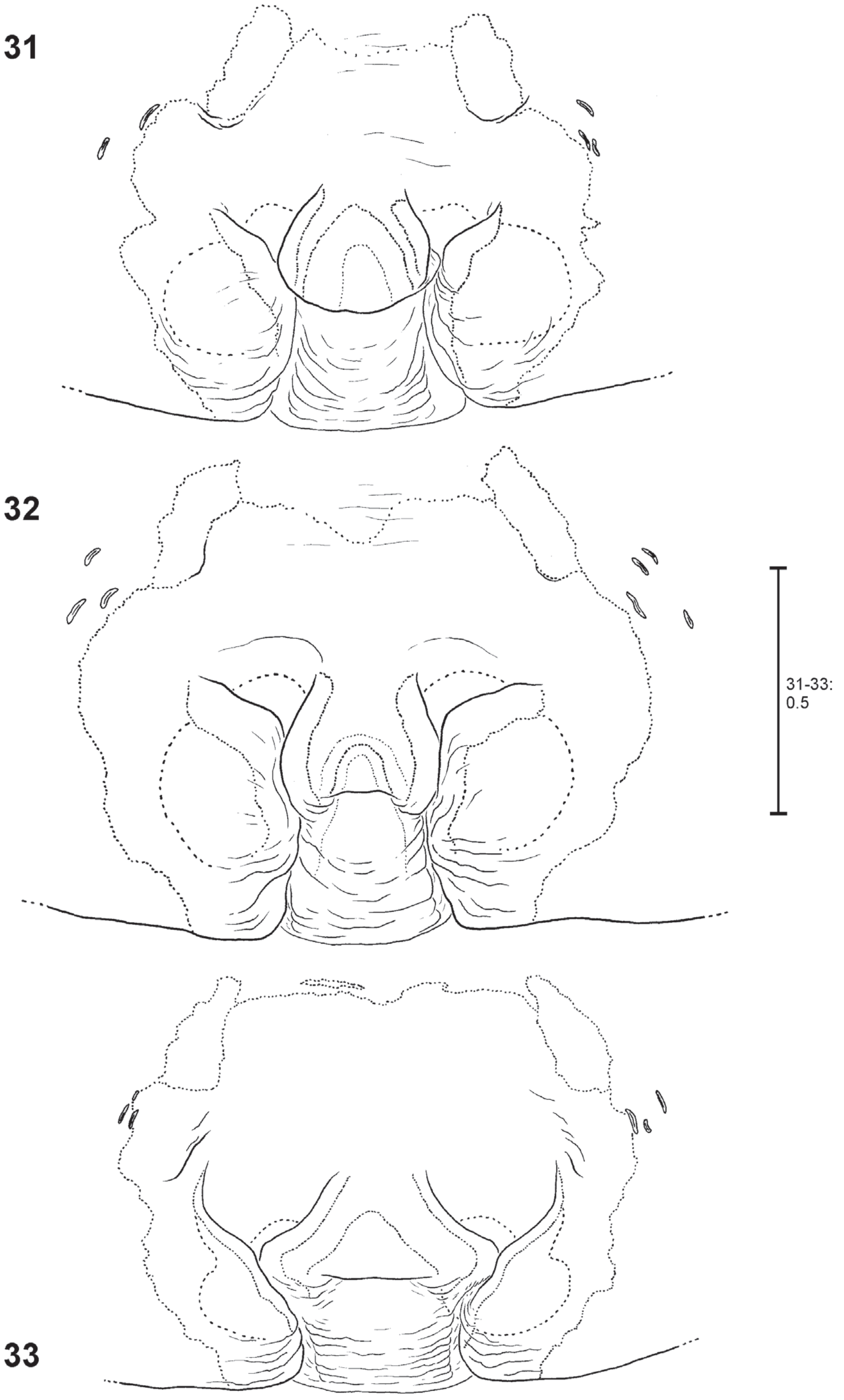
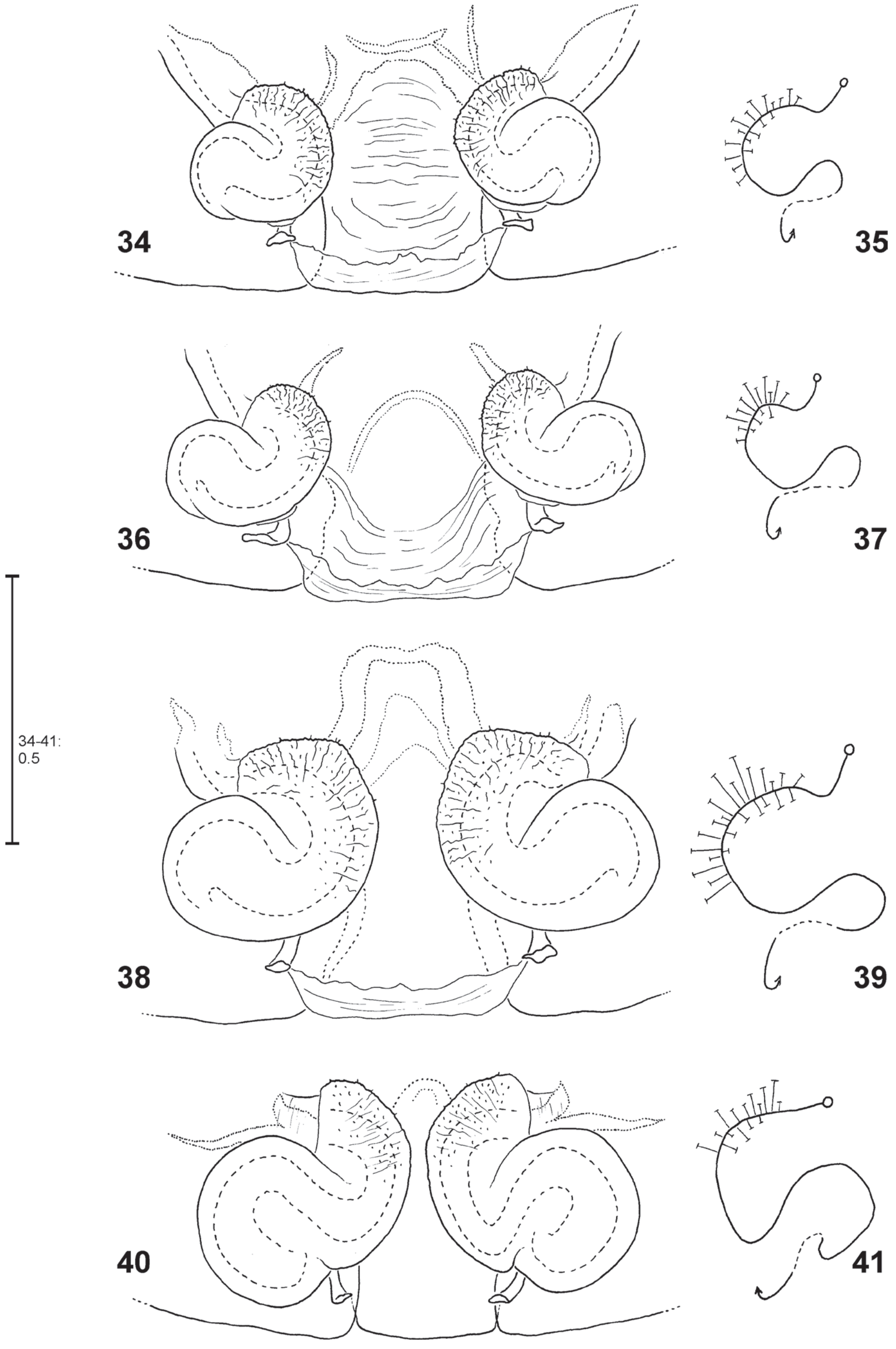
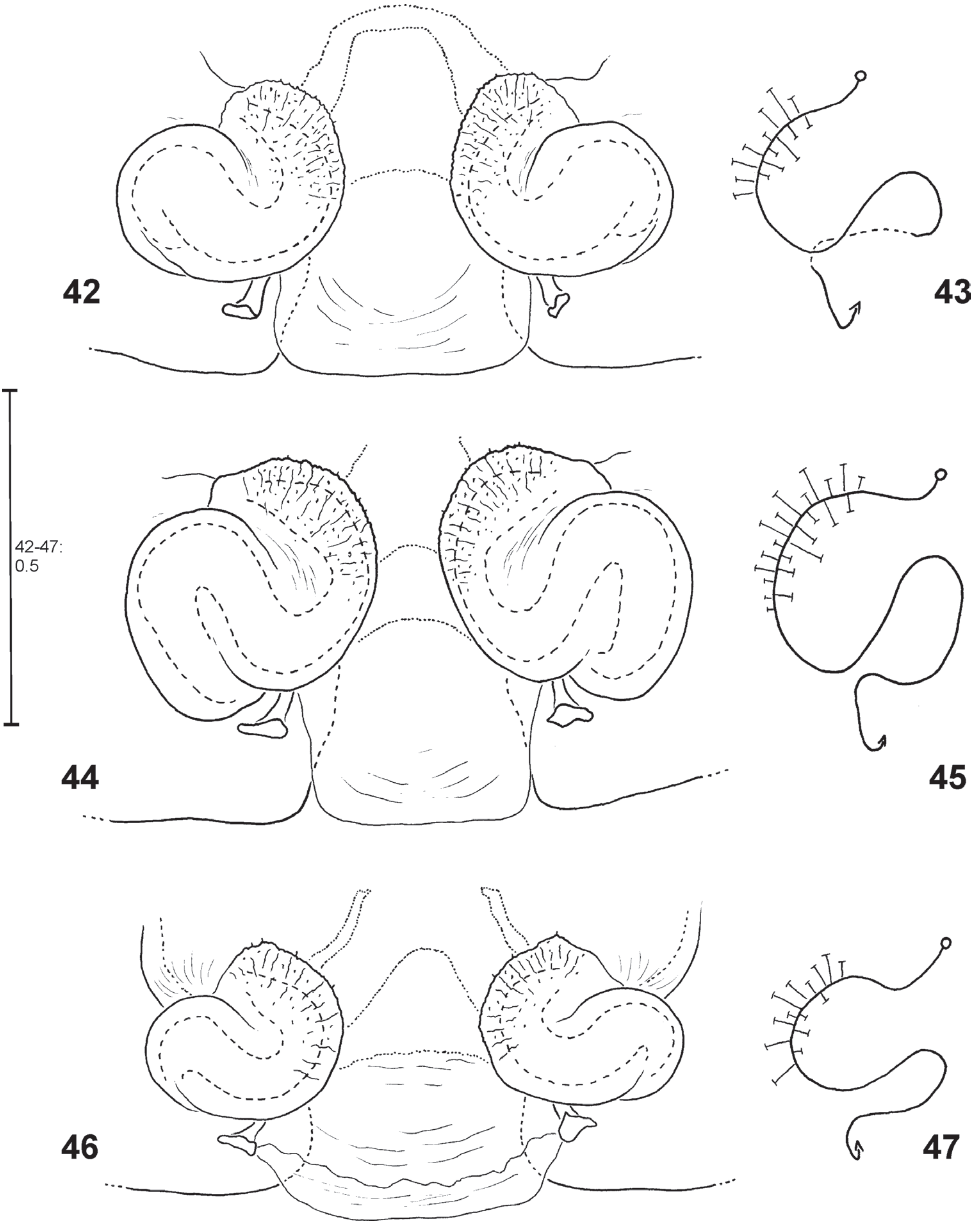
Figures 29-30. *Fecenia* ochracea, ♀ epigyne, ventral view **29** Holotype of *F. angustata* (SB 460) from Ternate, Indonesia **30** Lectotype of *F. buruana* (SB 418) from Buru, Indonesia.



Figures 31–33. *Fecenia ochracea*, ♀ epigyne, ventral view **31** SB 430 from Southeastern Papua Prov., Indonesia **32** SB 98 from Mindiptana, Southeastern Papua Prov., Indonesia **33** SB 127 from Northern Sumatra, Indonesia.



Figures 34–41. *Fecenia ochracea*, ♀ vulva, dorsal view **(34, 36, 38, 40)** with course of internal duct system **(35, 37, 39, 41). 34–35** Holotype of *F. angustata* (SB 460) from Ternate, Indonesia. **36–37** Lectotype of *F. buruana* (SB 418) from Buru, Indonesia. **38–39** Holotype of *F. maforensis* (SB 464) from Northwestern Irian Jaya, Indonesia. **40–41** Holotype of *F. cinerea* (SB 404) from Southern Papua Prov., Indonesia.



Figures 42–47. *Fecenia ochracea*, ♀ vulva, dorsal view **(42, 44, 46)** with course of internal duct system **(43, 45, 47). 42–43** SB 430 from Southeastern Papua Prov., Indonesia. **44–45** SB 98 from Mindiptana, Southeastern Papua Prov., Indonesia. **46–47** SB 127 from Northern Sumatra, Indonesia.

***Fecenia macilenta* (Simon, 1885)**

http://species-id.net/wiki/Fecenia_macilenta

Figs 48–54, 95, 101, 114–115

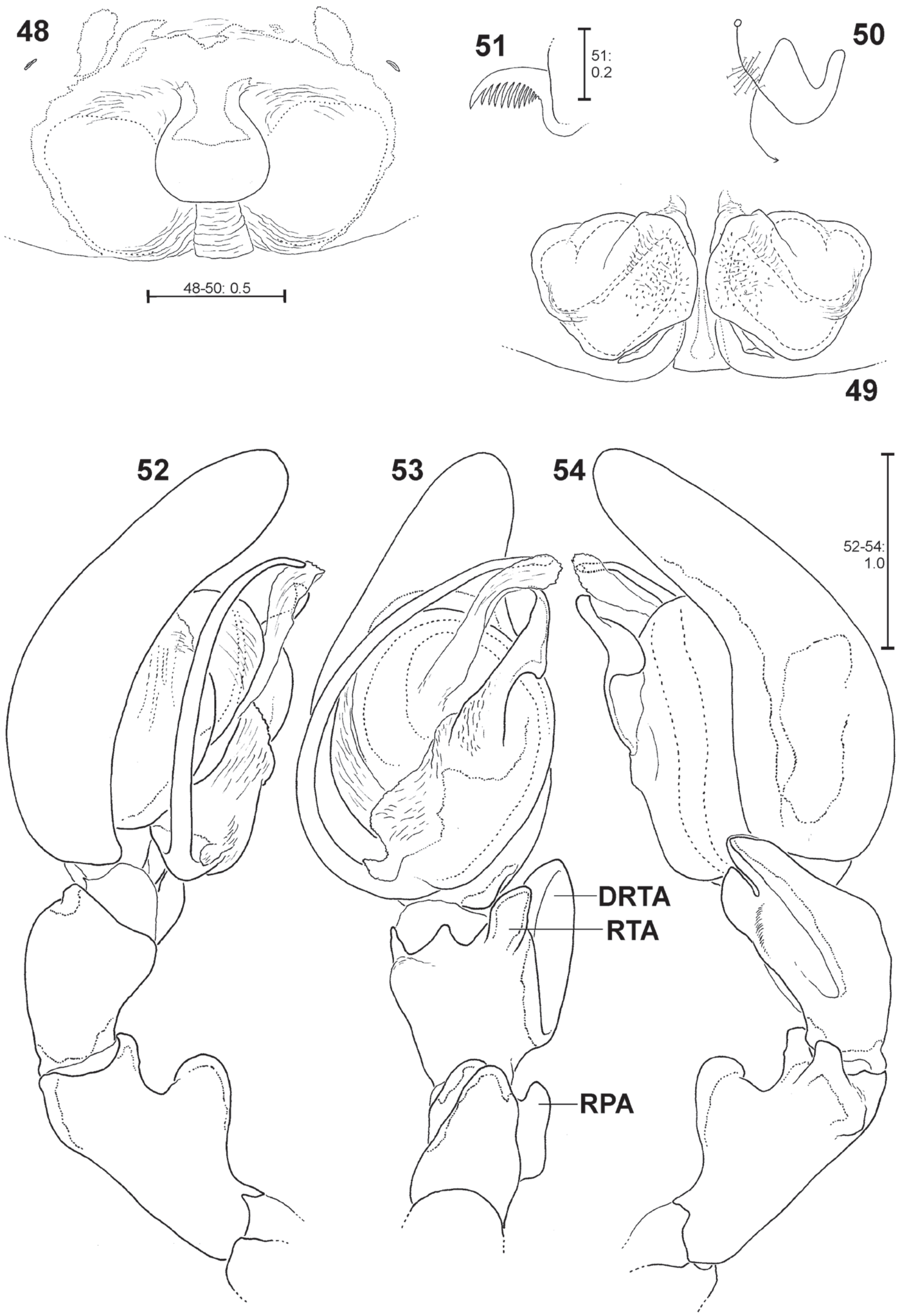
Mezentia macilenta Simon, 1885: 451, pl. 10, fig. 17 (Description and illustration of ♂), [Holotype ♂ (SB 395) from MALAYSIA: Perak Prov. (Malacca): Region of Ipoh, Kinta river valley; M.J. de Morgan leg. 1884; MNHN AR5164, examined].

Fecenia macilenta—Simon 1887: 194 (Formal transfer from *Mezentia*, preoccupied by Stål, 1878 in Orthoptera, replacement name *Fecenia*); Simon 1892: 223, figs 171–172 (Illustration of ♂); Kulczyński 1908: 570; Reimoser 1936: 406; Lehtinen 1967: 234; Levi 1982: 136, figs 83–87, ad part, figs 84–85 (Illustration of ♂), figs 83, 86–87 misidentified; Murphy 1986: 65, figs 1–2 (Description and illustration of ♀); Coddington 1990: 10, fig. 18 (Illustration of ♂); Murphy and Murphy 2000: plate 21, fig. 6 (photo of ♀).

Additional material examined. (1 ♂, 2 ♀♀). **MALAYSIA: Selangor Prov.:** Banting; W. Corley leg. VIII. 1981; 1 ♂ (SB389), 1 ♀ (SB 390), NHM. **INDONESIA: Sumatra: Sumatera Barat Prov.:** Panti (Road to Lubuk Sikaping & Bukittinggi), Rimba Panti Nature Reserve, primary rainforest; C. Deeleman leg.; 1 ♀ (SB 124), Deeleman Coll. in RMNH.

Diagnosis. Males differ from other species by prominent dorso-retrolateral tibial apophysis (DRTA) (Figs 53–54, 95, 101) and slender and rather inconspicuous median apophysis (MA) (Fig. 53). Furthermore, ventral patellar apophysis (VPA) larger and retrolateral patellar apophysis (RPA) extending more clearly than in all other *Fecenia* species (Fig. 53–54, 95). Females distinguished from other species by epigyne with anterior margins of lateral lobes (AML) hardly visible and by posterior half of anterior part of median septum (AS) being distinctly darker than surrounding parts of epigyne (Fig. 114). Moreover, AS with permanent semicircular posterior half (Figs 48, 114).

Description. MALE (Holotype (SB 395) is the largest of the males examined; consequently its measurements appear as maximum in each range. Eye measurements differ only insignificantly, so only those of the Holotype are listed): Body and eye measurements. Carapace length 5.4–5.8, carapace width 3.5–4.1, anterior width of carapace 2.3–2.7, opisthosoma length 5.4–7.4, opisthosoma width 2.8–3.2. Eyes: AME 0.47, ALE 0.34, PME 0.31, PLE 0.29, AME–AME 0.27, AME–ALE 0.08, PME–PME 0.35, PME–PLE 0.40, AME–PME 0.15, ALE–PLE 0.19, clypeus height at AME 0.67, at ALE 0.54. Measurements of palp and legs. Palp 7.3–8.5 [2.8–3.3, 1.2–1.4, 1.1–1.3, 2.2–2.5], I 53.5–67.4 [14.7–18.8, 2.3, 15.3–19.2, 16.7–19.9, 4.5–7.2], II 27.9–35.0 [7.5–9.4, 1.9–2.2, 7.7–9.7, 7.7–9.9, 3.1–3.8], III 15.9–19.4 [4.6–5.6, 1.5–1.7, 3.8–4.8, 4.1–4.9, 1.9–2.4], IV 25.1–30.9 [6.8–8.3, 1.7–2.0, 6.4–8.2, 7.4–8.9, 2.8–3.5]. Leg formula: 1243. Male chelicerae differing from general appearance of *Fecenia*: Basal limb ca. 4 times longer than broad. Spination (holotype from Kinta river, Malaysia). Palp: without any spines; legs: femur I 410(300), II 100, III 010, IV 001; patella I–IV 000; tibia I–II 2004, III 0000(0001), IV 0013; meta-



Figures 48–54. *Fecenia macilenta*. **48–51** ♀ (SB 390) from Selangor Prov., Malaysia. **52–54** Holotype ♂ (SB 395) from Perak Prov., Malaysia. **48** Epigyne, ventral view. **49** Vulva, dorsal view. **50** Course of internal duct system. **51** Left palpal claw, retrolateral view. **52–54** left palp, prolateral **(52)**, ventral **(53)** and retrolateral **(54)** view. DRTA = Dorso-retrolateral tibial apophysis; RPA = Retrolateral patellar apophysis; RTA = Retrolateral tibial apophysis.

tarsus I 3014(1014), II 1015, III 1015(1014), IV 1015. Copulatory organ: Ventral patellar apophysis (VPA) arising centrally on palpal patella (Figs 52, 54), RTA small, less than 1/3 of the length of the massive DRTA. Median apophysis (MA) distally slightly bent. General direction of MA is 12:30 or 1:00-o'clock. Embolus (E) arising in ca. 6:30-o'clock-position on tegulum (T), broader than in all other *Fecenia* species and almost twice as long as width of T. The latter slightly longer than broad. Membranous process (MP) of tegulum directed proximally (Figs 53, 95). Conductor (C) longer than MA, arising centrally in upper third of T.

FEMALE (The two females examined differ not or only marginally in almost all measurements, so only those of SB 390 are listed, except for opisthosoma measurements [ranges, SB 390 from Banting, Malaysia first]): Body and eye measurements. Carapace length 5.3, carapace width 3.7, anterior width of carapace 3.0, opisthosoma length 7.6–8.3, opisthosoma width 4.5–4.9. Eyes: AME 0.34, ALE 0.27, PME 0.27, PLE 0.22, AME–AME 0.26, AME–ALE 0.12, PME–PME 0.34, PME–PLE 0.46, AME–PME 0.22, ALE–PLE 0.24, clypeus height at AME 0.44, at ALE 0.41. Measurements of palp and legs. Palp 5.9 [2.0, 1.0, 1.0, 1.9], I 30.2 [8.1, 2.3, 8.5, 7.9, 3.4], II 19.7 [5.4, 1.9, 5.3, 4.7, 2.4], III 12.4 [3.6, 1.5, 2.9, 2.8, 1.6], IV 17.7 [4.9, 1.7, 4.6, 4.4, 2.1]. Leg formula: 1243. Palpal claw with 12 teeth (Fig. 51). Copulatory organ: Anterior part of median septum (AS) of epigyne "nose-like", broader than posterior part (PS) (Fig. 48). Lateral lobes voluminous (Figs 48, 114). Epigynal muscle sigilla (EM) integrated in epigynal field. Slit sense organs (SO) outside epigynal field. Vulva with voluminous sclerotised section of internal duct system (SSI) (Fig. 49) and short and narrow transparent section (TSI), which is in dorsal view partly covered by SSI. The latter almost in contact with each other. Duct of SSI with three curves (Fig. 50). Fertilisation duct (FD) narrow. Colouration: Male and female: As described for *Fecenia* in general, but white to beige patch in front of spinnerets in one female rather unclear and smaller. Variation of copulatory organs: Males varying only insignificantly. Females: In female from Banting, Malaysia (SB 390) dark section of AS reaching further anteriorly (dotted line within AS in Fig. 48) than in SB 124 (Fig. 114). Number of SO among specimens varies from two to four. Distance between SSI slightly longer in SB 124 (Fig. 115).

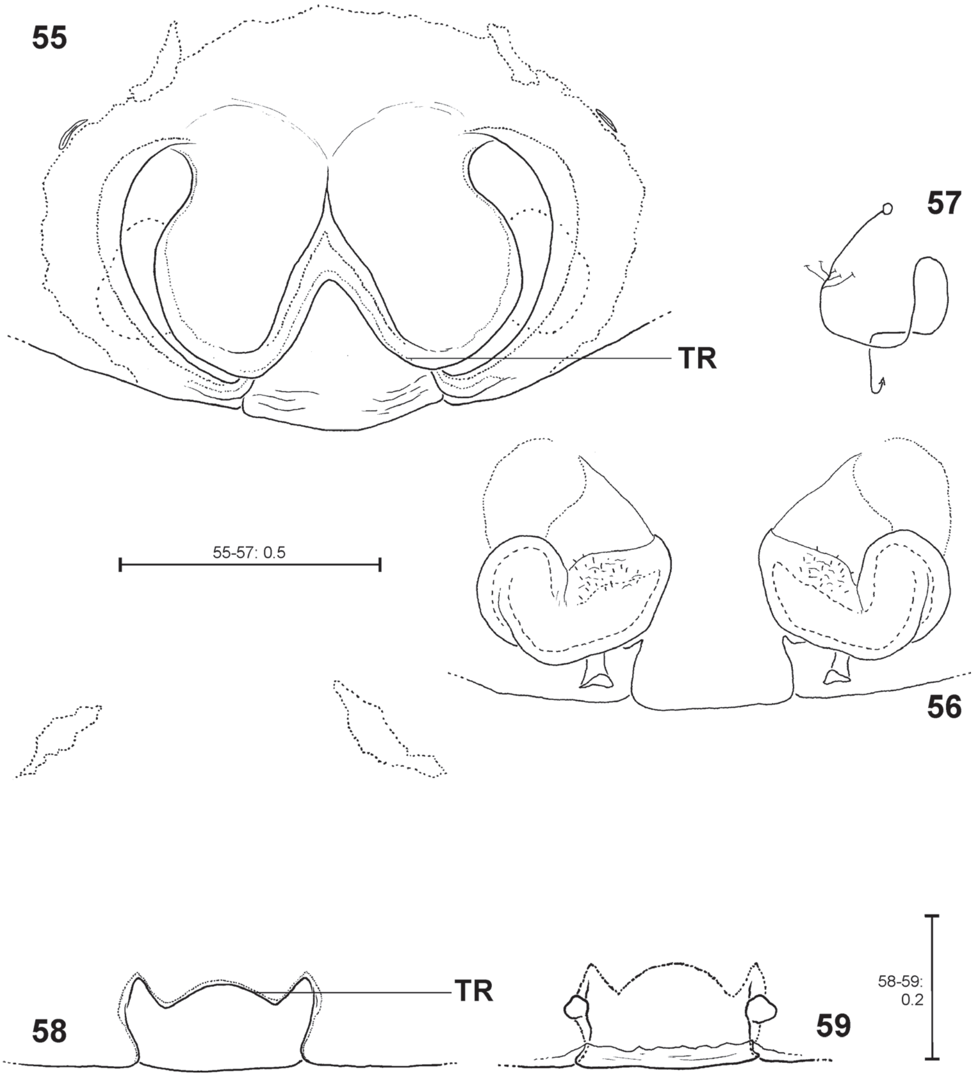
Disribution. Malaysia, Indonesia [Sumatra].

Fecenia protensa **Thorell, 1891, stat. n.**

http://species-id.net/wiki/Fecenia_protensa

Figs 55–70, 98–99, 108–110, 119

Fecenia protensa Thorell, 1891: 31 (Description of immature ♀), [Holotype s.a. ♀ (SB 620) from INDIA: Nicobar Islands: Nancowry; Bille, Kjellerup, Behn and Reinhardt leg. 1845–1847, Galathea Expedition; ZMUC 13091, examined]; Kulczyński 1908: 570; Reimoser 1936: 406; Lehtinen 1967: 234; Levi 1982: 136 (Synonymy with *F. macilenta*, rejected); Murphy 1986: 65 (Statement concerning synonymy with *F. macilenta*).



Figures 55–59. *Fecenia protensa*, ♀ copulatory organ/primordial copulatory organ **55–57** Holotype ♀ of *F. sumatrana* (SB 357) from Southern Sumatra, Indonesia **58–59** Holotype s.a. ♀ (SB 620) of *F. protensa* from Nicobar Islands, India **55** Epigyne, ventral view **56** Vulva, dorsal view **57** Course of internal duct system **58** Pre-epigyne, ventral view **59** Pre-vulva, dorsal view. TR = Transversal edge/ridge of median septum (**55** in epigyne, **58** corresponding structure in pre-epigyne).

Fecenia sumatrana Kulczyński, 1908: 568, pl. 23, fig. 20 (Description of ♀), [Holotype ♀ (SB 357) from INDONESIA: Sumatra: Lampung Prov.: Palembang; Dr S. Libelt leg.; MIZ 212·322, examined]; Reimoser 1929: 132 (Listing of first record from Mentawai islands); Reimoser 1936: 407; Lehtinen 1967: 234 (Synonymy with *F. macilenta*, rejected by subsequent author); Murphy 1986: 65 (Synonymy with *F. travancoria*, rejected). Syn. n.

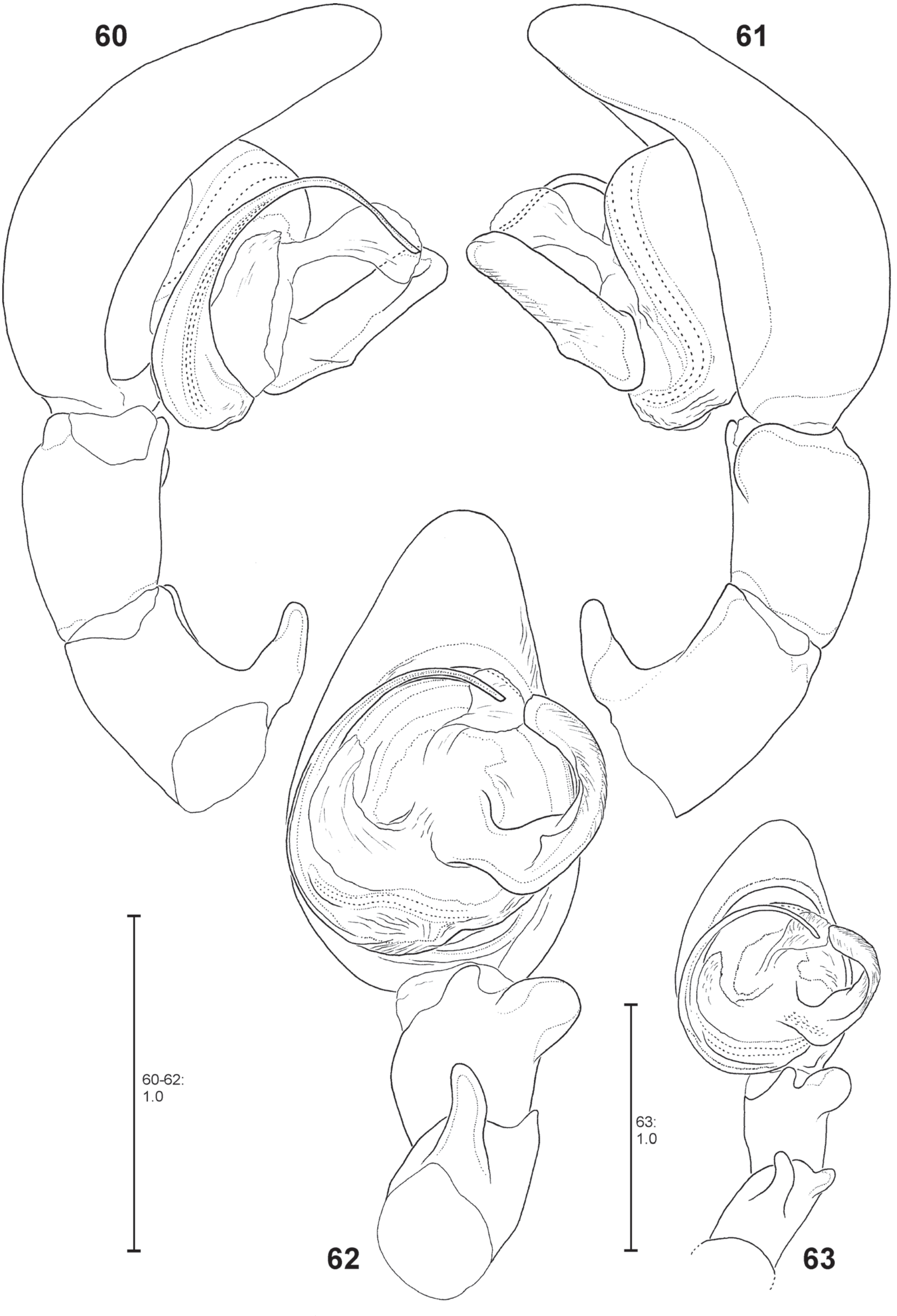
Psechrus nicobarensis Tikader, 1977: 208, fig. 27A–E (Description and illustration of ♂ and ♀), [Holotype ♀ as well as 8 ♀♀ paratypes and 2 ♂♂ paratypes from INDIA: West Bengal Province: Nicobar Islands, Car-Nicobar Isl., Kakana village; B.K. Tikader leg. 9.III.1970; NZSI, not available on request, thus not examined]; Jose and Sebastian 2001: 304 (genus name misapplied). Syn. n.

Fecenia nicobarensis—Levi 1982: 138 (Transfer from *Psechrus*).

Fecenia macilenta—Levi 1982: 136, figs 83–87, ad part, figs 83, 86–87 misidentified (figs 83 and 87: Illustration of s.a. ♀ and ♀); Koh 1989: 76, fig. embedded in text, misidentified (Illustration of ♀).

Psechrus alticeps—Jose and Sebastian 2001: 304, fig. 1, misidentified. Note: Jose and Sebastian (2001) copied the illustrations of fig. 27 in Tikader (1977), pasted them in their fig. 1 and partly modified them. In their fig. 1a they changed the eye arrangement and colour pattern of the carapace as well as the colour pattern of the opisthosoma "*Psechrus*"-like. Their figs 1b and 1g show the female and male copulatory organs of *F. protensa* after Tikader (1977, there sub *Psechrus nicobarensis*). Their fig. 1f is a misinterpretation and definitely shows neither the vulva of *F. protensa* nor the one of *Psechrus alticeps* Pocock, 1899, which is a junior synonym of *P. torvus* (O. Pickard-Cambridge, 1869) (Levi 1982).

Additional material. (6 ♂♂, 38 ♀♀, 2 s.a. ♂♂, 5 s.a. ♀♀, 10 juvenile specimens). **THAILAND: Nakhon Nayok Prov.:** Khao Yai N.P. located ca. 120 km North-East of Bangkok, evergreen tropical rainforest, ca. 150 m; P. Hillyard leg. 12.III.1984; 1 ♀ (SB 393), NHM. Khao Yai N.P., forests surrounding Park Headquarters, 800-900 m; P. Dankittipakul leg. 15.XI.2006; 1 ♂ (SB 218), MHNG. **Nakhon Ratchasima Prov.:** Khao Yai N.P., rainforest; C.L. and P.R. Deeleman leg. 28.XII.1988; 1 ♂ (SB 128, died directly after adult moult), Deeleman Coll. in RMNH. **Chantaburi Prov.:** Chantaburi Distr.: Nam Tok Phliu N.P., 50 m; P. Schwendinger leg. 11.IX.1993; 1 ♂ (SB 136), MHNG. **Trat Prov.:** Koh Chang Isl.: Khlong Chao Luam, 12°06'30''N, 102°17'49''E, 30–150 m, secondary forest along stream, in shrubs; P. Jäger and S. Bayer leg. 3.XI.2009; 1 ♂ (SB 512), 1 ♀ (SB 458), 2 juvs (SB 328, 350), SMF. **Surat Thani Prov.:** Khao Nan N.P.; P. Dankittipakul leg. 17.VIII.2006; 1 ♀ (SB 202), MHNG; P. Dankittipakul leg. 27.X.2006; 1 ♀ (SB 206), SMF. **Krabi Prov.:** Krabi Distr.: Thab Khaek, Hang Nak Hill Nature Trail, 8°05'43''N, 98°45'11''E, 300 m, semi-evergreen rainforest; P. Schwendinger leg. 6.VI.2009; 1 ♀ (SB 195), SMF. **Phuket Prov.:** Phuket, Ton Sai Waterfall, 8°01'N, 98°25'E, 150–200 m; M. Andersen, O. Martin and N. Scharff leg. 12.X.1991; 3 ♀♀ (SB 888–890), 1 s.a. ♂ (SB 891), ZMUC 4536. **Song Khla Prov.:** Khao Khor Hong, a small mountainous area behind Prince of Song Khla University campus; B. Phongsee leg. 15.IX.2005; 1 ♀ (SB 215), 1 s.a. ♀ (SB 216), 3 juvs (SB 782–784), MHNG. **MALAYSIA: Pahang Prov.:** Cameron Highlands at Tanah Rata, 4°28'N, 101°23'E; V. and B. Roth leg. 14.-20.IV.1990; 1 ♀ (SB 184), 1 s.a. ♀ (SB 185), USNM, 1 ♀ (SB 949), CAS ENT9032226. **Selangor Prov.:** Gombak, field station, forest; C.L. Deeleman leg. 6.VII.1992; 1 ♀ (SB 117); C.L. Deeleman and J.C. van Kempen leg. 2.VII.1992, by night; 1 ♀ (SB 112), both

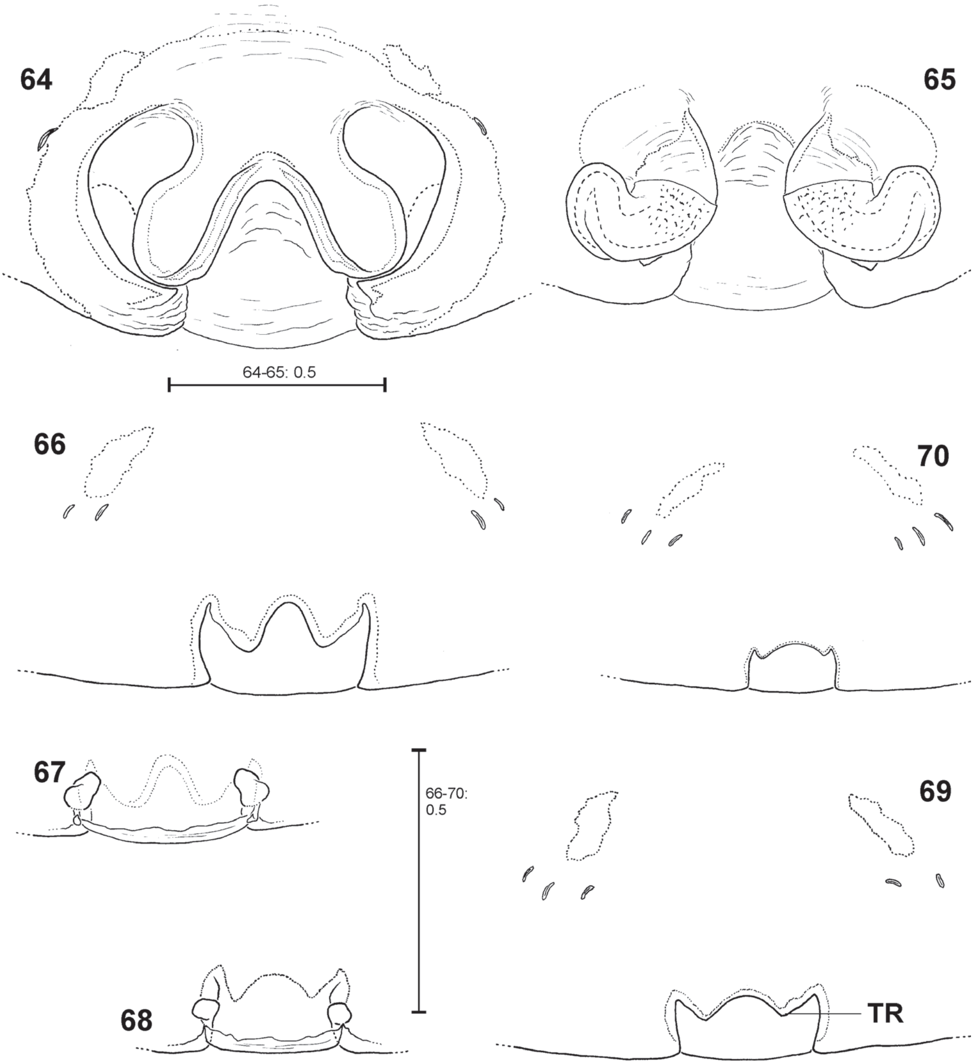


Figures 60–63. *Fecenia protensa*, ♂ palp **60–62** SB 218 from Nakhon Ratchasima Prov., Thailand **63** SB 137 from Bali, Indonesia **60** Prolateral view. **61** Retrolateral view **62–63** Ventral view.

Deeleman Coll. in RMNH. **Borneo: Sarawak Prov.:** Northern Sarawak; P. Nabawi leg.; [ex Coll. Wunderlich]; 1 ♀ (SB 1142), SMF. Gunong Mulu N.P., Environs Camp I, 1150 m, shrubs; F. Wanless leg. by net sweeping, R.G.S. Mulu Exped. 1977–78; 1 ♀ (SB 391), NHM. Gunong Mulu N.P., rain forest; C.L. and P.R. Deeleman leg. 4.X.2003; 1 ♀ (SB 131), s.a. ♀ (SB 897), 1 juv. (SB 898), Deeleman Coll. in RMNH. Kuching: Matang Reserve, primary forest, big old tree in clearing; C.L. and P.R. Deeleman leg. 25.III.1986; 2 ♀♀ (SB 107–108), 1 s.a. ♂ (SB 899), 3 juvs (SB 900–902), Deeleman Coll. in RMNH. **Sabah Prov.:** Kinabalu N.P., Poring Hot Springs, 5°02'N, 116°42'E, 600–700 m, primary forest; A. Floren leg. 3.III.1996 by canopy fogging "Ridge"; 1 ♀ (SB 519), Deeleman Coll. in RMNH. **SINGAPORE:** Singapore (no further details); H.N. Ridley leg.; 7 ♀♀ (SB 408–414), 1 s.a. ♀ (SB 407), NHM. Singapore: Sime Road: secondary forest; J. Koh leg. 1998; 1 ♀ (SB 186), USNM. **INDONESIA: Sumatra: Nanggroe Aceh Darussalam Prov.:** Simeulue Isl.; E. Jacobson leg.; 1 s.a. ♀ (SB 462), NHMW 12387. **Sumatera Barat Prov.:** Lubuk Sikaping, Panti Reserve; C.L. and P.R. Deeleman leg. 14.VIII.1982; 1 ♀ (SB 125), Deeleman Coll. in RMNH. **Borneo: Kalimantan Timur Prov.:** 40 km NNW of Balikpapan, Sepaku, isolated stand of rainforest; C.L. and P.R. Deeleman leg. 5.VIII.1980; 1 ♀ (SB 126), Deeleman Coll. in RMNH. **Bali Prov.:** Air Terjung Waterfall, c/o Munduk, 8°15'27.8''S, 115°04'14.1''E, ca. 1000 m; S. Huber leg. 11.IV.2011; 5 ♀♀ (SB 1013–1017), SMF. Ubud, 8°29'51''S, 115°15'18.4''E, ca. 330 m; S. Huber leg. 30.III.2011; 1 ♀ (SB 1028), SMF. Candi Dasa, creek forest, 8°30'13''S, 115°33'47''E; S. Huber leg. 16.–20.III.2009; 1 ♂ (SB 137), 2 ♀♀ (SB 196, 256), 1 juv. (SB 906), SMF. **Nusa Tenggara Barat Prov.:** Flores Isl., East of Labuan Bajo, rainforest, 8°33'60''S, 120°00'02''E; S. Huber leg. 24.III.2009; 1 ♂ (SB 196, only left palp and a few body parts remained), SMF.

Diagnosis. Females distinguished from other *Fecenia* species except *F. travancoria* by having anterior margins of lateral lobes (AML) anteriorly more or less converging and surrounding epigynal pit partly and the anterior part of median septum (AS) comprising a longitudinal, anteriorly pointed folding (Fig. 55); moreover, by having a notched transversal edge (TR) of median septum. Distinguished from *F. travancoria* by borderline (BL) between strongly sclerotised section of internal duct system (SSI) and transparent section (TSI) running almost transversal (Fig. 56). In males RTA short, at most ½ the width of palpal tibia, and knobbed, almost as broad as long (Figs 62–63, 98). Median apophysis (MA) almost semicircular and shorter than width of tegulum (T) (Fig. 62, 98). In contrast to the similar male of *F. cylindrata* embolus (E) without basal apophysis (bEA) and ventral patellar apophysis (VPA) arising proximally on patella (Figs 60–61, 99).

Description. MALE: Body and eye measurements. Carapace length 3.1–4.4, carapace width 2.1–3.0, anterior width of carapace 1.4–1.9, opisthosoma length 4.1–6.4, opisthosoma width 1.6–2.6. Eyes: AME 0.25–0.27, ALE 0.17–0.18, PME 0.18–0.19, PLE 0.17–0.19, AME–AME 0.14–0.22, AME–ALE 0.07–0.19, PME–PME 0.18–0.25, PME–PLE 0.25–0.34, AME–PME 0.13–0.19, ALE–PLE 0.10–0.18, cl-



Figures 64–70. *Fecenia protensa*, ♀ copulatory organ/primordial copulatory organ **64–65** ♀ SB 410 from Singapore **66–67** s.a. ♀ SB 185 from Pahang Prov., Malaysia **68–69** s.a. ♀ SB 216 from Songkhla Prov., Thailand **70** p.s.a. ♀ SB 897 from Sarawak Prov., Malaysia **64** Epigyne, ventral view **65** Vulva, dorsal view **66, 69** Pre-epigyne, ventral view **67–68** Pre-vulva, dorsal view **70** Pre-pre-epigyne, ventral view. TR = Transverse edge/ridge of (in this case primordial) median septum.

ypeus height at AME 0.29–0.35, at ALE 0.21–0.26. Measurements of palp and legs. Palp 4.0–5.2 [1.5–2.1, 0.7–0.9, 0.5–0.7, 1.3–1.6], I 34.7–52.5 [9.1–14.2, 1.4–2.1, 9.5–14.6, 10.6–16.2, 4.1–5.4], II 16.3–25.1 [4.3–6.7, 1.2–1.6, 4.5–7.0, 4.3–7.0, 2.0–2.8], III 9.2–14.0 [2.6–4.0, 0.9–1.3, 2.2–3.6, 2.3–3.4, 1.2–1.7], IV 15.5–23.1 [4.1–6.3, 1.1–1.6, 4.1–6.2, 4.4–6.5, 1.8–2.5]. Leg formula: 1243. Copulatory organ. Retrolateral patellar apophysis (RPA) rather inconspicuous (Figs 61–63, 98–99). Median apophysis (MA) with tip in ca. 1:00-o'clock-position (Fig. 62) and in retrolateral view almost straight (Figs 61, 99). Embolus (E) arising in ca. 7:30-o'clock-position on tegulum (T), distally thicker than in *F. cylindrata* and at most as long as width of T. The latter almost round. Membranous process of tegulum (MP) reaches far up, mostly 10:00–10:30-o'clock-position. Conductor (C) small, size and shape similar like in *F. ochracea*, arises medially in upper third of T.

FEMALE: Body and eye measurements. Carapace length 3.3–4.7, carapace width 1.9–3.1, anterior width of carapace 1.6–2.3, opisthosoma length 5.5–8.1, opisthosoma width 2.4–4.2. Eyes: AME 0.22–0.28, ALE 0.15–0.21, PME 0.17–0.22, PLE 0.16–0.19, AME–AME 0.19–0.26, AME–ALE 0.10–0.14, PME–PME 0.23–0.29, PME–PLE 0.29–0.40, AME–PME 0.23–0.24, ALE–PLE 0.16–0.19, clypeus height at AME 0.33–0.41, at ALE 0.29–0.38. Measurements of palp and legs. Palp 3.5–5.1 [1.2–1.7, 0.6–0.9, 0.6–1.0, 1.1–1.5], I 19.2–26.8 [4.8–7.0, 1.5–2.0, 5.4–7.8, 5.1–7.2, 2.4–2.8], II 11.3–16.5 [3.0–4.3, 1.1–1.6, 3.1–4.7, 2.7–4.0, 1.4–1.9], III 7.1–10.6 [2.1–3.1, 0.8–1.3, 1.8–2.6, 1.5–2.3, 0.9–1.3], IV 10.7–16.0 [2.8–4.4, 1.1–1.7, 3.1–4.6, 2.5–3.6, 1.2–1.7]. Leg formula: 1243. Palpal claw with 8–11 teeth. Spination (immature holotype of *F. protensa* from Nicobar Islands in poor condition! spination of holotype of *F. sumatrana* from Palembang, Sumatra listed instead). Palp: 110, 110, 0100, 1004 (spines on patella, tibia and tarsus with only half the size as those of femur!); legs: femur I 310, II 320, III 011, IV 020; patella I–IV 000; tibia I–II 3006, III 0023, IV 0024; metatarsus I 2025, II–III 2015, IV 1015. Copulatory organ: Epigyne in general appearance characteristically rounded-"W"-shaped (Figs 55, 64, 108). AML mostly strongly sclerotised, converging anteriorly and surrounding epigynal pit partly. AS clearly broader than PS. Epigynal muscle sigilla (EM) integrated in epigynal field or at least located very close by, same for slit sense organs (SO) (Figs 55, 64). Vulva with medium sized (longer than in *F. ochracea*, *F. macilenta* and *F. travancoria*, shorter than in *F. cylindrata*) and broad TSI (56, 65, 109). SSI more slender than in all other *Fecenia* species, duct with 2–3 curves (Fig. 57). Primordial copulatory organ: Pre-epigyne: "Crown"-like (Figs 58, 66, 69, 110). Primordium of AS already recognisable, broad "W"-like. Epigynal field not or only poorly developed, EM far outside epigynal field (Fig. 69). Pre-pre-epigyne: Prongs of the "crown" small (Fig. 70). Pre-vulva: Pre-receptacula bulbous/spherical (Figs 59, 67–68). Distance between centres of pre-receptacula more than three times diameter of one pre-receptaculum. Variation of copulatory organs: Cymbium length of male palp differing slightly among specimens examined (Figs 60–63, 98–99), MA may be extending further beyond retrolateral cymbium margin (Figs 63, 98). T in some specimens slightly broader (Fig. 98) than in others. RPA may be slightly larger (Fig. 63) than in general. In females the shape of AS may vary, e.g. the posterior notch is larger and the anteriorly pointed longitudinal folding is as such hardly recognisable (Fig. 64). Number of SO among specimens varying without geographical dependence. TSI varying in length (Fig. 56, 65). In dorsal view BL direction of vulva varies from 8:30 (Fig. 65) to almost 9:30-o'clock-position (Fig. 56). Pre-epigynes differing in shape of TR (Figs 58, 66). The most frequent shape seems to be the one of SB 216 (Fig. 69) and holotype SB 620 (Figs 58, 110). Number of SO varying strongly.

Pre-vulva may be slightly more structured (Fig. 67).

Remarks. The reasons for revalidation of *F. protensa* and the synonymy of *F. sumatrana* with the former are as follows: In Thailand, Malaysia, Singapore and on Bali at several localities subadult *Fecenia* females were collected together with adult females respectively, which showed the characteristic rounded-"W"-shaped epigyne. The pre-epigyne of the subadult female holotype of *F. protensa* (SB 620) matches the ones of the subadult females mentioned above. In 1908 Kulczyński described *F. sumatrana.* The (adult) female holotype of this species exhibits the characteristic rounded-"W"-shaped epigyne. The adult females mentioned above match the holotype of *F. sumatrana*. *F. protensa* is the oldest name available and hence the valid name for this taxonomical species. It is distinguished from *F. travancoria* by the BL of the vulva running almost transversal. Consequently, *F. sumatrana* is not a junior synonym of *F. travancoria* as postulated in Murphy (1986), but a junior synonym of *F. protensa*. Both, *F. protensa* and *F. travancoria* are regarded as valid species (see also remarks sub species description of *F. travancoria*).

Reason for synonymy of *F. nicobarensis* with *F. protensa*: Although the types of *Psechrus nicobarensis* were not available on request it became obvious that Tikader (1977) dealt with *F. protensa*. The drawing of the female epigyne in Tikader (1977: 208, fig. 27B) is not very informative, however, the rounded-"W"-shaped character of the epigyne is very clear. His fig. 27E of the right male palp is more detailed. However, the proportions probably do not reflect the real situation. Additionally, this illustration does not represent an exact ventral view of the palp. If the left palps of the males examined herein (SB 128, 136, 137, 218, 219, 512) were arranged in the same way/position, they would match the (mirrored) drawing in Tikader (1977).

Disribution. India [Nicobar Islands], Thailand, Malaysia, Singapore, Indonesia [Sumatra, Borneo, Bali].

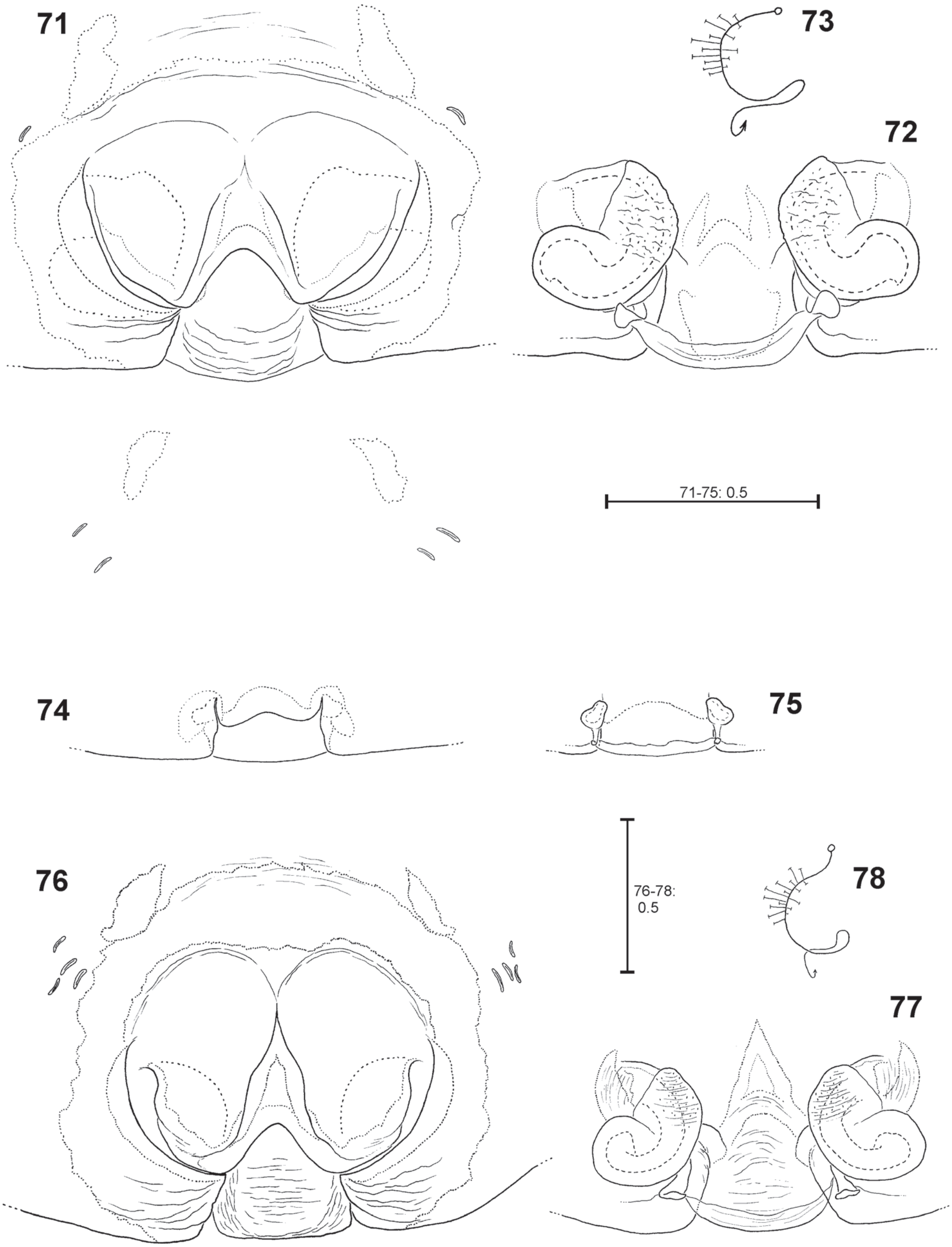
Fecenia travancoria Pocock, 1899

http://species-id.net/wiki/Fecenia_travancoria

Figs 71–78, 111–113

Fecenia travancoria Pocock, 1899: 750 (Description of ♀), [Holotype ♀ (SB 403) from INDIA: Kerala Prov.: Madatory; H. Ferguson leg. III.1896; NHM 99·1·17·36, examined]; Kulczyński 1908: 570; Reimoser 1936: 406; Lehtinen 1967: 234 (Synonymy with *F. macilenta*); Murphy 1986: 65 (Removed from synonymy with *F. macilenta*); Jose and Sebastian 2001: 304; Sebastian and Peter 2009: 277 (Description of ♀).

Fecenia macilenta—Levi 1982: 136, figs 83–87, ad part, figs 83, 86–87 misidentified (fig. 86: Illustration of ♀).



Figures 71–78. *Fecenia travancoria*, ♀ copulatory organ/primordial copulatory organ **71–73** ♀ SB 118 **74–75** s.a. ♀ SB 119, both from Erawan, Kanchanaburi Prov., Thailand **76–78** Holotype ♀ (SB 403) from Kerala Prov., India **71, 76** Epigyne, ventral view **72, 77** Vulva, dorsal view **73, 78** Course of internal duct system **74** Pre-epigyne, ventral view. **75** Pre-vulva, dorsal view.

Additional material examined. (3 ♀♀, 2 s.a. ♀♀, 2 juvenile specimens). **INDIA: Kerala Prov.:** Ernakulam; K. S. Jose leg. 23.III.2001; 1 ♀ (SB 863, checked via photo of entire specimen, ventral view, kindly provided by K. S. Jose), SJPC. **SRI LANKA: Sabaragamuwa Prov.:** Ratnapura, peak wilderness area; W. Sedgwick leg. 11.VIII.1979; 1 juv. (SB 481), MCZ 82528. Pitadeniya, Sinharaja Nature Reserve, 6°21'40.2''N, 80°29'03.6''E, ca. 300 m, primary forest, in palm, 1.5 m above ground; V. Hartmann leg. 16.I.2011 as immature, raised in laboratory, adult 05.IV.2011; 1 ♀ (SB 982, from this specimen the exuviae of the subadult instar, thus its pre-epigyne, was kept and preserved), SMF. **THAILAND: Kanchanaburi Prov.:** Erawan Waterfall in Erawan N.P., evergreen rainforest; C.L. & P.R. Deeleman leg. 15.III.1986; 1 ♀ (SB 118), 1 s.a. ♀ (SB 119), 2 juvs (SB 903–904), Deeleman Coll. in RMNH.

Diagnosis. Females distinguished from other *Fecenia* species except *F. protensa* by having anterior margins of lateral lobes (AML) anteriorly more or less converging and surrounding epigynal pit partly and the anterior part of median septum (AS) comprising a longitudinal, anteriorly pointed folding (Fig. 76); moreover, by having a notched transversal edge (TR) of median septum. Females are distinguished from *F. protensa* by the almost longitudinal borderline (BL) between strongly sclerotised section (SSI) and the transparent section of internal duct system (TSI) in vulva (Fig. 77).

Description. MALE: unknown.

FEMALE (measurements of holotype first, those of other females in parentheses): Body and eye measurements. Carapace length 5.9 (4.4–5.2) , carapace width 4.0 (3.0–3.3), anterior width of carapace 2.9 (2.2–2.5), opisthosoma length 7.8 (7.2–12.3), opisthosoma width 4.3 (4.0–5.4). Eyes: AME 0.36 (0.23–0.28), ALE 0.20 (0.12–0.18), PME 0.24 (0.14–0.21), PLE 0.23 (0.14–0.20), AME–AME 0.37 (0.22–0.31), AME–ALE 0.15 (0.09–0.13), PME–PME 0.47 (0.26–0.39), PME–PLE 0.48 (0.39–0.43), AME–PME 0.37 (0.22–0.30), ALE–PLE 0.26 (0.21–0.24), clypeus height at AME 0.43 (0.36–0.40), at ALE 0.39 (0.32–0.34). Measurements of palp and legs. Palp 6.2 (4.5–5.7) [2.1 (1.5–1.9), 1.1 (0.8–1.0), 1.1 (0.8–1.0), 1.9 (1.4–1.8)], I 33.3 (24.4–29.7) [8.8 (6.4–7.9), 2.4 (1.9–2.1), 9.0 (7.1–8.0), 9.2 (6.2–8.1), 3.9 (2.8–3.6)], II 21.3 (15.0–18.9) [5.9 (4.0–5.1), 2.0 (1.5–1.9), 5.7 (4.1–5.0), 5.2 (3.5–4.6), 2.5 (1.9–2.3)], III 13.1 (9.8–11.8) [3.9 (2.8–3.4), 1.6 (1.3–1.5), 3.1 (2.4–2.8), 2.9 (2.1–2.7), 1.6 (1.2–1.4)], IV 19.8 (14.5–17.9) [5.5 (4.0–4.9), 2.0 (1.5–1.7), 5.2 (4.1–4.8), 4.8 (3.3–4.5), 2.3 (1.6–2.0)]. Leg formula: 1243. Palpal claw with 9 (9–10) teeth. Spination (holotype from Madatory, India). Palp: 110, 000, 0000, 0000; legs: femur I 412, II 312, III 113, IV 011; patella I–IV 000; tibia I 2006, II 3004, III 0013, IV 0013; metatarsus I–II 2015, III 1015, IV 1014. Colouration: As described for the genus *Fecenia*. Sebastian and Peter (2009, plate 94) show a photo of female habitus. Copulatory organ: In epigyne AS clearly broader than PS (Figs 76, 111). AML strongly sclerotised. Epigynal muscle sigilla (EM) integrated in epigynal field. Female holotype with four slit sense organs (SO) on each side outside the epigynal field (EF) (Fig. 76), ♀ SB 982 from Sri Lanka with three SO on each side, all in EF and ♀ SB 118 from Thailand with one on each side outside EF (Fig. 71). In contrast to *F. protensa*, folding of AS may be extending further anteriorly than AML (Figs 76, 111), but not always. Vulva with short (shorter than in all *Fecenia* species but *F. macilenta*) and broad TSI (Fig. 77). SSI may be darker than in *F. protensa* and with ca. 2 curves (Figs 78, 112). Primordial copulatory organ: Pre-epigyne: Very similar to *F. protensa*, but lateral prongs of the "crown" narrower (Fig. 74, in Fig. 113 hard to recognise). Pre-vulva: Very similar to *F. protensa* in having bulbous/spherical pre-receptacula (Figs 59, 67–68, 75), with centres of the latter being rather far away (more than three times the diameter of one pre-receptaculum). *F. travancoria* is hard to distinguish from *F. protensa* by the characters of the pre-vulva. In *F. travancoria* the receptacula are rather oval in shape (Fig. 75), in *F. protensa* round. Variation of copulatory organs: In ♀ SB 118 (Fig. 71) from Erawan, Thailand the distance between AS and AML is shorter than in holotype. In ♀ SB 118 (Fig. 71) and in ♀ SB 982 from Sri Lanka the folding of AS extending not as far anteriorly than in holotype (Fig. 76). The vulvae of the ♀♀ examined as well as the primordial copulatory organs of the s.a. ♀♀ showed no significant variation.

Remarks. This species is very similar to *F. protensa*. There are only fine differences in characters of the vulva (see diagnosis). Up to now, no intermediate forms concerning the shape of vulva have been found. Though it cannot be fully excluded, it seems rather unlikely that *F. travancoria* is a junior synonym of *F. protensa*. Generally, in *Fecenia* species the vulva shows less intraspecific variation than the epigyne. By now I consider *F. travancoria* as valid species. But with more material from the southern Provinces of India, especially males, it may be possible to clarify this 'difficult taxonomic case'.

Disribution. India [Kerala Prov.], Sri Lanka, Thailand.

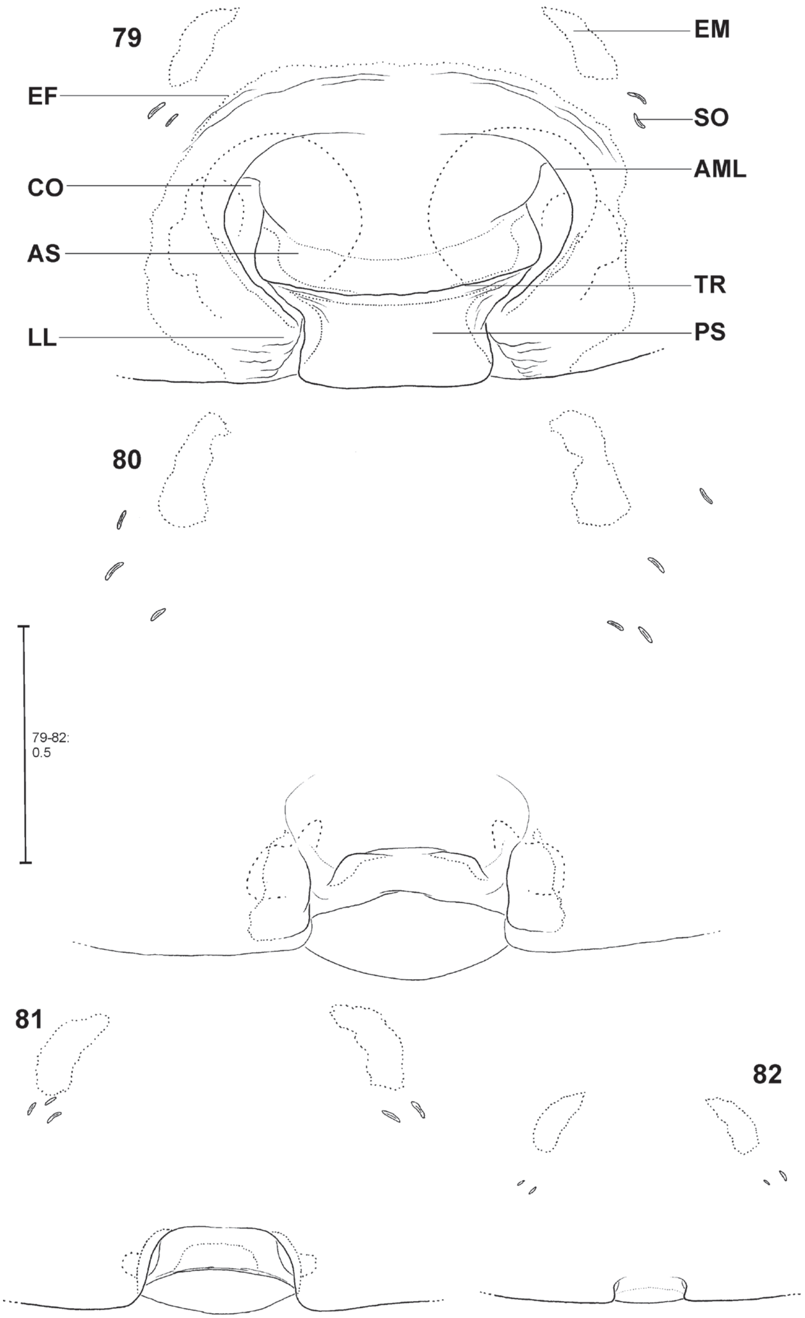
Fecenia cylindrata Thorell, 1895

http://species-id.net/wiki/Fecenia_cylindrata

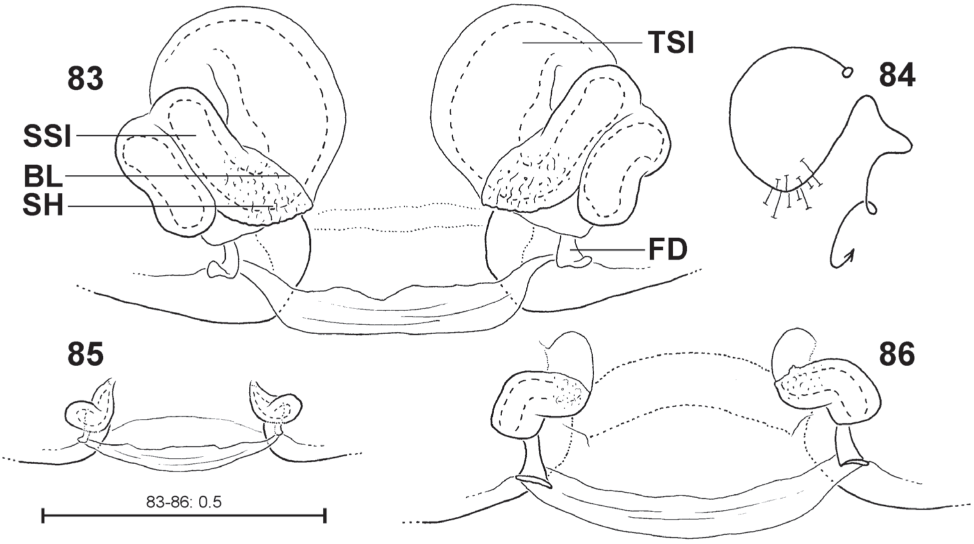
Figs 79–94, 97, 100, 105–107, 116–117, 120–123

Fecenia cylindrata Thorell, 1895: 64 (Description of juveniles), [2 syntypes: juvenile syntype (SB 281, neither penultimate nor antepenultimate instar, thus sex unknown) from MYANMAR: Bago Prov.: Delta near Tharrawaddy (ca. 100 km NW of Yangon); 1884–1887, ded. E.W. Oates; NRS Thorell-Coll.-No. 70a., examined; other juvenile syntype from MYANMAR: Tanintharyi Prov.: Dawei, "on an island in Tavoy river"; 1884–1887, ded. E.W. Oates; type deposition unknown, maybe lost, thus not examined]; Thorell 1897: 263 (Description of ♂ and ♀); Pocock 1900: 212 (Description of ♀); Kulczyński 1908: 570; Reimoser 1936: 406; Lehtinen 1967: 234, figs 472–473 (Illustration of carapace, illustration of ♂); Levi 1982: 136, figs 80–82 (Illustration of ♂ and ♀); Murphy 1986: 65; Yang and Wang 1993: 29, figs 1–4 (Illustration of ♂ and ♀); Song et al. 1999: 397, figs 231O–Q (Illustration of ♂ and ♀); Wang and Yin 2001: 332, figs 1–4 (Illustration of ♂ and ♀).

Fecenia hainanensis Wang, 1990: 257, figs 1–3 (Description of ♀), [Holotype ♀ from CHINA: Hainan Province: Tongqian city, 18°30' N, 109°45' E; Liu leg. 01.VII.1984; HBI, not available on request, thus not examined, examined by Wang and Yin (2001)]; Wang and Yin 2001: 332 (Synonymy).

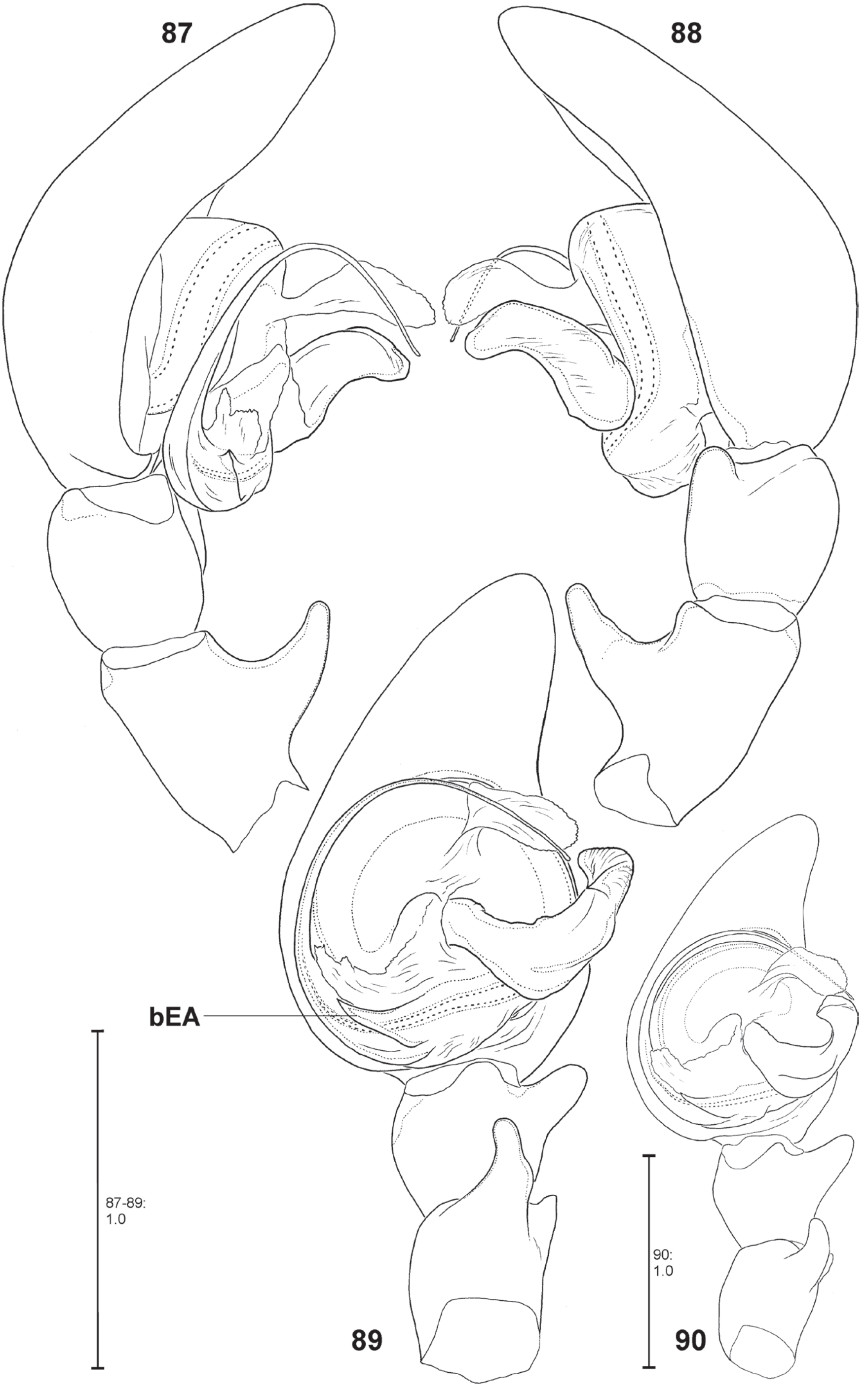


Figures 79–82. *Fecenia cylindrata*, ♀ epigyne/primordial epigyne, ventral view **79** ♀ SB 919 **81** s.a. ♀ SB 911, both from Bago Prov., Myanmar **80** s.a. ♀ SB535 from Champasak Prov., Laos **82** p.s.a. ♀ SB 937 from Luang Prabang Prov., Laos **79** Epigyne **80–81** Pre-epigyne **82** Pre-pre-epigyne. AML = Anterior margin of lateral lobe; AS = Anterior part of median septum; CO = Copulatory opening; EF = Epigynal field; EM = Epigynal muscle sigilla; LL = Lateral lobe; PS = Posterior part of median septum; SO = Slit sense organ; TR = Transversal edge/ridge of median septum.

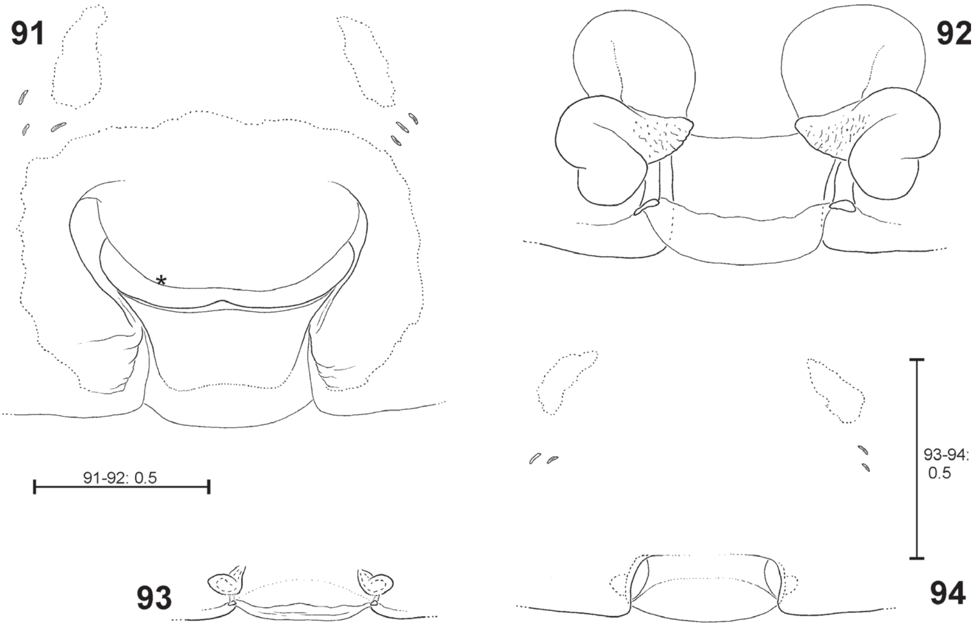


Figures 83–86. *Fecenia cylindrata*, ♀ vulva/pre-vulva, dorsal view **83–84** ♀ SB 919 **85** s.a. ♀ SB 911, both from Bago Prov., Myanmar **86** s.a. ♀ SB535 from Champasak Prov., Laos **83** Vulva **84** Course of internal duct system **85–86** Pre-vulva. BL = Borderline between SSI and TSI; FD = Fertilisation duct; SH = Spermathecal head; SSI = Strongly sclerotised section of internal duct system; TSI = Transparent section of internal duct system.

Additional material examined. (10 ♂♂, 35 ♀♀, 5 s.a. ♂♂, 15 s.a. ♀♀, 1 p.s.a. ♀, 12 juvenile specimens). **CHINA: Hainan Prov.:** Mount Jainfeng; 20.IV.1990, ded. D.X. Song; 1 ♂ (SB 111), 1 ♀ (SB 110), Deeleman Coll. in RMNH. **MYANMAR: Sagaing Prov.:** Chattin Wildlife Sanctuary, Takontaing camp, 22°37'20''N, 95°31'52''E; J. Coddington & R.L.C. Baptista leg. 7–12.X.1998 by night; 2 ♀♀ (SB 182, 188), USNM. **Bago Prov.:** Palon; L. Fea leg. 1885–1889, "Viaggio in Birmania"; T. Thorell det. 20.X.1896; 2 ♂♂ (SB 289–290), 5 ♀♀ (SB 282–286), 1 s.a. ♀ (SB 287), 1 s.a. ♂ (SB 288), NRS Thorell-Coll.-No. 70b; 5 ♀♀ (SB 915–919), 3 s.a. ♀♀ (SB 910–912), 2 s.a. ♂♂ (SB 913–914), ZMH; 1 ♂ (SB 928), 4 ♀♀ (SB 929–932), 8 s.a. ♀♀ (SB 920–927), 2 s.a. ♂♂ (SB 933–934), 1 juv. (SB 935), ZMUC 5772. The following material has the same dates as above, but was checked via photos of copulatory organs kindly provided by P. Dankittipakul: 2 ♂♂ (SB 827–828), 5 ♀♀ (SB 822–826), MCSN. **THAILAND: Chiang Mai Prov.:** Doi Suthep N.P.; P. Dankittipakul leg.; 1 ♀ (SB 205), MHNG. Lamphun Prov.: Mae Tha Distr.: Doi Khuntan N.P., 800 m; P. Schwendinger leg. 22.IX.1994; 1 ♀ (SB 135), MHNG. **Loei Prov.:** Na-Haeo, field research station; J. Constant, K. Smets & P. Frootaart leg.15.–19.V.2003; 1 ♀ (SB 11), IRSN. **Chaiyaphoom Prov.:** Phu Kradung N.P., 1200-1300 m, flat plateau with mixed deciduous + pine + evergreen forest; P. Dankittipakul leg. 15.VIII.2006; 1 ♂ (SB 204), MHNG. **LAOS: Luang Prabang Prov.:** near Luang Prabang: Tham Sieng Mang, 19°54'09''N, 102°08'32''E, 270 m, sunny + dry area, low shrubs; P. Jäger & S. Bayer leg. 15.XI.2009; 1 ♀ (SB 485), SMF. Luang Prabang: Phou Si, 19°53'23'' N, 102°08'04'' E, 300 m, dry



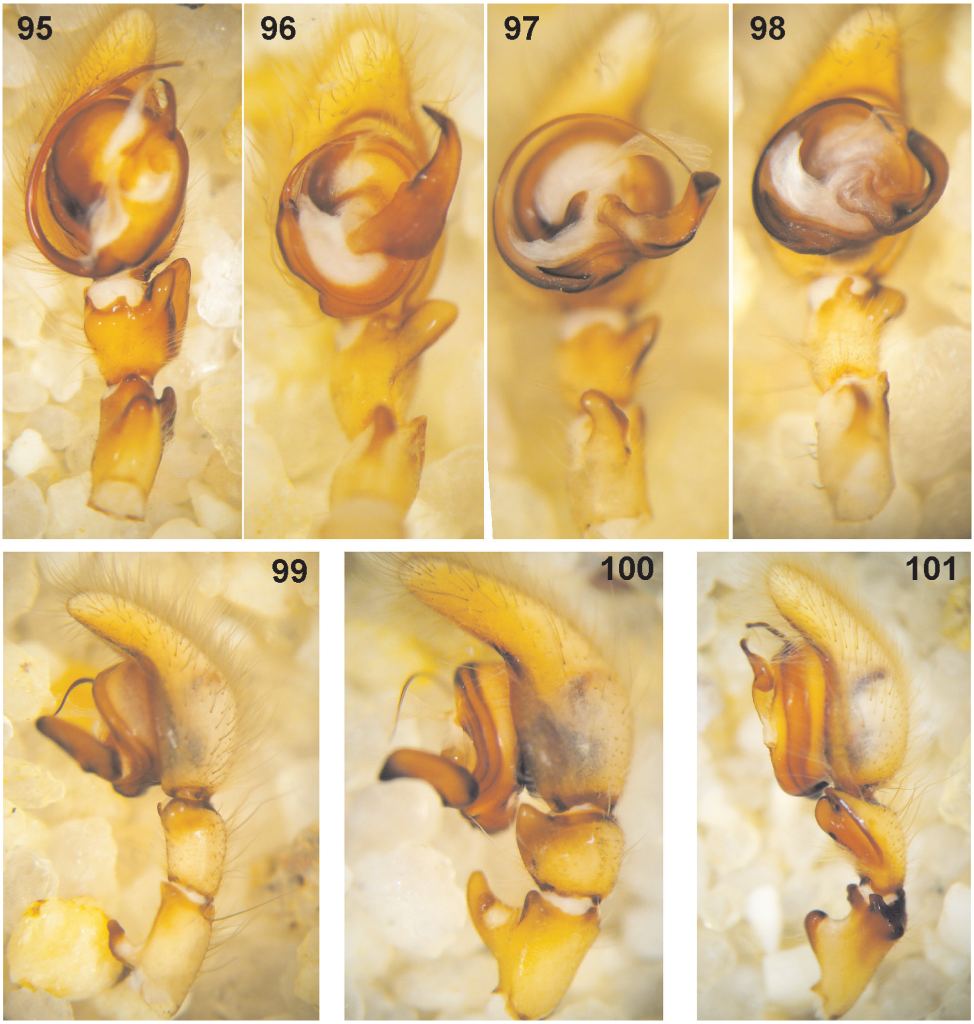
Figures 87–90. *Fecenia cylindrata*, ♂ palp **87–89** SB 928 from Bago Prov., Myanmar **90** SB 111 from Hainan, China **87** Prolateral view **88** Retrolateral view **89–90** Ventral view. Remark on Fig. 90: Details omitted, embolus slipped behind conductor. bEA = Basal embolus apophysis.



Figures 91–94. *Fecenia cylindrata*, ♀ copulatory organ/primordial copulatory organ **91–92** ♀ SB 110 from Hainan, China **93–94** s.a. ♀ SB 921 from Bago Prov., Myanmar **91** Epigyne, ventral view **92** Vulva, dorsal view **93** Pre-vulva, dorsal view. **94** Pre-epigyne, ventral view. Remark on Figs **91–92**: Details omitted. Asterisk indicates the folding, which divides the anterior from the posterior part of AS.

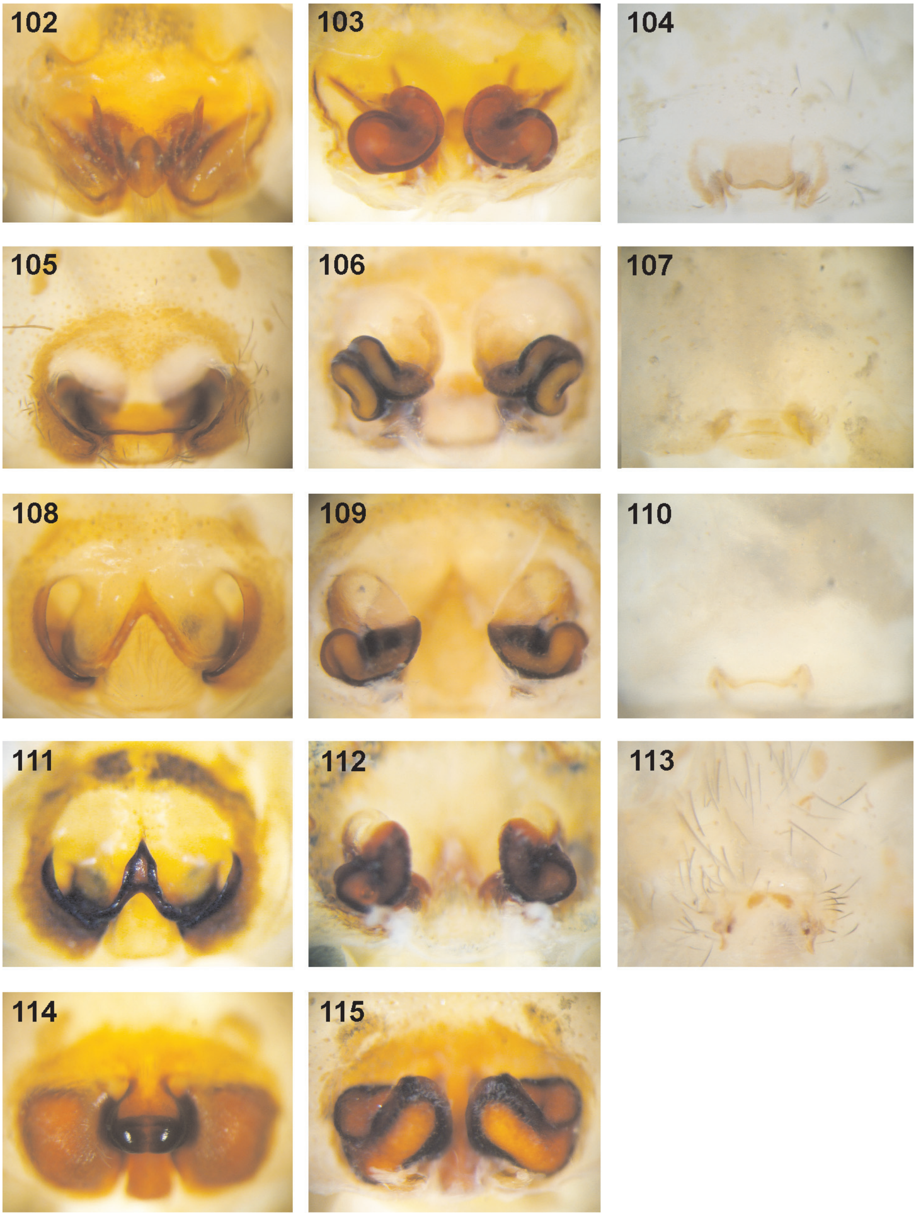
secondary forest in town, in shrubs; P. Jäger & V. Vedel leg. 12.XI.2004; 3 juvs (SB 938–940); P. Jäger leg. 25.III.2007; 1 s.a. ♀ (SB 62), 1 p.s.a. ♀ (SB 937); P. Jäger & S. Bayer leg. 14.XI.2009; 1 ♂ (SB 488, deformed, died during adult moult), all SMF. SE of Luang Prabang: Nam Khan, Xieng Ngeun Distr., Ban Keng Koung, 19°40'963''N, 102°18'442''E, ca. 370 m, along river bank; P. Jäger leg. 24.II.2008; 1 juv. (SB 936), SMF. **Champasak Prov.:** Muang Bachieng: That Paxuam, 15°10'35''N, 105°55'21''E, 200 m, secondary forest; P. Jäger & S. Bayer leg. 25.XI.2009; 1 ♀ (SB 318), 2 juvs (SB 40–401), SMF. Ban Lak 38, That Fane, 15°11'03''N, 106°07'37''E, 950 m, coffee plantation; P. Jäger leg. 11.–16.III.2010; 1 ♀ (SB 528), 1 s.a. ♀ (SB 535), 3 juvs (SB 527, 532–533), SMF. Near Pakse: Ban Ke, 15°07'57''N, 105°48'54''E, 100 m, dry shrubs; P. Jäger & S. Bayer leg. 27.XI.2009, by night; 1 juv. (SB 351), SMF. Muang Pathoumphone: Vat Phou Salao, 15°05'39''N, 105°48'35''E, 150 m, dry bed of stream, dry shrubs; P. Jäger & S. Bayer leg. 24.XI.2009, by night; 3 ♀♀ (SB 48–487, 514), 3 juvs (SB 349, 398, 526), SMF. Ban Nog Hoy, N slope of Phou Malong, 15°03'14''N, 105°49'07''E, 115 m, dry bed of stream, dry shrubs; P. Jäger leg. 23.XI.2009; 2 ♂♂ (SB 50–510), 1 ♀ (SB 511), 1 s.a. ♀ (SB 420), 2 juvs (SB 39–397), SMF. Ban Tha Hou, 14°46'10''N, 105°59'35''E, 130 m, dry forest, near summit of a prominent hill; P. Jäger & S. Bayer leg. 22.XI.2009; 2 ♀♀ (SB 513, 525), SMF.

Diagnosis. Females distinguished from other *Fecenia* species except *F. protensa* and *F. travancoria* by having anteriorly converging anterior margins of lateral lobes (AML)



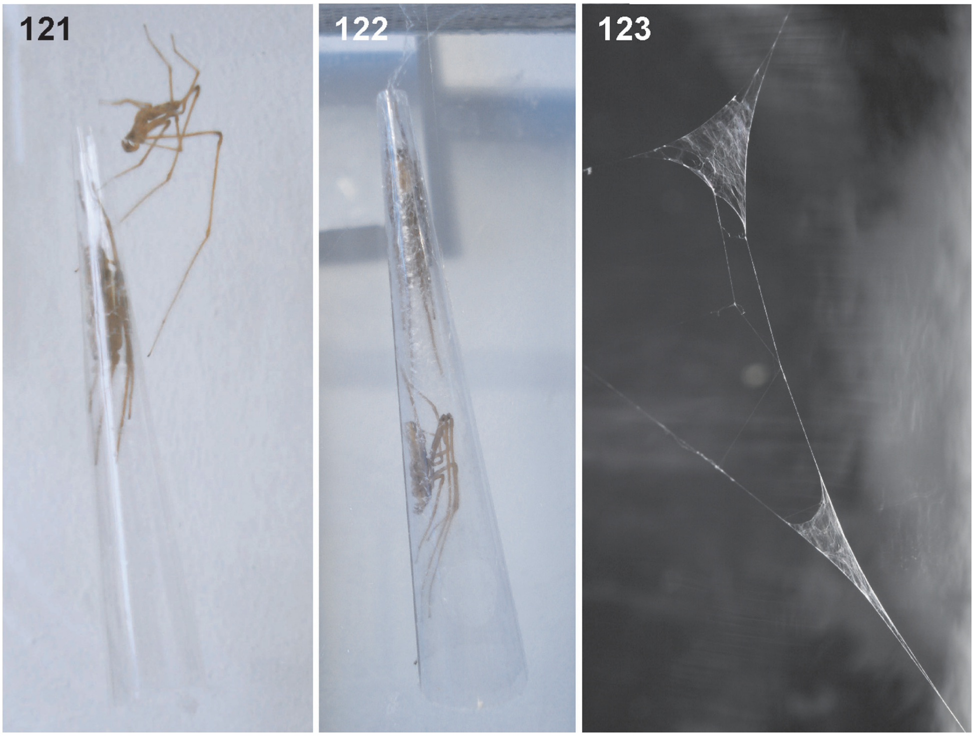
Figures 95–101. *Fecenia* spp., male palp **95, 101** *F. macilenta* **96** *F. ochracea* **97, 100** *F. cylindrata* **98–99** *F. protensa* **95, 101** SB 389 from Selangor Prov., Malaysia **96** SB 187 from Halmahera, Indonesia **97** SB 510 from Champasak Prov., Laos **100** SB 204 from Chaiyaphoom Prov., Thailand **98–99** SB 512 from Koh Chang, Thailand **95–98** ventral view **99–101** retrolateral view.

partly surrounding epigynal pit; distinguished from *F. protensa* and *F. travancoria* by the even and unfolded anterior part of median septum (AS) and by transverse edge of median septum (TR) lacking distinct notch (Figs 79, 105). In vulva transparent section of internal duct system (TSI) larger than strongly sclerotised section (SSI) (Figs 83, 92, 106). Males distinguished from other *Fecenia* species except *F. protensa* by having short (at most half as long as width of palpal tibia) RTA; distinguished from *F. protensa* in having RTA, which is longer than broad, and ventral patellar apophysis (VPA) arising centrally on patella (Fig. 88). Median apophysis (MA) running almost in transversal plane (Figs 87–88, 100). Embolus (E) with pointed basal apophysis (bEA) (Fig. 89).



Figures 102–115. *Fecenia* spp., female copulatory organs/primordial copulatory organs **102–104** *F. ochracea* **105–107** *F. cylindrata* **108–110** *F. protensa* **111–113** *F. travancoria* **114–115** *F. macilenta* **102–103** ♀ SB 668 from New Guinea **104** s.a. ♀ SB 540 from New Britain, Papua New Guinea **105–106** ♀ from Loei Prov., Thailand **107** s.a. ♀ from Palon, Bago Prov., Myanmar **108–109** ♀ SB 215 from Songkhla Prov., Thailand **110** s.a. ♀ holotype of *F. protensa* (SB 620) from Nicobar Islands. **111** ♀ holotype of *F. travancoria* (SB 403) from Kerala Prov., India **112–113** ♀ SB 982 from Sri Lanka (remark on 113: photo of exuviae of subadult instar of same specimen as in 112) **114–115** ♀ SB 124 from Sumatera Barat Prov., Indonesia **102, 105, 108, 111, 114** ♀ epigyne, ventral view **103, 106, 109, 112, 115** ♀ vulva, dorsal view **104, 107, 110, 113** pre-epigyne of s.a. ♀.

Figures 116–120. *Fecenia* spp., habitus, web **116–117, 120** *F. cylindrata*, ♀ SB 486 (**116**), ♂ SB 509 (**117**) from Champasak Prov., Laos, web (**120**) from Xishuangbanna, China **118** *F. ochracea*, ♀ SB 161 from Auki, Solomon Islands **119** *F. protensa*, ♀ SB 256 from Bali, Indonesia **116, 118** Habitus, ventral view **117** Habitus, dorso-lateral view **119** Habitus, dorsal view **116–117, 119** Photos by Peter Jäger **120** Photo by Jeremy Miller.



Figures 121–123. *Fecenia cylindrata*, ♂ (SB 510) and ♀ (SB 487) from Champasak Prov., Laos, mating behaviour, sperm web **121** ♂ stroking behaviour upon the retreat of the female **122** ♂ and ♀ together in the retreat **123** ♂ sperm webs (SB 510) **123** Photo by Peter Jäger.

Description. MALE: Body and eye measurements. Carapace length 3.6–4.4, carapace width 2.2–2.8, anterior width of carapace 1.6–1.9, opisthosoma length 4.8–6.5, opisthosoma width 1.9–2.5. Eyes: AME 0.23–0.29, ALE 0.17–0.22, PME 0.17–0.22, PLE 0.18–0.21, AME–AME 0.16–0.23, AME–ALE 0.09–0.14, PME–PME 0.17–0.25, PME–PLE 0.28–0.35, AME–PME 0.12–0.16, ALE–PLE 0.10–0.15, clypeus height at AME 0.30–0.41, at ALE 0.24–0.35. Measurements of palp and legs. Palp 4.0–5.0 [1.6–2.0, 0.6–0.7, 0.4–0.5, 1.4–1.8], I 35.1–48.3 [9.5–12.9, 1.5–2.1, 9.3–13.6, 10.5–14.9, 4.3–4.8], II 16.6–22.0 [4.3–5.9, 1.3–1.6, 4.6–6.4, 4.3–5.6, 2.1–2.5], III 8.7–11.8 [2.5–3.4, 1.0–1.2, 2.0–2.9, 2.1–2.8, 1.1–1.5], IV 15.0–20.2 [4.2–5.4, 1.2–1.6, 3.8–5.6, 4.0–5.4, 1.8–2.2]. Leg formula: 1243. Copulatory organ: Retrolateral patellar apophysis (RPA) mostly more clearly visible (Fig. 89) than in *F. protensa* and *F. ochracea*. Tip of MA in ca. 2:30–3:00-o'clock-position, MA shorter than width of tegulum (T) (Figs 89–90, 97) and in pro- and retrolateral view curved distally (Figs 87–88, 100). E very slim, especially distally, arising in ca. 7:30-o'clock-position on T and clearly longer than width of T (Figs 89–90, 97). The latter almost round. Membranous process of tegulum (MP) reaches at most to 8:30-o'clock-position (Figs 89–90, 97). Conductor (C) longer than in *F. ochracea* and *F. protensa*, shorter than in *F. macilenta*, arises medially (or slightly shifted retrolaterally) in upper third of T (Figs 89–90). Cymbium in relation a bit longer than in all other *Fecenia* species (Figs 87–88, 97, 100). Scopula dorsally on cymbium slightly less developed than in other *Fecenia* species.

FEMALE: Body and eye measurements. Carapace length 3.7–7.2, carapace width 2.2–4.2, anterior width of carapace 1.7–3.2, opisthosoma length 7.3–13.0, opisthosoma width 3.5–6.0. Eyes: AME 0.20–0.27, ALE 0.15–0.24, PME 0.16–0.22, PLE 0.16–0.22, AME–AME 0.18–0.34, AME–ALE 0.07–0.18, PME–PME 0.20–0.29, PME–PLE 0.33–0.54, AME–PME 0.14–0.27, ALE–PLE 0.12–0.27, clypeus height at AME 0.27–0.54, at ALE 0.25–0.48. Measurements of palp and legs. Palp 3.8–6.5 [1.3–2.3, 0.6–1.1, 0.7–1.1, 1.2–2.0], I 22.7–39.3 [6.0–10.8, 1.6–2.9, 6.3–10.8, 6.1–10.7, 2.7–4.1], II 13.1–23.7 [3.3–6.4, 0.9–2.3, 3.7–6.8, 3.1–5.7, 1.6–2.5], III 7.5–14.1 [2.2–4.1, 0.9–1.9, 1.8–3.4, 1.6–3.1, 1.0–1.6], IV 12.3–21.4 [3.3–5.9, 1.2–2.3, 3.5–6.2, 2.9–4.9, 1.4–2.1]. Leg formula: 1243. Palpal claw with 8–11 teeth. Spination (remaining immature syntype from Tharrawaddy in poor condition! Spination of female SB 285 from Palon, Birma (Myanmar) listed instead). Palp: 110, 000, 0100, 2004 (spines on tibia and tarsus with only half the size as those of femur!); legs: femur I 300(200), II 210, III 221(111), IV 010; patella I–IV 000; tibia I 0006(1005), II 2004(3005), III–IV 0024; metatarsus I 2015(2016), II–III 2015, IV 1018. Copulatory organ: Anterior part of AS divided from posterior part of AS by a differently developed folding (asterisk in Fig. 91). AS broader than PS (Fig. 79). Epigynal muscle sigilla (EM) clearly outside epigynal field (Figs 79, 91). Slit sense organs (SO) outside epigynal field. Vulva with large and broad TSI (Fig. 83), mostly larger than SSI. The latter with longer duct than in *F. protensa*, *F. travancoria* and *F. ochracea*, with 3–4 curves (Fig. 84). Border line (BL) between TSI and SSI of vulva in ca. 7:00-8:00 o' clock position (Figs 83, 92, 106). Primordial copulatory organs: Pre-epigyne: TR continuous (Fig. 81, 107), slightly recurved. AML anteriorly bent sharply, running medially and (almost) meeting each other (Figs 81, 94, 107). Epigynal field not or only poorly developed, EM far outside epigynal field. Pre-pre-epigyne: AML similar to pre-epigyne, TR hardly recognisable (Fig. 82). Pre-vulva: Pre-receptacula with lateral extension (Figs 85, 93). Distance between centres of pre-receptacula more than three times the diameter of one pre-receptaculum (Figs 85, 93). Variation of copulatory organs: In males position of VPA may shift retrolaterally (Fig. 90). Direction of MA (Figs 89–90, 97) may vary. Anterio-medial section of C differs among specimens examined (Figs 89–90, 97). RTA in some specimens basally broader (Fig. 90). In females the folding which divides (or partly divides) the anterior from the posterior part of AS differently developed (Figs 79, 91). TR rarely with a very small, flat and indistinct notch (Fig. 91). AS and PS in some specimens less broad than in others. Number of SO among specimens varying without geographical dependence. Anterio-lateral section of SSI may differ in shape (Figs 83, 92). Pre-epigynes differing in length and direction of AML (Figs 81, 94), further in shape of TR (Figs 81, 94). The most frequent pre-epigyne type is the one of SB 911 (Fig. 81). Number of SO varying strongly. SB 535 from Champasak Province, Laos (Fig. 80) is an exception, which is discussed explicitly (see discussion below).

The pre-vulvae differ only slightly (Figs 85, 93). SB 535 (Fig. 86) is an exception, which is discussed explicitly (see discussion below).

Remarks. Thorell (1895) described this species based on juvenile types. Two years later Thorell himself redescribed this species based on ♂♂ and ♀♀ recorded just ca. 70 km away from type locality Tharrawaddy (Thorell 1897). This material is deposited in NRS, ZMH and MCSN and was examined (see material list above). Moreover, to date no other *Fecenia* species than the one described above had been found in Myanmar. For that reason there are no doubts about the identiy of *Fecenia cylindrata*.

Fecenia hainanensis Wang, 1990 was synonymised with *F. cylindrata* by Wang and Yin (2001). The female holotype from Tonqian, Hainan Province, China was not available on request. According to the illustrations in Wang (1990), which are not very detailed, it is more likely that his *F. hainanensis* was in fact conspecific with *F. cylindrata*. The specimens from Hainan checked in the present study are considered belonging to *F. cylindrata*, though there are slight differences (see variation of copulatory organs in the description of *F. cylindrata*). More material from Hainan and also from regions of South East China and Northern Vietnam is necessary to assess the consistency of those slight differences among the different specimens. At the moment *F. hainanensis* is regarded as junior synonym of *F. cylindrata*.

Distribution. China, Myanmar, Laos, Thailand.

Discussion

Characteristics of the pre-epigyne

The pre-pre-epigyne (antepenultimate instar), although hardly useful for species determination, may bear important information. In some *Fecenia* species both pre-subadult and subadult females were available for examination. A continuous developmental trend from pre-pre-epigyne (p.s.a. ♀♀) to the epigyne of adults can be traced (e.g. Figs 19–22 for *F. ochracea*, Figs 79–82 for *F. cylindrata*). Sierwald (1989) showed that in most of the American Pisauridae even more primordial epigyne stages exist. In *Pisaurina mira* (Walckenaer, 1837) up to five stages with differently developed primordial copulatory organs (which Sierwald denominated as "anlagen") occur. Gradually from earlier to later stages the anlagen resemble more and more the adult. The changes from penultimate instar to adult constitute the largest developmental step as the shapes of pre-epigynes and adult epigynes differ the most. The number of primordial stages in *Pisaurina mira* varies between three and five (Sierwald 1989). Interestingly, in specimens with only three primordial stages, the anlagen of the antepenultimate and penultimate instars were less developed and differentiated. Anyway, these specimens moult following their third anlage to "normal" mature females (Sierwald 1989). The total number of juvenile stages varies in Pisauridae. For example in *Dolomedes triton* (Walckenaer, 1837) the number ranges from 10 to 15 in males and 9 to 15 in females (Zimmermann and Spence 1998).

The present study reveals the occurrence of a different developmental stage of the pre-epigyne (penultimate instar) in the pseudo-orbweaver *F. cylindrata* (Fig. 80). The following preliminary considerations may explain this phenomenon:

In insects a juvenile hormone (JH) regulates the development of the larva throughout the several moults up to the imago. Following Wigglesworth (1952), a controlled hormone balance between JH and prothoracotrope hormone is essential for regular development of the bug *Rhodnius prolixus* Stål, 1859. From 1st to 4th stage larva the concentration of JH decreases more or less continuously, but from the 4th to 5th stage the decrease is much stronger and from 5th stage to imago JH is completely absent (Wigglesworth 1952). It is likely that JH exists in spiders, too (Webber 2005). Prothoracotrope hormone does not exist in spiders, but instead of this it is possible, that another, equivalent hormone exists.

On the other hand it is known from spiders that the number of moults, and thus the number of instars, to reach maturity may differ, for example in Pisauridae (see above). In *Latrodectus mactans* (Fabricius, 1775) the number of instars varies from 7 to 9 depending on food supply (Deevey 1949). From particular species of *Stegodyphus* Simon, 1873 it is also known that maturity is reached after different numbers of moults in different specimens examined, irrespective of their sex (Kullmann et al. 1972, Kraus and Kraus 1988). Furthermore, Kraus and Kraus (1988) state that the enormous size variation in species of *Stegodyphus* seems to be caused mainly by this flexibility. At least in the species *F. ochracea* and *F. cylindrata*, the size variation is high. This becomes obvious by their carapace-length size ranges (see respective descriptions). It is possible that in *Fecenia* the number of moults required to reach maturity differs intraspecifically, too. Considering that the number of stages of immature females with differently developed primordial copulatory organs varies in Pisauridae (see above), a family also belonging to the Lycosoidea (Griswold et al. 2005), it is not unlikely that this applies to the pseudo-orbweavers too. A pre-epigyne of a s.a. ♀ of the 6th instar would then most likely differ from the one of an 8th instar.

In *Fecenia* it seems to be rare, that the pre-epigyne of a particular subadult female differs from the ones of the others belonging to the same species. But, anyway, as the example of the subadult female of *F. cylindrata* (Fig. 80) shows, this phenomenon may appear. In such a case additional consideration concerning the identification of subadults is necessary. Does the respective subadult female fit into a conceivable developmental continuum for the species in question? This is, of course, much easier if several "regularly" developed s.a. ♀♀ and/or p.s.a. ♀♀ are available. As the pre-epigyne of a "further developed" s.a. ♀ most likely resembles more an adult epigyne than a "regularly developed" one does, it should not be too difficult to identify it. Thus, in *Fecenia* the pre-epigynal characters apparently are species-specific (pre-epigynes, take notice; this must not inevitably mean that this applies also to the pre-pre-epigynes or other primordial epigynes of instars below subadult females!). Following the studies of Sierwald (1987, 1989) the pre-epigynes of the Pisauridae species examined seem to be specific, too. Hence, it is justified to use the pre-epigyne as a tool for identification.

Validity of characters in *Fecenia*.

Somatic characters are not useful for species determination in *Fecenia*. Colouration and spination, for example, are highly variable intraspecifically. Figures 69 and 82 in Levi (1982) suggest that species discrimination between *F. ochracea* and *F. cylindrata* via colouration of the ventral surface of the opisthosoma is possible. According to the present study, this cannot be confirmed. Species identification is only possible by checking the copulatory organs.

Remarks on spination

In the description of the genus *Fecenia* above a characteristic aspect of the spination pattern on the tibiae is mentioned. This may be explained by the life style of the pseudo-orbweavers. *Fecenia* is the only spider genus in which all representatives spend at least 95% of their lifetime in a very narrow enrolled-leaf retreat or cone retreat in early juveniles. In Araneidae there are several genera including species, that have similar lifestyles, e.g. *Acusilas, Cyclosa, Neoscona, Araneus, Cyrtophora*, also in Theridiidae, e.g. *Parasteatoda simulans* (Thorell, 1875). In any case, there is no genus in which all representatives use enrolled leaves as a retreat. Furthermore, in representatives of the families mentioned above the leaf-retreat is never as narrow (in relation to body size) as in *Fecenia*. A pseudo-orbweaver enters its retreat always with its opisthosoma first. The patellae and tibiae have the most intensive contact with the inner walls of the leaf retreat. As the legs are prograde with leg pairs I–II held anteriorly and III–IV posteriorly it becomes obvious that in the first two leg pairs the retrolateral and in the last two leg pairs the prolateral spines on the tibiae would be an impediment while moving inside the retreat. Perhaps in the course of the evolution of this genus, specimens with shorter spines or even no more spines at these respective positions were preferred? Like in *Psechrus* the patellae completely lack spines (Lehtinen 1967). This characteristic aspect of the tibial spination pattern in *Fecenia* may be an adaptation to this special life style. It would be interesting to check if the tibial spination pattern of species from the Araneidae and Theridiidae genera listed above using enrolled leaves, differ from the ones with different lifestyles. But in contrast to Psechridae in Araneidae and Theridiidae the spines are in any case not so prominent in comparison to leg diameter.

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The lace-sheet-weavers—a long story (Araneae: Psechridae: *Psechrus*)

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Content

Abstract

Various publications of the last twelve years have shown that the species richness of the genus *Psechrus* is much higher than was assumed 30 years ago. Based upon trends in the structures of the copulatory organs, for the first time, eight species groups are recognised and, including the present study, 46 species are now known. 20 species are recognised and described as new: *P. ulcus* **sp. nov.**, *P. aluco* **sp. nov.**, *P. decollatus* **sp. nov.**, *P. elachys* **sp. nov.**, *P. norops* **sp. nov.**, *P. arcuatus* **sp. nov.**, *P. laos* **sp. nov.**, *P. inflatus* **sp. nov.**, *P. pakawini* **sp. nov.**, *P. demiror* **sp. nov.**, *P. jaegeri* **sp. nov.**, *P. vivax* **sp. nov.**, *P. obtectus* **sp. nov.**, *P. fuscai* **sp. nov.**, *P. clavis* **sp. nov.**, *P. hartmanni* **sp. nov.**, *P. zygon* **sp. nov.**, *P. tauricornis* **sp. nov.**, *P. crepido* **sp. nov.** and *P. schwendingeri* **sp. nov.** Two species are removed from synonymy with *P. singaporensis* Thorell, 1894: *P. annulatus* Kulczyński 1908 (stat. nov.) and *P. libelti* Kulczyński 1908 (stat. nov.). One junior synonym of *P. tingpingensis* Yin, Wang & Zhang, 1985 is recognised: *P. xinping* Chen, Zhang, Song & Kim, 2002 (syn. nov.). New records are reported: *P. libelti* from Thailand, Malaysia & Brunei; *P. ancoralis* Bayer & Jäger, 2010 from Thailand; *P. himalayanus* Simon, 1906 from Bhutan; *P. ghecuanus* Thorell, 1897 from Laos. Pre-epigynes/pre-vulvae of 20 *Psechrus* species are examined and illustrated. In these species they apparently exhibit consistent and species-specific characters. However, since in several species only one subadult female was available for examination and in 57% of the *Psechrus* species even none at all, the characters of the pre-epigyne/pre-vulva are not included in the *Psechrus* identification key introduced herein. Additional information on the biology of *Psechrus*—for which the trivial name “lace-sheet-weavers” is introduced herein—is provided.

Key words: Taxonomy, revision, identification key, species-groups, copulatory organs, expanded bulb, spination, distribution, South-East Asia, predatory behaviour, mating behaviour, pre-epigyne, pre-vulva.

Introduction

Psechrus species are distributed in South East Asia. Their distribution range reaches from India in the West to the Solomon Islands in the East. In the North it reaches up to the Southern half of Shaanxi Province, China and in the South to the Northern most part of Queensland, Australia. Psechrus occurs in shady habitats, mostly in forests, but also in rocky areas, in the entrance areas of caves or at escarpments or road cuts. The representatives of this genus build extensive, slightly dome-shaped sheet webs, which reach a length up to 1.2 metres. As these spiders are cribellate and include cribellate capturing wool into their web, the common name ‘lace-sheet-weavers’ is introduced in the present study. At one side the web merges into a tube-retreat, which is located e.g. in rock crevices, or in holes in the tree trunk, in the compact soil or between roots.

Together with *Fecenia* Simon, 1887 the lace-sheet-weavers belong to the Psechridae Simon, 1890 (Simon 1892; Dalmas 1917; Petrunkevitch 1923, 1928; Lehtinen 1967; Levi 1982; Griswold 1993; Griswold *et al.* 2005; Platnick 2011), which—up to now—have been twice revised. Levi (1982) revised all the world’s Psechridae then known and Wang and Yin (2001) highlighted the Chinese representatives. The conception of Levi’s work was characterised by “lumping” (specific) diversity. He often considered clearly differing structures of copulatory organs as intraspecific variation. Based on that notion in a few cases he synonymised species, e.g. *Psechrus annulatus* Kulczyński, 1908. Further, he matched a *Psechrus* female from Taiwan with the male syntypes of *P. sinensis* Berland & Berland, 1914, although their recorded localities are ca. 1500 km apart and stating that “the conspecificity is not certain” (Levi 1982). After Song *et al.* (1999) synonymised the female types of *P. guiyangensis* Yin, Wang & Zhang, 1985 as being conspecific with *P. sinensis*, it was obvious that the female Levi (1982) described and illustrated sub *P. sinensis* was actually a new species, which was later described as *P. taiwanensis* Wang and Yin, 2001. In *P. himalayanus* Simon, 1906, Levi regarded a subadult female as adult (Bayer

2011) and illustrated it, although Hubert (1973) had already illustrated and characterised the “real” adult female of this species. Lehtinen (1967) synonymised *P. castaneus* Hogg, 1914 with *P. annulatus* as well as *P. ghecuanus* Thorell, 1897 with *P. torvus* (O. Pickard-Cambridge 1869) but gave no reason for those taxonomic acts. After checking the types of all four nominal species involved Levi (1982) recognised that Lehtinen’s decisions were incorrect and that *P. castaneus* is actually a synonym of *P. argentatus* (Doleschall, 1857) and that *P. ghecuanus* is a valid species. Kayashima (1962), Lee (1966), and Hu (1984) reported *Psechrus torvus* from Taiwan. According to subsequent publications (see below) all those reports have been found to be misidentifications. After Yoshida (2009) the epigyne of a female *P. torvus* sensu Kayashima (1962, figs 1–4) was that of a *P. taiwanensis*. Song *et al.* (1999) and Wang and Yin (2001) clarified that the illustrations of the female epigyne in Lee (1962) and Hu (1984) did not represent that of a *P. torvus*. From Papua New Guinea, *Uloborus flavolineatus* Rainbow, 1898 was described; Davies (in Davies and Gallon 1986) detected the conspecificity of the types of this nominal species with *Psechrus argentatus*. Further taxonomic misinterpretations persist; the labelling of many *Psechrus* specimens in museum collections is incorrect (Bayer, unpubl.) and a thorough revision of the lace-sheet-weavers is necessary.

Taxonomically the Psechridae were neglected from 1930 to 1981. This period had only seen one new description of a *Fecenia* species, *F. buruana* Reimoser, 1936, which was later (Lehtinen 1967) recognised as junior synonym of *F. ochracea* (Doleschall, 1859). After Levi (1982) revised the Psechridae, ten *Psechrus* species were considered valid, four of them newly described by Levi. Three years later Yin *et al.* (1985) described four new species from China, and Murphy (1986) one new species from the Philippines. According to several descriptions of all in all eleven new *Psechrus* species in the decade from 2000–2010 (Wang and Yin 2001; Chen *et al.* 2002; Yang *et al.* 2003; Jäger 2007; Yoshida 2009; Bayer and Jäger 2010), it became obvious that the diversity (species richness) of the lace-sheet weavers was underestimated. In the meantime I gathered many more *Psechrus* specimens, either from recent expeditions or from museum collections, which could not be assigned to any species described. Therefore, the description of new species is an important component of the present paper. Twenty new forms are recognised here and, including these, the number of species now totals 46. Particular trends, principally in the structure of copulatory organs are now recognised and the genus is subdivided into species-groups for the first time. The characters useful for such a division will be defined.

In *Fecenia*, the second genus of the family Psechridae, pre-epigynes have been useful when discriminating between species (Bayer 2011). Pre-epigynes can also be found in the subadult females of *Psechrus* and hence, in the present study, they are examined, illustrated and described for every species for which the respective subadult females are available. To what extent they provide species-specific information will be discussed later in this paper.

Material and methods

Most of the spider material examined in the present study was borrowed from several natural history museums, which are listed below. Part of the material was collected by hand during an expedition in Thailand and Laos from October–December 2009. Further material was obtained from colleagues, who collected specimens in different regions of SE Asia. Examinations and drawings were done with a Leica M 165 C stereomicroscope with drawing mirror. Photos of living spiders were taken with a Canon EOS 500D (equipped with a Sigma 105 macro lens and a Canon ringlite). Several photos were kindly provided by colleagues (equipment not listed here). Photos of preserved spiders and copulatory organs were taken with a Sony DSC W70 compact camera via ocular of the stereomicroscope. The material was preserved in 70% denatured ethanol. Female copulatory organs were cleared from surrounding hairs and dissected. The (opaque) tissue surrounding the vulva was removed. Vulvae were cleared in 96% DL-lactic acid ($C_3H_6O_3$). As the cuticula surrounding the epigyne may curl and structures may get shifted in the course of using lactic acid, this method could not be applied to every specimen. Other clearing-methods were unfortunately not successful in *Psechrus*. In males the hairs of cymbium sections close to the bulb were removed so that structures could be clearly viewed.

All measurements (and all numbers next to the scale bars) are in millimetres (mm). In the present study the “opisthosoma length” is regarded as length of the main part of opisthosoma only, thus without spinnerets and petiolus. Leg formula (from longest to shortest leg) and leg spination pattern follow those in Bayer and Jäger (2010). In leg/palp spination the limbs femur, patella, tibia and metatarsus (tarsus in palp) are listed in exactly this sequence. First, all spines on the prolateral surface of the respective limb are counted and listed, then those on the dorsal, then retrolateral and finally the ventral surfaces. Thus the resulting number is generally 4-digits. Some limbs, e.g. femur and patella, always lack ventral spines, so here the number is 3-digits. If a spination pattern from a certain limb article differs between the left and right sides, the pattern for the right article is listed in curly brackets behind, without a blank. Palp and leg lengths are listed as: total (femur, patella, tibia, metatarsus, tarsus). A rough characterisation of the leg-length of males and females of the different species-groups (see below) is given by the following ratio: femur + metatarsus of leg I / carapace length (FEM-I+MTT-I/CL).

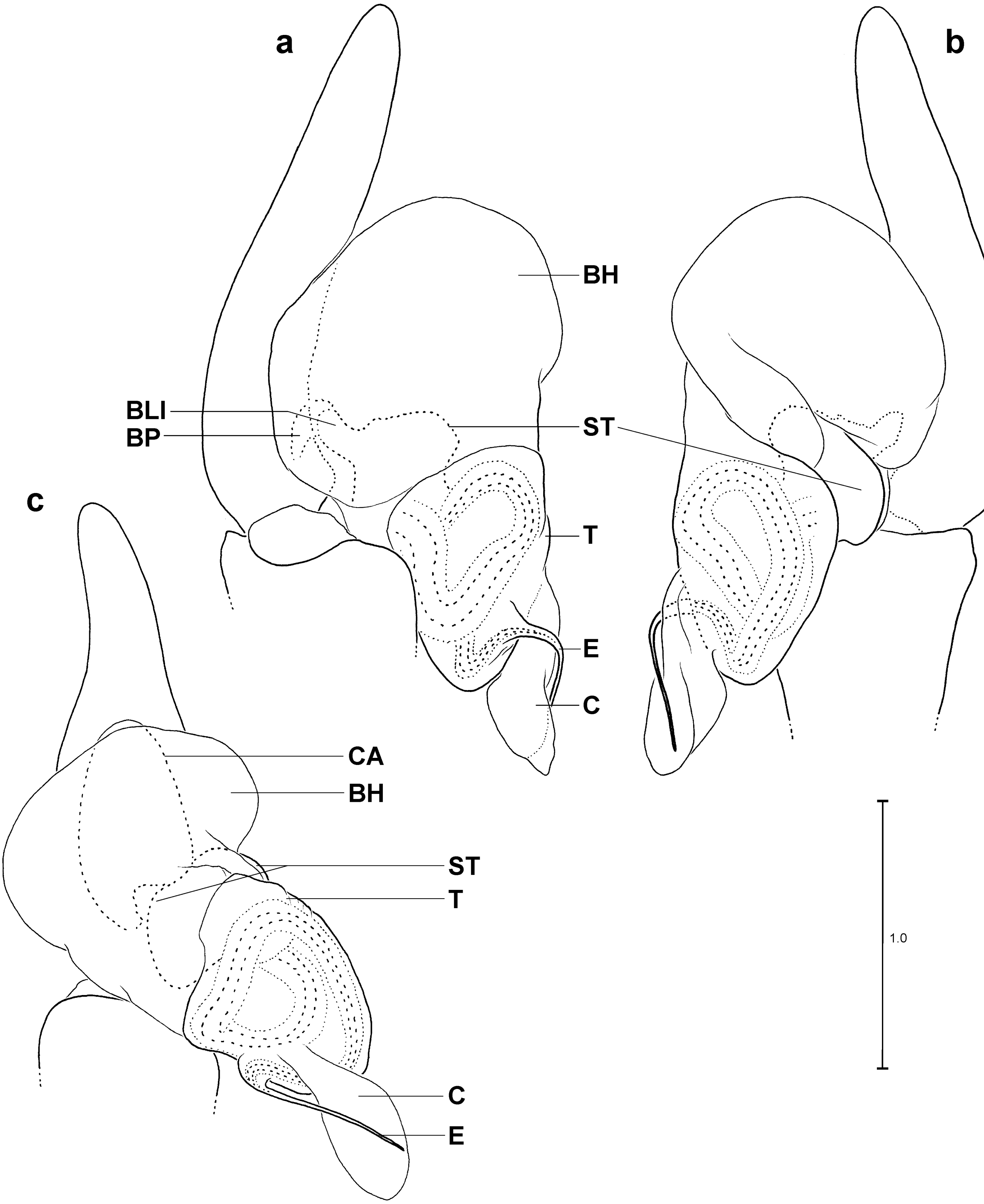
Abbreviations used in the text: ALE—Anterior lateral eye. AME—Anterior median eye. BH—Basal haematodocha. BLI—Bulbal ligament. BP—Bulbal petiolus. C—Conductor. CA—Cymbium alveolus. CB—Conductor base. CD—Copulatory duct. CL—Carapace length. CO—Copulatory opening. CS—Cymbium scopula. E—Embolus. EB—Embolus base. EF—Epigynal field. EM—Epigynal muscle sigilla. FD—Fertilisation duct. FEM-I—Femur of leg I. H—Harpago. juv.—Juvenile. LL—Lateral lobe. MC-I—Macrosetae ventrally on coxa of leg I. MC-II—Macrosetae ventrally on coxa of leg II. MS—Median septum. MT-I—Macrosetae in apical row ventrally on trochanter of leg I. MTT-I—Metatarsus of leg I. PLE—Posterior lateral eye. PME—Posterior median eye. p.s.a.—Pre-subadult. RTA—Retrolateral tibial apophysis. s.a.—Subadult. SB—Serial individual numbers of Psechridae examined by the author. SBA—Spermathecal base. SD—Sperm duct. SH—Spermathecal head. SO—Slit sense organ. ST—Subtegulum. T—Tegulum. TM—Tegimentum. TP—Palpal tibial process. W—Wrinkles anteriorly in/anterior to epigynal field.

Terminology of structures belonging to the copulatory organs is given as follows:

The female epigyne consists of two slits, which separate the lateral lobes (LL) from the median septum (MS) (Figs 2g, 29e). In most *Psechrus* species the latter is simple. However, in representatives of the *torvus*-group it is complicatedly folded. This results in a particular, strongly sclerotised structure (Figs 69d, 71a, 75a, 89m–p), which is here called tegimentum (TM). If viewed from ventral, it gives the impression there are two anterio-lateral extensions that at least partly cover the copulatory opening (CO) (well recognisable in Figs 69d or 89m,p). In females of other species groups the area of each copulatory opening may possess a peculiar, flattened, glossy field (asterisks in Figs 14f and 59a). The entire epigyne is mostly surrounded by an epigynal field (EF), which is a sclerotised area. It is not as intensively sclerotised as the MS or LL and is distinguished from the adjacent areas of ventral opisthosoma by the stronger pigmentation (brown or red-brown colour, instead of light brown in the surrounding areas). There are two muscle sigilla (epigynal muscle sigilla, EM) in front of the EF. Sometimes they are integrated within the latter. These and the slit sense organs (SO) near the epigyne (Figs 2g, 29e) may feature additional taxonomic information and these are also illustrated. Either within the anterior section of EF or anterior to the EF there are mostly lots of curved wrinkles (W) (Fig. 29e).

The internal parts of the female copulatory organ (here called vulva) comprises a duct system (more exactly a folded slit system), which can be divided into different parts. The localisation of the receptacula seminis (spermathecae) in *Psechrus* is not fully understood. Consequently it is not clear if the section, which is here called ‘spermatheca’, and which mostly includes a spermathecal head (SH) additionally to the large spermathecal base (SBA) (Figs 2h, 69e), truly represents a functional spermatheca. In a few species SBA and SH are not even directly conjoined (Fig. 29d). Up to now the exact location where the sperm gets stored following copulation is unknown. However, because of their numerous pores, it is clear that the spermathecal heads are connected to accessory glands. The initial section of the vulva leading to SBA is here termed the copulatory duct (CD). From the SBA a narrow fertilisation duct (FD), leads to the uterus externus. The latter and parts of the FD are inevitably removed along with the dissection and clearing of the copulatory organ.

Apart from structures that are well known in arachnology, e.g. conductor, sperm duct and embolus, the *Psechrus* palp may bear special structures. In a few species there is a voluminous conductor base (CB) (Fig. 25b), in some others a large and/or complex embolus base (EB) (Figs 10b & 70b) exists. In a few species out of the *mulu*-group (see below) the male palps possess a tibial process (TP) with a bunch of long setae apically (Figs 10b,c). The male representatives of the *torvus*-group possess a hook-like apophysis apically on the tegulum (Figs 70b,c). In the present publication this structure is named “harpago” (H), which is a Latin term and means grappling hook. Most *Psechrus* males carry a scopula dorsally on cymbium (CS) (Figs 83d–g). Moreover, the males of several species posses macrosetae ventrally on their coxae of leg I or leg I & II (but in II they are much less conspicuous) (Figs 82l–n,p–r) and/or ventrally in an apical row on trochanter of leg I (Figs 82m,n,q). In the descriptions the abbreviations MC-I, MC-II and MT-I will be used to describe this feature. It is not unlikely that these macrosetae have a function during copulation.



FIGURES 1a–c. *Psechrus ancoralis*, bulb expanded. a–c ♂ SB 321 from Laos, Luang Prabang Prov. a–c ♂ palpal cymbium and bulb (a prolateral, b retrolateral, c ventral view).

Symbols/styles used in the illustrations: Regular solid lines indicate edges/margins/rims of structures as recognised in the respective view; Weak solid lines indicate edges of fine structures, e.g. membranous structures, or wrinkles in the area of the epigyne; Dashed lines indicate inner walls of ducts and/or slits; Dotted lines (wide) indicate structures visible through cuticula (e.g. parts of vulva visible through epigynal cuticula). Dotted lines (fine) indicate clear colour differences (e.g. border of epigynal field). In schematic illustrations showing the course of the internal duct system the spermathecal head area is marked with a “T”-symbol, the copulatory opening with a circle and the end of the fertilisation duct in direction of the uterus externus with an arrow (see e.g. Fig. 2i). When a copulatory opening comprises an elongated slit/area, the circle is put at the central position of that slit/area. Arising points and/or directions of tegular appendages in males are described as clock-positions of the left palp in ventral view.

Museum collections (with curators): AMNH—American Museum of Natural History, New York, USA (N.I. Platnick, L. Sorkin). CAS—California Academy of Sciences, San Francisco, USA (C. E. Griswold, A. Carmichael). CJW—Collection Jörg Wunderlich, Hirschberg, Germany (J. Wunderlich). DUY—Dali University, Invertebrate-Collection, Yunnan, China (Z.Z. Yang). HBI—Hunan Biological Research Institute, Hunan Normal University, Changsha, China (X. J. Peng, L. Ping). HNHM—Hungarian Natural History Museum, Budapest, Hungary (S. Mahunka). IZB—Institute of Zoology, Beijing, China (S. Li). MC—F. & J. Murphy Collection, Hampton, London, United Kingdom. MCSN—Museo Civico di Storia Naturale, Genoa, Italy (M. Tavano). MCZ—Harvard University, Museum of Comparative Zoology, Cambridge, Massachusetts, USA (G. Giribet, L. Leibensperger). MHBU—Museum of Hebei University, Baoding, China (F. Zhang). MHNG—Muséum d'histoire naturelle, Geneva, Switzerland (P. Schwendinger). MIZ—Museum and Institute of Zoology, Warszawa, Poland (D. Mierzwa). MNHN—Muséum National de Histoire Naturelle, Paris, France (C. Rollard, E. Leguin). NHM—Natural History Museum, London, United Kingdom (J. Beccaloni). NHMB—Naturhistorisches Museum, Basel, Switzerland (A. Hänggi). NHMW—Naturhistorisches Museum Wien, Vienna, Austria (J. Gruber, C. Hörweg). NMI—National Museum of Ireland, Dublin (M. Nolan, N.T. Monaghan). NRS—Naturhistoriska Riksmuseet, Stockholm, Sweden (G. Lindberg). NSMT—National Science Museum, Tokyo, Japan (H. Ono). NZSI—Zoological Survey of India, National Zoological Collection, Calcutta. OUMNH—Oxford University Museum of Natural History, United Kingdom (Z. Simmons). QM—Queensland Museum, Brisbane, Australia (R. Raven, W. Hebron). RMNH—Nationaal Natuurhistorisch Museum Naturalis, Leiden, Netherlands (J. Miller, I. J. Smit, K. van Dorp). SMF—Senckenberg Museum, Frankfurt am Main, Germany (P. Jäger, J. Altmann). USNM—National Museum of Natural History, Washington D.C., USA (J. Coddington). WII—Wildlife Institute of India, Dehradun (V.P. Uniyal, S. Quasin). YPM—Yamagata Prefectural Museum, Japan (H. Yoshida). ZMA—Zoologisch Museum Amsterdam, Netherlands (B. Brugge). ZMB—Museum für Naturkunde, Berlin, Germany (J. Dunlop, B. Nitsche, A. Friederichs). ZMH—Zoologisches Institut und Zoologisches Museum, Hamburg, Germany (H. Dastych). ZMUC—Zoological Museum of the University of Copenhagen, Denmark (N. Scharff).

In the species descriptions the spider material is listed as follows:
Primary type(s), secondary type(s), additional material. Localities are listed from North to South, then from West to East. Countries, provinces, towns or villages are listed by their presently valid names, if known.

Taxonomy

Family Psechridae Simon, 1890

Psechridae Simon 1890: 80. **[**Type genus: *Psechrus* Thorell, 1878**]**. Simon 1892: 223. Dahl 1901: 185. Dalmas 1917: 324. Petrunkevitch 1923: 164. Giltay 1926: 129. Petrunkevitch 1928: 20. Gerhardt and Kästner 1932: 646. Petrunkevitch 1939: 142. Bristowe 1938: 293. Homann 1950: 66, 137. Lehtinen 1967: 382. Forster and Wilton 1973: 296. Levi 1982: 117. Griswold 1993: 5. Chen 1999: 431. Murphy and Murphy 2000: 264. Griswold *et al.* 2005: 37. Jocque and Dippenaar-Schoeman 2006: 218. Bayer 2011: 7.

For family diagnosis, generic key as well as description and diagnosis of the genus *Fecenia* Simon, 1887 see Bayer (2011).

Psechrus Thorell, 1878

Psechrus Thorell 1878: 170. [Type species: *Tegenaria argentata* Doleschall, 1857, transferred to *Psechrus* by Thorell (1878)]. Simon 1890: 80 (Transfer to Psechridae). Simon 1892: 226. Dalmas 1917: 324. Homann 1950: 66. Lehtinen 1967: 260, 383. Levi 1982: 118. Coddington 1990: 7. Griswold 1993: 539. Murphy and Murphy 2000: 264. Griswold *et al.* 2005: 37.

Lancaria Karsch 1879: 557. [Type species: *Tegenaria torva* O. Pickard-Cambridge, 1869, transferred to *Lancaria* by Karsch (1879)]. Simon 1887: 194 (Syn., formal transfer of *Lancaria torva* to *Psechrus*).

Species transferred to other genera:

Psechrus nicobarensis Tikader, 1977 to *Fecenia* (Levi 1982: 138).
Note: *Fecenia nicobarensis* (Tikader, 1977) is junior synonym of *Fecenia protensa* Thorell, 1891 (Bayer 2011).

Diagnosis. *Psechrus* is distinguished from *Fecenia* by the following characters: AME at most equal to other eyes, mostly smaller; white longitudinal line ventrally on opisthosoma; clypeus (relatively) high, 2–3.5 times diameter of AME, consequently cephalic region of carapace higher than in *Fecenia*; length of leg IV more or less equal to leg II; males (mostly) without RTA or apophyses on other palp limbs (except femoral extension, see below) and always without median apophysis on tegulum; females with rather simple median septum of epigyne; vulva mostly with spherical spermathecal heads.

Description. Large Psechridae, body length in males: 8.5–23.8 mm; females: 11.0–31.1 mm. Width of anterior part of carapace smaller than broadest section of carapace. Both anterior and posterior eye row recurved. Chelicerae long and strong, basal limb at least 2.5 times longer than broad. Cheliceral furrow with three teeth anteriorly, four to five posteriorly and a longitudinal row of 5–10 small denticles in between both rows of teeth (Fig. 66e). Their number varies intraspecifically. Basal limb of chelicerae ventrally with long field of short, transversal striae. Labium longer than broad (Fig. 2e). Gnathocoxae ca. 2.5 times longer than broad (Fig. 2e). Sternum longer than broad, with pointed posterior ending and broad-angled (160°) anterior ending (Fig. 2f). Pedipalp in females with single, toothed claw (Fig. 21g), which is similarly shaped as the pair of distal tarsal claws of the legs. The tarsi of the legs long, gracile, elastic, and apically additionally with a third, small, toothed and short tarsal claw (median hook). Legs very long in males (metatarsus I ca. 2.5–3.5x carapace length, Fig. 81c), long in females (metatarsus I ca. 2x carapace length, Fig. 81d). Leg formula 1243 or 1423. Coxae of legs I and II slightly broader than of IV and especially III, which is smallest. Calamistrum dorso-retrolaterally on metatarsus IV consisting of 4–5 rows of setae, inner rows generally with irregular arrangement. In adult males calamistrum rudimentary, if not completely reduced.

Spination of palp and legs: Variable within each species. Mostly no species-specific spination pattern recognisable. The spination pattern is in parts useful for the characterisation of the different species groups (see below). At the following positions spines are always absent: All patellae, tarsi, dorsal surface of all metatarsi, ventral surface of all femora. Ventral spines on tibiae and metatarsi generally paired, except for most distal one (in the case of odd numbers).

Males of many species possess macrosetae ventrally on coxae of legs I (MC-I) and/or II (MC-II) as well as an apical row of macrosetae ventrally on trochanter I (MT-I).

Colouration: Chelicerae brown to dark red-brown. Sternum mostly yellowish brown at lateral margins and with (dark) brown, tapered patch centrally (Fig. 82h). Rarely unicoloured light brown (Fig. 82j) and even more rarely brown with light longitudinal line (Fig. 82k). Carapace yellowish brown, always with two dark brown median bands (Figs 82a–g), which may be serrated laterally. Most distal lateral margins often also with dark bands (Figs 82a,f–g), however these are (much) narrower than median ones. Palpal femur ventrally with a longitudinal row of 6–10 long bristles, which may be reduced in adult males. Legs from yellowish brown or light brown to brown, often dark brown annulated (Figs 81a–d). Opisthosoma dorsally yellowish-brown with (dark) brown patches (Figs 81a–b), ventrally brown with a straight, light, longitudinal line (Figs 81e–i). On each side next to that line with a longitudinal row of small patches of muscle sigillae (Figs 81h–i). Opisthosoma ventrally very rarely unicoloured brown (Fig. 81j).

Anterior lateral spinnerets are short (broader than long) and more or less conical, posterior median spinnerets distinctly smaller, slender and cylindrical. Posterior lateral spinnerets also cylindrical and bipartite, similar size to anterior lateral spinnerets. Cribellum divided into two very narrow parts (Fig. 81h).

Copulatory organs: Male palp with more or less oval tegulum (T). Embolus (E) filiform (Figs 2b–c, 25b–c), broad and strong (Figs 10a–c, 54b), or of intermediate shape. E arising in retrolateral half of T or centrally. Conductor (C) mostly membranous, rarely sclerotised, rudimentary or completely reduced. C arising medially in upper half of T (Figs 2b, 70b). Expanded bulb clearly showing the large basal haematodocha (BH), surrounding subtegulum partly (Figs 1a–c). A median haematodocha, like present e.g. in Araneidae (Grasshoff 1968), *Oecobius* Lucas, *Uroctea* Dufour (Baum 1972), *Liphistius* Schiödte (Kraus 1978) or in Pisauridae (Sierwald 1987), is absent in *Psechrus*. Bulbal ligament (BL) and bulbal petiolus (BP) are visible through the BH (Figs 1a–b). Cymbium (slightly) broader than palpal tibia and patella or more or less equal in width. RTA usually absent, but a few species belonging to the *mulu*-group (see below) with a tibial process (TP) with a bunch of long setae (Figs 10b–c). It is not clarified if this process represents a RTA, if it is homologous to a RTA or if it is a completely different structure. A "regular" RTA usually lacks setae and is generally strongly sclerotised. Palpal femur may be modified (e.g. Figs 2d, 10d, 15d or 55d). The respective modifications may be species-specific. Cymbium dorsally mostly with scopula (CS) (Figs 83a–b, d–g). There are differences in density among the different species: very dense (Figs 83d–g) or moderate dense (Figs 83a–b). CS can be of different length (covering cymbium from 1/4 up to 6/7, Figs 83d–g). In a few species CS is absent (Fig. 83c).

Female epigyne mostly with simple septum (e.g. Fig. 29e). Anterior to septum mostly lots of curved wrinkles (Figs 29e, 32a). Vulva specifically shaped (see each species description) with internal duct system generally divided into three sections: copulatory duct, receptaculum with spermathecal head and fertilisation duct (Figs 2h, 29d).

Biology. The lace-sheet-weavers generally live in shady habitats near the ground. They can be found in forests (e.g. between tree roots, in holes of tree trunks or underneath dead wood), between rocks, boulder, at rock walls or at clay escarpments. Sometimes they appear in untended barracks or huts, too. Several species, especially those that are often found at rock walls or between boulders, can be found in the entrance areas of caves, too. According to colleagues' and my own observations in the field in Laos, there are several species, *Psechrus laos* **sp. nov.**, *P. ancoralis* Bayer & Jäger, 2010, *P. antraeus* Bayer & Jäger, 2010, *P. khammouan* Jäger, 2007 and *P. steineri* Bayer & Jäger, 2010, which prefer these habitats (rock walls etc., see above). Others, *P. luangprabang* Jäger, 2007, *P. ghecuanus* Thorell, 1897 and *P. jaegeri* **sp. nov.**, are found mainly in forests, between roots or in tree holes or at escarpments. There are a few *Psechrus* species reported only from caves, e.g. *P. mulu* Levi, 1982, *P. cebu* Murphy, 1986 or *P. steineri*. However, they had mostly been reported from the entrance areas of caves (rarely from the aphotic zone). Presumably they can be found on rock walls or boulders outside of the caves, too. I would not assume that there is any *Psechrus* species that is restricted to caves. The lace-sheet weavers build a horizontal sheet web, which reaches up to 1.2 m length (in rare cases even 2 m [Robinson and Lubin 1979]). At one side the web turns into a long tube, which leads into a narrow crevice or hole, where the spider is safe from invaders. This tube-retreat is generally located in a rigid environment, e.g. rocks, stones, rigid soil or wood. It never appears between leaves and only very rarely between grass. *Psechrus* moves upside down underneath the sheet web like representatives of Linyphiidae do. *Psechrus* behaves extremely shyly and careful in its sheet web. At the slightest disturbance it runs back to its retreat with extreme speed. This explains why *Psechrus*, though it is abundant in many regions, is not easy to catch. Females carry their egg sacs, which can be up to 25 mm in diameter, in their chelicerae (Fig. 93b). According to my own observations in *P. jaegeri* **sp. nov.**, *P. argentatus* (Doleschall, 1857), *P. mulu* Levi, 1982, *P. ghecuanus* Thorell, 1897 and according to Jäger (2007) for *P. khammouan* Jäger, 2007, egg sacs contain 70–96 eggs. Yoshida (2009) counted 174 spiderlings in an egg sac of *P. clavis* **sp. nov.** (sub *P. taiwanensis*).

Robinson and Lubin (1979) observed and described the predatory behaviour of *Psechrus argentatus* (Doleschall, 1857). Most of the behavioural units described therein, were also observed in my own trials using several *P. laos* **sp. nov.**, *P. luangprabang* Jäger, 2007 and *P. torvus* (O. Pickard-Cambridge, 1869) specimens. Each spider was transferred into a glass terrarium with a piece of wood in one corner. A sheet web was built by the second day at the latest, with the retreat situated between the piece of wood and the corner of the terrarium. Crickets or large flies were used as prey, which were placed in the centre of the web. After a fly was put into the web, it took at most one second until the spider moved slightly forward in its retreat. A few seconds later it moved to the mouth of the retreat and pulled slowly at the web with the forelegs. Finally it ran out very fast to the respective site of the sheet web, grasped the fly with its forelegs and bit it. Immediately it ripped the fly out of the web with the chelicerae and ran back with it forward into the retreat. Later, it turned its direction within the retreat to be ready for the next prey attack (in some cases not before finishing up eating the fly). When larger prey items, e.g. large crickets, were offered, the behaviour was the same up to the point before grasping the prey. In this case the spider moved more slowly before directly encountering the prey. After a few attempts of stretching out and drawing back the forelegs over the cricket, it was bitten. The bite was mostly located between head and thorax or at the base of antennae and lasted for ca. 5 seconds. Then shorter bites at other sites of the cricket's body (e.g. legs, antennae) followed. After ca. 1 minute the prey seemed to be paralysed and *Psechrus* began to bind its prey with threads produced from the spinnerets but also with threads taken from the web. Subsequently the prey was cut out of the web and carried within the chelicerae back to the retreat. The binding behaviour was not executed in every trial, but in ca. 50 % of prey attacks upon large prey items. The approaching behaviour in the terrarium is rapid and does not pass off stepwise as has been observed in the natural environment by Robinson and Lubin (1979) and myself. In the wild the webs are far larger in size and consequently prey are much more difficult to localise. The three *Psechrus* species examined showed no significant differences in web structure and predatory behaviour.

Mating behaviour was observed only once. In the respective trial a male of *Psechrus luangprabang* was released into the terrarium of a conspecific female (ca. 11:00 o' clock a.m). It moved to an upper corner of the terrarium and stayed there for 4 ½ hours. At ca. 3:30 p.m. the male slowly approached from a peripheral section of the web. The approach was interrupted by stops, from about 5–15 minutes duration. At each resting position the web was gently pulled rhythmically with the two pairs of forelegs. Meanwhile the female appeared at the mouth of the tube retreat. Finally the male reached the females legs and stroked them with his tarsi for about 5–10 minutes. Then he crawled underneath the female, both specimens facing the same direction. He surrounded her body with his long legs. They both swung violently up and down. Suddenly the male turned underneath the female and once again surrounded the latter with his legs. The spines on his legs, especially the femora, were erected to ca. 45°. The male turned again and pulled down the two first legs of the female with the metatarsus of his right leg I. Once again he turned and both spiders showed trembling movements. Then the male approached very closely to the female and a few seconds after that he departed again. This sequence was repeated about three times. Finally he moved his body perpendicular to the female and cleaned his two first legs and the palps. Both specimens trembled, even more intensely than before and the male's spines erected to almost 90°. The male changed his position to a 45° angle towards the female and in this position he pulled her towards him and copulation took place. It was very rapid, lasting about 20 seconds. During copulation the first two pairs of the female's legs and the second pair of the male's legs were stretched straight forward. The expansion of the bulb and the exact position of insertion could not be observed with the naked eye. After copulation the male was chased away by the female and moved to an upper corner of the terrarium (Fig. 93a shows a *Psechrus* couple in the field observed by a colleague).

Species groups. The species groups are defined mainly by the basic structures of the copulatory organs of their representatives (see diagnoses of each species group below). A few somatic characters are in parts useful for such a "classification", but often only by trend as there are exceptions in character patterns. These useful characters are: 1) the shape of median and lateral bands on carapace, 2) the shape of the light, longitudinal line ventrally on opisthosoma, 3) the relative leg length (measured as ratio between femur I + metatarsus I / carapace length), 4) dorsal spines on tibia III and IV. The length of legs is variable among different specimens of the same sex, which is the case for every species. It will be noted as an approximate ratio for males and females in the description of each species-group, with the following convention: Ratio between femur + metatarsus of leg I / carapace length (FEM-I + MTT-I / CL). Presently, eight groups, the *argentatus*-, *mulu*-, *annulatus*-, *singaporensis*-, *ancoralis*-, *himalayanus*-, *sinensis*-, and the *torvus*-group are differentiated.

Key to species of *Psechrus*:

1 Male [unknown in: *borneo, annulatus, aluco* **sp. nov.**, *norops* **sp. nov.**, *arcuatus* **sp. nov.**, *jinggangensis, fuscai* **sp. nov.**, *kenting, taiwanensis, tauricornis* **sp. nov.**; identification not absolutely certain in: *demiror* **sp. nov.**, *zygon* **sp. nov.**; those of *demiror* **sp. nov.** and *zygon* **sp. nov.** are included in the present key, but with question mark] 2
\- Female [unknown in: *ulcus* **sp. nov.**, *kinabalu, schwendingeri* **sp. nov.**] 37
2 Harpago (Figs 70b–c, 72b–c, 74b–c) present 3
\- Harpago absent 5
3 C longer than width of T . . . . *torvus*
\- C shorter than width of T 4
4 C centrally as broad as in distal fourth and located medially in upper half of T . . . . *hartmanni* **sp. nov.**
\- C broadest in distal fourth and located in retrolateral half of T . . . . *zygon* **sp. nov.** (?)
5 C absent or strongly reduced 6
\- C well developed 9
6 C absent 7
\- C rudimentary (a very short and stout structure still recognisable), E quite broad and strongly sclerotised, resting in CA (Figs 78a–c) . . . . *schwendingeri* **sp. nov.**
7 With three apophyses close to E (Figs 7a–b) . . . . *mulu*
\- With less than three apophyses close to E 8
8 E retrolaterad; E and EB constitute an extremely bulky structure (Fig. 10b) . . . . *ulcus* **sp. nov.**
\- E rather slim, prolatero-apicad . . . . *kinabalu*
9 C with numerous small or very small, short spines or tubercles (Figs 52a–b, 54a–b, 57a–b, 66a–b) 31

-	C without such structures	10
10	Palpal femur modified with ventral bulge (the latter may be flat) (Figs 14d, 15d) or with pointed, ventral extension (Fig. 2d)	11
-	Palpal femur without modification	16
11	E dorsally with one distinct, pointed apophysis (Fig. 79b)	*cebu*
-	E different	12
12	C strongly sclerotised and narrow, its distal half just as broad as E (Figs 2b, 6b)	13
-	C membranous and/or fleshy, its distal half (distinctly) broader than E	14
13	C more than half as long as E	*libelti*
-	C less than half as long as E	*argentatus*
14	C ca. as long as T	*decollatus* **sp. nov.**
-	C far shorter than T	15
15	EB in ventral view in alignment with upper retrolateral margin of T (Fig. 15b)	*singaporensis*
-	EB protruding beyond upper retrolateral margin of T (Fig. 17b)	*elachys* **sp. nov.**
16	Bulb with elongated EB possesing a distinct ventral protrusion basally (Figs 76a–c)	*crepido* **sp. nov.**
-	Bulb different	17
17	E arising medially on upper half of T, coxa of leg I (Figs 82l,r) or proximal part of palpal femur (Fig. 35d) ventrally with distinct field of macrosetae	23
-	E arising retrolaterally on T, neither coxa of leg I nor proximal part of palpal femur ventrally with distinct field of macrosetae (may be with few unconspicuous macrosetae subdistally in addition to an apical row of macrosetae)	18
18	C with distinct, broadened base (Figs 23b, 25b)	19
-	C without distinct, broadened base	20
19	E longer than T	*laos* **sp. nov.**
-	E shorter than T	*rani*
20	C broader than 1/3 the width of T	*ancoralis*
-	C narrower than 1/3 the width of T	21
21	E longer than width of T	*antraeus*
-	E shorter than width of T.	22
22	E longer than half the width of palpal tibia	*khammouan*
-	E shorter than half the width of palpal tibia	*steineri*
23	E (almost) straight	26
-	E curved	24
24	EB with particular flat, elongated and proximally curved extension (Fig. 43b)	*luangprabang*
-	EB different	25
25	Distal section of E curved and distinctly narrower than central section (Fig. 50f)	*jaegeri* **sp. nov.**
-	Distal section of E hardly curved and not significantly narrower than central section (Fig. 50e)	*vivax* **sp. nov.**
26	C as long as T	*demiror* **sp. nov.** (?)
-	C shorter than T.	27
27	T apically with quite strongly sclerotised, semicircular extension (Figs 37b, 39g, 41b)	28
-	T apically without such an extension	29
28	E arising distinctly further distally than C	*ghecuanus*
-	E arising at most at the same level as C, but mostly further proximally	*pakawini* **sp. nov.**
29	Sperm duct simply U-shaped	*himalayanus*
-	Sperm duct with at least two loops	30
30	C with broad and large proximal section and small and narrow distal section (Fig. 35b)	*inflatus* **sp. nov.**
-	C broadest distally	*marsyandi*
31	C apically (at least slightly) bifid (Figs 56a–c, 57a–c)	32
-	C apically not bifid	33
32	EB with apophyses only in its distal half (Figs 55b–c, 56b–c)	*tingpingensis*
-	EB with apophyses only in its proximal half (Figs 57b–c)	*obtectus* **sp. nov.**
33	C in ventral view proximally with striking, hemispherical bulge (Fig. 62b)	*senoculatus*
-	C without such a bulge	34
34	Sperm duct with distinctly U-shaped section in prolateral half of T (Figs 66b)	*clavis* **sp. nov.**
-	Sperm duct different (e.g. as in Figs 52b, 54b, 86m,o)	35
35	EB with long, apically bifurcated apophysis (Fig. 86n)	*kunmingensis*
-	EB without long, apically bifurcated apophysis	36
36	E in ventral view short, broad and blunt (Fig. 54b)	*triangulus*
-	E in ventral view with filiform distal section (Fig. 52b)	*sinensis*
37	Epigyne complex, tegimentum (TM) present (Figs 69a,d, 71a,d, 73a,e, 75a,e, 89m–p)	38
-	Epigyne without TM	41
38	Branches of TM distally rounded (Figs 69a, 73a)	39
-	Branches of TM distally pointed, resembling the horns of a bull (Figs 75a,e)	*tauricornis* **sp. nov.**
39	Branches of TM directed anterio-mediad	*torvus*
-	Branches of TM directed (anterio-) laterad	40

40 Distal section of CD located medial to SH . . . . *zygon* **sp. nov.**
- Distal section of CD located lateral to SH . . . . *hartmanni* **sp. nov.**
41 Epigyne with flat, large-area bulge in front of MS (Figs 77a,e, 89k) . . . . *crepido* **sp. nov.**
- Epigyne without such a bulge in front of MS 42
42 MS longer than broad 43
- MS broader than long 51
43 Anterior half of MS broader than posterior half (Figs 61a, 63a, 65a, 67a) 44
- Posterior half of MS broader than anterior half (Figs 53a, 56d, 60a,e) 48
44 CD with twisted section (Fig. 61b), the latter narrower than spermatheca . . . . *jinggangensis*
- CD with bulbous section, the latter broader than spermatheca 45
45 MS distinctly longer than broad (more than 1.6 times, Fig. 63a), initial section of CD straight (Fig. 63b) . . . . *senoculatus*
- MS less than 1.6 times longer than broad, initial section of CD either integrated within bulbous section (Fig. 67b) or anteriorly curved mediad (Figs 64b, 65b) 46
46 Initial section of CD integrated in kidney-shaped, bulbous section . . . . *clavis* **sp. nov.**
- Initial section of CD anteriorly curved mediad 47
47 Posterior half of MS just slightly narrower than anterior half (Fig. 65a), bulbous section of CD anteriorly with small bulge (Fig. 65b) . . . . *taiwanensis*
- Posterior half of MS clearly narrower than anterior half (Figs 64a,d), bulbous section of CD anteriorly without small bulge ... . *kenting*
48 CD with twisted section (Figs 55f, 58b, 59b) 51
- CD without twisted section (Figs 53b, 54f, 60b,d) 49
49 MS and LL complicatedly folded interleaved (Figs 60a,e) . . . . *kunmingensis*
- MS and LL different 50
50 Posterior half of MS anteriorly rounded (Figs 53a,d) . . . . *sinensis*
- Posterior half of MS triangular (Fig. 54e) . . . . *triangulus*
51 Epigyne anteriorly with two rounded, flattened, glossy fields near CO (Figs 59a, 89e) . . . . *fuscai* **sp. nov.**
- Epigyne without rounded, flattened, glossy fields near CO 52
52 CD at least 4x longer, but less than 2x broader than diameter of receptaculum 53
- CD different 54
53 Twisted sections of CD, located anteriorly beyond transversal, initial sections of CD, shorter than half the diameter of one receptaculum (Figs 58b,g) . . . . *obtectus* **sp. nov.**
- Twisted sections of CD, located anteriorly beyond transversal, initial sections of CD, almost as long as diameter of one receptaculum (Figs 55f, 56f) . . . . *tingpingensis*
54 CD with voluminous, spherical/bulbous section, the latter distinctly larger than receptaculum (Figs 64b,e, 65b) 47
- CD may be large and broad (Figs 2h, 5c), but without voluminous, spherical/bulbous section 55
55 Epigyne and EF strongly sclerotised, with dark red-brown colour (Figs 87c,d) 56
- At least EF different 57
56 CD running transversally and straight (Figs 7e, 8f) . . . . *mulu*
- CD curved and flowing into receptaculum from anterior (Fig. 9b) . . . . *borneo*
57 Epigyne protruding, CO large (Figs 12a,b, 13a, 14f, 87e–g) 58
- Epigyne not or hardly protruding, CO rather small 60
58 Vulva with spherical SH 59
- Vulva without spherical SH (Fig. 14h) . . . . *decollatus* **sp. nov.**
59 CD distinctly larger than receptaculum (Fig. 12c) . . . . *annulatus*
- CD not larger than receptaculum (Fig. 13b, 90f) . . . . *aluco* **sp. nov.**
60 CD very large, broad and flat (CD at least 5x larger than receptaculum, Figs 2h, 5c, 20b) 61
- CD not or not distinctly larger than receptaculum 63
61 CO located anterior to SH, receptacula round . . . . *arcuatus* **sp. nov.**
- CO located posterior to SH, receptacula cross-oval 62
62 MS at most half as long as broad and with notches laterally (Figs 2g, 3i) . . . . *argentatus*
- MS not distinctly broader than long, with continuous lateral margins (Figs 5a–b) . . . . *libelti*
63 Lateral, dark bands on carapace clearly broader than diameter of PME (Fig. 82a, f–g), receptacula remarkably round (Figs 15f, 17e), CD curved medially (Figs 15h,f, 19b) 64
- At least one of the features listed in item 63 different 68
64 CD ca. 4–5x larger than receptaculum . . . . *arcuatus* **sp. nov.**
- CD at most 2x larger than receptaculum 65
65 Anterior margins of LL strongly diverging (Fig. 80a; Attention: anterior margins of LL may be confound with the anterior margins of MS, but the latter are short and pointing more or less anteriad) . . . . *cebu*
- Anterior margins of LL not or hardly diverging 66
66 SH located upon receptacula . . . . *norops* **sp. nov.**
- SH (still) located upon CD 67
67 CO small, pointing anteriorly (Fig. 17d), penetration of E happens frontally . . . . *elachys* **sp. nov.**
- CO elongated (Fig. 15e,i), penetration of E happens laterally . . . . *singaporensis*
68 Lateral bands on carapace quite broad (1.5–2.5x diameter PME) . . . . *cebu*

-	Lateral bands on carapace narrow to medium-sized (at most 1.2x diameter PME)	69
69	MS mushroom-like shaped (Figs 49a, 51a)	70
-	MS differently shaped	71
70	Anterior half of MS more than 2.5x broader than posterior section	*jaegeri* **sp. nov.**
-	Anterior half of MS less than 2.5x broader than posterior section	*vivax* **sp. nov.**
71	Lateral margins of MS anteriorly diverging	72
-	Lateral margins of MS anteriorly converging	73
72	Lateral margins of MS strongly diverging anteriorly (Fig. 30e), CD at most 1.5x longer than receptaculum	*steineri*
-	Lateral margins of MS moderately diverging anteriorly (Figs 29a,e), CD 2.5–3x longer than receptaculum	*khammouan*
73	MS ca. 2x broader than long, its anterior margins running transversally mediad, parallel with anterior margins of LL (Figs 32a, 34a, 88h–i)	74
-	MS and/or anterior margins of LL different	75
74	CD shorter than distance in between both CO	*marsyandi*
-	CD longer than distance in between both CO	*himalayanus*
75	MS more than 2x broader than long	*ancoralis*
-	MS less than 2x broader than long	76
76	Epigyne without EF	77
-	Epigyne with EF	79
77	Initial parts of CD clearly located anterior to spermathecae (Fig. 27f)	*antraeus*
-	Initial parts of CD located posterior to spermathecae or (at most) at the same level	78
78	Helical section of spermatheca high, with more than three windings (Figs 25d, 26d)	*laos* **sp. nov.**
-	Helical section of spermathecae not or just slightly higher than broad, with less than two windings (Fig. 24b)	*rani*
79	Spermathecae high, with at least three helical windings (Figs 25d, 26d)	*laos* **sp. nov.**
-	Spermathecae compact, with at most one helical winding	80
80	Anterior margins of LL constitute strongly sclerotised clasps (Figs 44a, 47a, 88l–m), CD longer than diamter of one spermatheca	81
-	Anterior margins of LL rather inconspicuous, CD shorter than diameter of one spermatheca	82
81	CD ca. two times longer than diameter of one spermatheca (Fig. 47b)	*demiror* **sp. nov.**
-	CD at most 1.5x longer than diameter of one spermatheca (Fig. 44b, 45b)	*luangprabang*
82	SH very flat, hardly protruding out of spermathecae	*inflatus* **sp. nov.**
-	SH regularly spherical, protruding out of spermathecae	83
83	CD extending medially (clearer in frontal view) (Figs 41f,h)	*pakawini* **sp. nov.**
-	CD constitutes one compact structure together with spermathecae (Fig. 37e,g)	*ghecuanus*

argentatus-group

Diagnosis. Males with very long, filiform embolus (E), which is at least 2x as long as tegulum (T). Conductor (C) long (ca. as long as T), narrow, sclerotised and with slightly broadened base (Figs 2a–c), the latter ca. three times broader than median section.

Females with very large, distinctly broad and flat copulatory ducts (Figs 2h, 5c). Spermathecal heads (SH) upon long ‘stalks’, SH including stalks ca. four times longer than broad.

Description. Median bands on carapace slightly serrated (Fig. 82a). Lateral bands broad (ca. 2x diameter of PME) and serrated (Fig. 82a). Sternum yellowish brown at lateral margins and with (dark) brown tapered patch centrally. Light longitudinal line ventrally on opisthosoma mostly continuous, sometimes with one to three gaps and rather narrow or width at most medium sized. If measured centrally on opisthosoma, its width is ca. ½ the width of one half of the cribellum. Dorsal spines on tibia III and IV mostly present, sometimes small and rarely completely absent. Legs longer than in most other species groups: FEM-I+MTT-I/CL: Males: ca. 7; Females: ca. 4. Males with cymbium about three times as long as tegulum, the latter more or less oval. Sperm duct in ventral view (very) broad U-shaped. Cymbium dorsally with very dense scopula (like in *P. kinabalu*, Fig. 83e), covering ca. 2/3 of cymbium. Palpal femur modified with ventral extension. The latter quite pointed (Fig. 2d). Macrosetae ventrally on coxae of leg I (MC-I) and trochanter of leg I (MT-I) present, but only as apical row (like in *P. senoculatus* Yin,Wang & Zhang, 1985, Fig. 82q) and far less developed than in other species-groups, e.g. *himalayanus*-group (Figs 82l,r). In some specimens completely absent. Palpal tibia distally broader than proximally (Figs 2a,c).

Females with long epigynal field (EF), at least 2.5x as long as median septum (MS). Spermathecae located posterio-laterally.

Psechrus argentatus (Doleschall, 1857)

Figs 2a–i, 3a–i, 4a–h, 84a, 87a, 90a

Tegenaria argentata Doleschall 1857: 407 (Description of s.a. ♂ and ♀). [Syntype s.a. ♂ (SB 463) from INDONESIA: Maluku Province: Ambon Island; C. L. Doleschall leg. 1855–1857; 'Eingang: 24.XII.1858, Akquisitions-Nummer: I. 26'; NHMW 12·384, examined]. Doleschall 1859: 49, pl. 8, fig. 9 (Illustration of ♀). Van Hasselt 1877: 52 (Listing of ♀ sub *Tegenaria* with question mark).

Note: All syntypes of *T. argentata* except the s.a. male listed above were formerly deposited in RMNH. Among these former syntypes there must have been at least one adult female, which was examined by Van Hasselt (1877), who noted its poor condition. Maybe the other syntypes were of similar bad condition at that point of time. Levi (1982) noted that the 'holotype' [sic.] of *T. argentata* is lost. According to a personal communication of Jeremy Miller and Karen van Dorp, the current curators of the arachnid collection in RMNH, there are no type specimens of *T. argentata* deposited there. It is possible that they got lost during the confusion of one of the world wars.

Psechrus argentatus — Thorell 1878: 171 (Transfer from *Tegenaria*, description of ♀). Thorell 1881: 207 (Description of ♂). Karsch 1891: 275. Simon 1892: 225, fig. 174 (Description of ♂ and ♀, illustration of ♂). Thorell 1897: 101. Simon 1906: 286. Kulczyński 1908: 562, pl. 23, fig. 30 (Illustration of ♀). Kulczyński 1911: 429. Strand 1911a: 7. Strand 1911b: 131. Berland and Berland 1914: 132. Hogg 1914: 56; 1915: 436. Strand 1915: 191. Sherriffs 1919: 223. Fage 1929: 359. Roewer 1938: 10. Homann 1950: 66. Chrysanthus 1967: 105. Lehtinen 1967: 260, 462, fig. 475 (Illustration of ♂). Robinson and Lubin 1979: 149. Levi 1982: 128, figs 1–6, 62–67 (Description of ♂ and ♀, illustration of ♂ and ♀). Davies and Gallon 1986: 236. Deeleman-Reinhold 2001: 38, fig. 17 (illustration of tarsal tip). Song *et al.* 2002: 373 (Erroneously listed as fauna element of Singapore). Griswold *et al.* 2005: 265, figs 164C–D (SEM-photos of ♀), 268, figs 167A–C (SEM-photos of ♂).

Uloborus flavolineatus Rainbow 1898: 333 (Description of ♀). [Holotype ♀ (SB 942) from PAPUA NEW GUINEA: Central Province: Boirave (at Orangerie Bay), 1500 ft.; A. Giulianetti leg. VII/1896; QM W3504; 3 ♀♀ paratypes (SB 943–945), two of which from same locality as holotype, one (not explicitly labelled) from Milne Bay Province: Rossel Island (Louisiade Group); QM W2505-3507, all type material examined via photos of dorsal habitus of the specimens (from holotype and one paratype photo of copulatory organ in detail), which were kindly provided by Robert Raven (QM), who also confirmed the adult nature of all paratype specimens]. Davies and Gallon 1986: 236 (Syn. proposed by V.T. Davies, formal transfer to *Psechrus*).

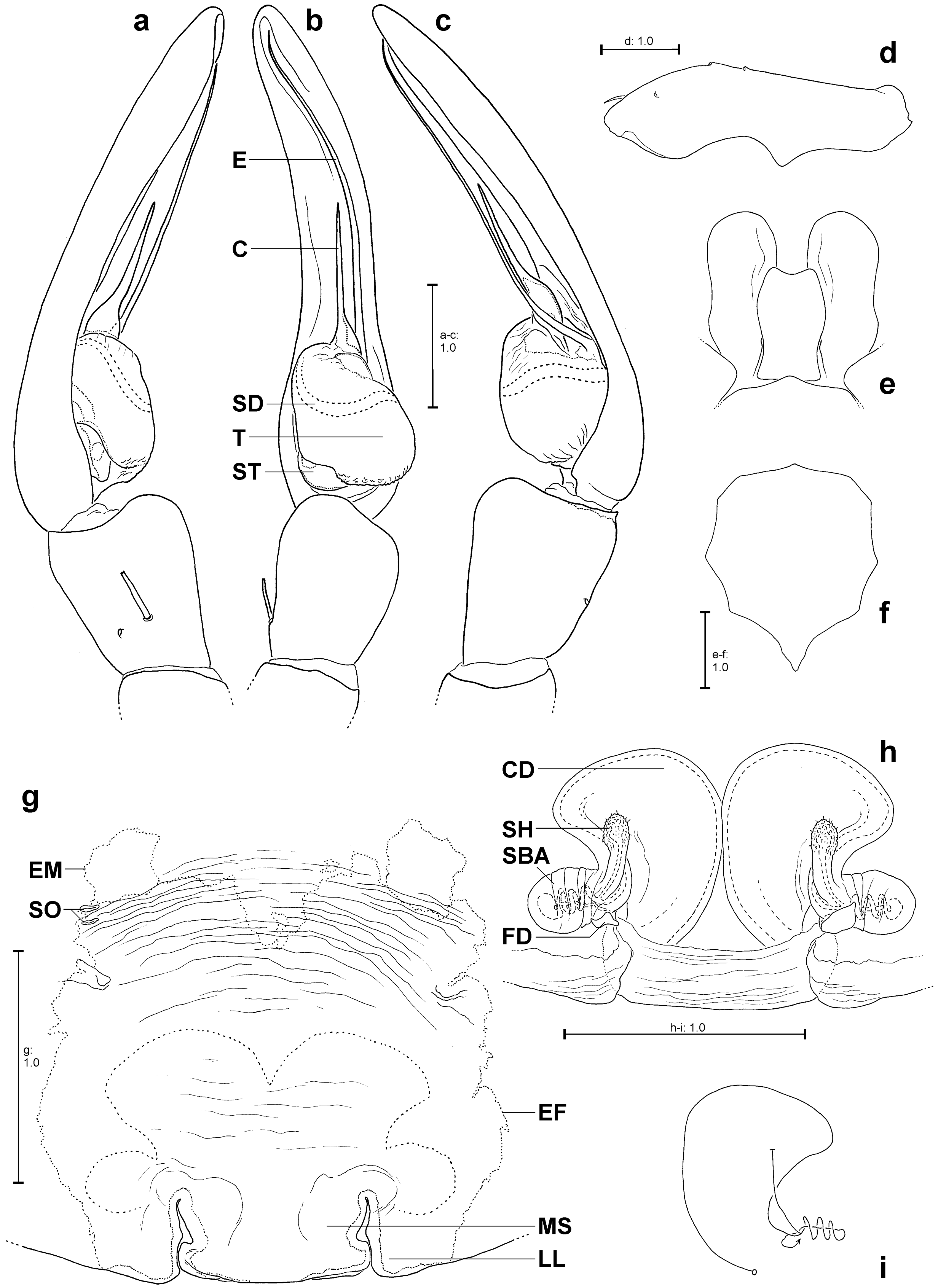
Psechrus castaneus Hogg 1914: 56 (Description of ♀). [Syntypes: 2 ♀♀ (SB 224, 233), 1 ♂ (SB 225), 1 s.a. ♂ (SB 422), 1 juvenile (SB 423), all from INDONESIA: Papua Province (Southern part): Setakwa river; A.F.R. Wollaston leg. 1912–1913 (Wollaston Expedition in Dutch New Guinea); NHM 1921·3·24·5–8, all type material examined]. Hogg 1915: 434, figs 22a–d (Description & illustration of ♀). Fage 1929: 360. Lehtinen 1967: 260 (Syn. with *P. annulatus*, rejected by subsequent authors). Robinson and Lubin 1979: 149. Levi 1982: 128 (Syn.).

Additional material examined (26 ♂♂, 90 ♀♀, 21 s.a. ♂♂, 22 s.a. ♀♀, 3 p.s.a. ♂♂, 18 p.s.a. ♀♀, 59 juveniles**). INDONESIA: Sulawesi: Sulawesi Utara Province:** Mt. Sapoetan (Soputan); C.T. Brues leg. VIII.1937; 1 ♀ (SB 171), MCZ 82507. **Sulawesi Selatan Province:** Banti, Moerang; C.T. Brues & B.B. Brues leg. VIII.1937; 1 juv. (SB 558), MCZ 82509. **Sulawesi** with no further details; 2 ♀♀ (SB 571–572), MNHN AR179. **New Guinea:** Following material 'New Guinea' (?) with no further details (could also be in Papua New Guinea State); 1 ♂ (SB 575), 1 s.a. ♂ (SB 576), MNHN AR182. 1 ♀ (SB 701), 1 ♂ (SB 702), 1 juv. (SB 703), MIZ F·792. 'Roewer Coll.', Roewer det. 1952; 1 ♀ (SB 81), 1 s.a. ♀ (SB 83), 1 p.s.a. ♀ (SB 1119), SMF 10396. Dr. Smend ['Institut für Schiffs- und Tropenkrankheiten'] leg., ded. 11.X.1907; 24 ♀♀ (SB 1079–1093, 1095–1103), 1 s.a. ♀ (SB 1105), 1 p.s.a. ♀ (SB 1104), ZMH. **Papua Barat Province:** Biak Island (near Manokwari); Pers. Kon. Marine; Father Chrysanthus det.; 1 ♂ (SB104), RMNH 8158. Manokwari, Dorey Bay; A. Raffray leg. 1877; E. Simon det.; 2 ♀♀ (SB 12, 573), 1 juv. (SB 574), MNHN AR189. 'Iris-Spitze'; Dr. G. Duncker leg. 14.V.1909; 1 juv. (SB 1074), ZMH. **Papua Province:** Teba; Dr. Moszkowski leg. 26.V.1910; 1 ♂ (SB 804), 1 ♀ (SB 805), 5 juvs (SB 806–810), ZMB. Jayapura, 'Humboldts Bay'; L.E. Cheesman leg. IV.1936; 1 ♂ (SB 259), NHM 1937·12·13·485. 'Humboldts Bay'; G. Pijterka leg.; 1 s.a. ♂ (SB 717), MIZ. 'Humboldts Bay'; L.F. de Beaufort & H.A. Lorentz leg. III.–17.V.1903; W. Kulczyński det.; Coll. Kulczyński; 1 ♀ (SB 672), 3 juvs (SB 673–675), MIZ 46/51U. Genyem (Hollandia); Van der Hammen leg. 13.I.1954; 1 ♀ (SB 106), RMNH 7213. Bawe; L.F. de Beaufort & H.A. Lorentz leg. 04.III.1903; Coll. Kulczyński; 1 ♂ (SB 713), MIZ 46/51U. Orum; L.F. de Beaufort & H.A. Lorentz leg. 21.–23.VII.1903; W. Kulczyński det.; Coll. Kulczyński; 1 ♀ (SB 676), MIZ 46/51U. Wendesi; L.F. de Beaufort & H.A. Lorentz leg. 29.–30.VII.1903; W. Kulczyński det.; Coll. Kulczyński; 1 s.a. ♀ (SB 677), MIZ 46/51U. Moaif; L.F. de Beaufort & H.A. Lorentz leg. 26.VI.–04.VII.1903; W. Kulczyński det.; Coll. Kulczyński; 1 s.a.♂ (SB 678), MIZ 46/51U. Jendei (Ins. Row); 03.III.1903; 1 ♂ (SB 684), 2 ♀♀ (SB 682, 714), 1 s.a. ♀ (SB 683), 2 s.a. ♂♂ (SB 685–686), 3 juvs (SB 687, 715–716), MIZ F·673, MIZ F·793. Malu, „Hauptlager"; Dr. Bürgers leg. 20.I.1913; 1

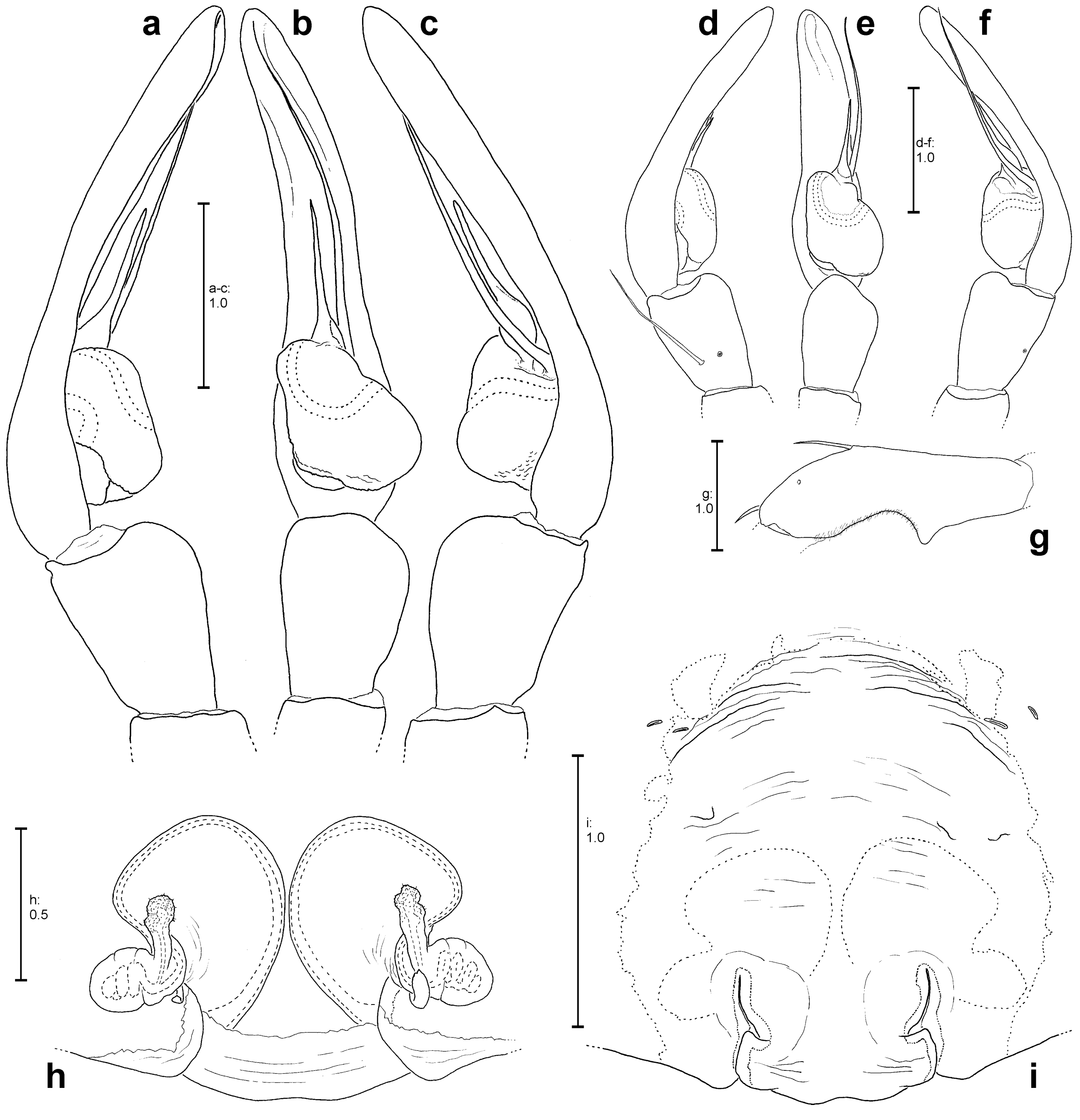
s.a. ♂ (SB 802), ZMB. Mt. Nomo (Northern part of Papua Prov.), 600 ft.; L.E. Cheesman leg. II.1936; 1 ♀ (SB 262), NHM 1937·12·13·182. Takam; Hifob leg. 10.IX.1959; Father Chrysanthus det.; 1 ♀ (SB 103), RMNH 8160. Eastern part of Papua Prov.; Dr. P. Wirz leg. 1923; E. Reimoser det.; 1 p.s.a. ♂ (SB 415), 1 juv. (SB 416), ZMA. Mindiptana; Br. Monulf leg. 1958; Father Chrysanthus det.; 1 ♀ (SB 105), 1 s.a. ♀ (SB570), 3 s.a. ♂♂ (SB 567–569), 2 juvs (SB 565–566), RMNH 8157. **Nusa Tenggara Timur Province:** Flores Island, East of Labuan Bajo, Tobedo, S 08°33'60", E 120°00'02", ca. 400 m, rainforest; S. Huber leg. 24.III.2009; 1 ♀ (SB 138), SMF. Flores Island, Road to Mt. Kilimoto; C.L. Deeleman & J.C. van Kempen leg. 16.VIII.1992; 1 ♀ (SB 114), 1 ♂ (SB 115), 1 p.s.a. ♀ (SB 564), Deeleman Coll. in RMNH. Sumba island; 1 ♀ (SB 258), NHM 1897·5·12·16. **Maluku Province:** Ambon island (‘Amboina’), [du Mus. Gen.]; Prof. Cel. O. Beccari leg. 1872–1877; T. Thorell det. 1877; 7 ♀♀ (SB 594–595, 597–601), 2 ♂♂ (SB 596, 602), 2 s.a. ♀♀ (SB 592–593), 2 s.a. ♂♂ (SB 590–591), 3 p.s.a. ♀♀ (SB 587–589), 2 p.s.a. ♂♂ (SB 585–586), 8 juvs (SB 577–584), MNHN AR192-1–2. Ambon, F.C. Muir leg. before 1908; 1 s.a. ♀ (SB 557), MCZ 82517. Ambon, “Gazelle”; 3 juvs (SB 789–791), ZMB. Pulau Kai-besar (Kai Islands), ‘Groß-Kei’, Elat; H. Merten leg. 11.IV.1908; 2 ♀♀ (SB 78, 1136), SMF 3129. H. Merten leg. 02.VI.1908; 4 juvs (SB 1137–1140), SMF 3124. H. Merten leg. 1914; 1 ♀ (SB 608), 1 p.s.a. ♀ (SB 609), 1 juv. (SB 610), NHMB 631b. Between Elat & Ohilim; H. Merten leg. 08.II.1908; 1 p.s.a. ♀ (SB 1135), 1 juv. (SB 1134), SMF 3125. ‘Kai Islands’, near Erlalaan; H. Merten leg. VI.1908; 1 ♀ (SB 77), 1 juv. (SB 1133), SMF 3131&3126. Aru Islands, Penambulei; H. Merten leg. 01.IV.1908; 1 ♀ (SB 1122), 1 s.a. ♂ (SB 1123), SMF 3130. Aru Islands, Maikoor & Batoe Bandera; H. Merten leg. 09.IV.1908; 9 juvs (SB 1124–1132), SMF 3127. **PAPUA NEW GUINEA: New Ireland Province:** Lemkamin, 900 m, in tree hole, “Noona Dan Exp.” 1961–62; leg. 18.IV.1962; Father Chrysanthus det.; 1 ♂ (SB 1117), 1 p.s.a. ♀ (1118), ZMUC4553. **East Sepik Province:** Sepik river (‘Kaiserin Augusta-Fluß’), ‘Lager 1’; Dr. J.G. Bürgers leg. 16.IV.1912; 2 ♂♂ (SB 1107–1108), 3 ♀♀ (SB 1106, 1109, 1114), 3 p.s.a. ♀♀ (SB 1110–1112), 1 juv. (SB 1113), ZMB. April river; Dr. J.G. Bürgers leg. 16–19.XII.1912; 1 ♂ (SB 803), ZMB. **Madang Province:** Madang (Friedrich-Wilhelm-Hafen); Biro leg. 1896; 1 ♀ (SB 654), 2 juvs (SB 655–656), MIZ. ‘Friedrich-Wilhelm-Hafen’; U. Schowe leg.; 1 ♀ (SB 811), 2 juvs (SB 812–813), ZMB 34963. Erima; 1 ♂ (SB 700), 4 ♀♀ (SB 663, 689–691), 1 s.a. ♂ (SB 688), 12 juvs (SB 664–667, 692–699), MIZ. Stephansort; 1900; W. Kulczyński det., Coll. Kulczyński; 1 ♂ (SB 719), MIZ. Ramu river; K. Lauterbach was header of “Ramu-Expedition” 1896–1899; 1 ♀ (SB 1115), ZMB. **Morobe Province:** Sakar Island; Dr. G. Duncker leg. 05.V.1909; 1 s.a. ♂ (SB 1078), ZMH. Huon Peninsula, Mongi Watershed, 1250–1300 m; E.O. Wilson leg. 11.–13.IV.1955; Father Chrysanthus det.; 1 ♀ (SB 542), MCZ 82513. Finschhafen (Sattelberg); 20.–30.IX.1898; W. Kulczyński det.; 2 ♀ (SB 679, 718), 1 s.a. ♀ (SB 681), 1 s.a. ♂ (SB 680), MIZ F·700, MIZ F·261. Lae Botanical Gardens; J.E. Carico leg. 02.–03.VII.1982; 2 ♀♀ (SB551–552), 1 ♂ (SB 555), 1 s.a. ♂ (SB 556), 2 p.s.a. ♀♀ (SB 553–554), MCZ 82512. Wau, Wau Ecological Institute; E.I. Schlinger leg. 17.II.1978; 1 juv. (SB 976), CAS 9032235. H. Levi, Y. Lubin & M. Robinson leg. III.1979; 1 ♀ (SB 547), 1 s.a. ♀ (SB 548), MCZ 82504. J.E. Carico leg. 22.–29.VI.1982; 3 ♀♀ (SB 174–176), 2 s.a. ♂♂ (SB 545–546), 2 juvs (SB 543–544), MCZ 82503. 30.VI.1982; 2 ♂♂ (SB 169–170), MCZ 82502. Wau, Mt. Kaindi Rd.; H. Levi, Y. Lubin & M. Robinson leg. 03.III.1979; 1 ♂ (SB 549), 1 s.a. ♂ (SB 550), MCZ 82505. Mt. Kaindi, summit; J.E. Carico leg. 28.VI.1982; 1 ♂ (SB 173), MCZ 82511. **Central Province:** near Port Moresby, Waigani; D.L.F. de Beaufore leg. 04.I.1910; 3 ♂♂ (SB 657, 709–710), 2 ♀♀ (SB 704–705), 1 s.a. ♀ (SB 658), 1 p.s.a. ♀ (SB 659), 2 juvs (SB 660, 703), MIZ 7·371, MIZ F·661. **New Britain:** No further details; A.S. Wiley leg. 1897; 1 ♀ (SB 257), NHM 1898·12·5·45. **West New Britain Province:** ‘Bismark-Archipel’; Heinroth leg. III.1887; 2 ♀♀ (SB 815–816), ZMB 34958. **East New Britain Province:** Rabaul; E. Wolf leg. 1909; 1 ♀ (SB 1121), SMF 2790. ‘Hanam-Hafen’ (North coast); Dr. G. Duncker leg. 29.XI.1908; 1 s.a. ♂ (SB 1077), ZMH. ‘Möve-Hafen’ (South coast), near waterfall; Dr. G. Duncker leg. 20.II.–14.VII.1909; 2 ♂♂ (SB 1061–1062), 8 ♀♀ (SB 1053–1055, 1067–1071), 2 s.a. ♂♂ (SB 1059–1060), 11 s.a. ♀♀ (SB 1046–1052, 1063–1066), 1 p.s.a. ♀ (SB 1056), 7 juvs (SB 1041–1045, 1057–1058), ZMH. ‘Putie-Bucht’; Dr. G. Duncker leg. 13.–14.XII.1908; 2 juvs (SB 1072, 1075), ZMH. Vaisisi, “Noona Dan Exp.” 1961–62; leg. 09.VII.1962; 1 ♀ (SB 1116), ZMUC 5724. Ralum, Lowon; F. Dahl leg. 26.V.1896; 1 ♀ (SB 814), 1 p.s.a. ♀ (SB 788), ZMB 34959. ‘Vorangoi’ (South-East coast); Dr. G. Duncker leg. 28.–30.XII.1908; 1 p.s.a. ♀ (SB 1076), ZMH.

Doubtful material examined. PAPUA NEW GUINEA: New Ireland Province: Lihir Island; E. Wolf leg. 1909; 1 juv. (SB 1120), SMF 2791.

Revised diagnosis. Males and females similar to *P. libelti* Kulczyński, 1908 (see diagnostic character states described for *argentatus*-group above). Males with conductor (C) less than half as long as embolus (E) (Figs 2b,c).



FIGURES 2a–i. *Psechrus argentatus* from Indonesia. a–d ♂ SB 602 from Ambon. e–f ♀ SB 676 from Irian Jaya Tengah Prov. g–i ♀ SB 598 from Ambon. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ right palpal femur, retrolateral view. e Labium and gnathocoxae, ventral view. f Sternum, ventral view. g Epigyne, ventral view. h Vulva, dorsal view. i Schematic course of internal duct system. C: Conductor; CD: Copulatory duct; E: Embolus; EF: Epigynal field. EM: Epigynal muscle silliga; FD: Fertilisation duct; LL: Lateral lobe; MS: Median septum; SBA: Spermathecal base; SD: Sperm duct; SH: Spermathecal head; SO: Slit sense organ; ST: Subtegulum; T: Tegulum.



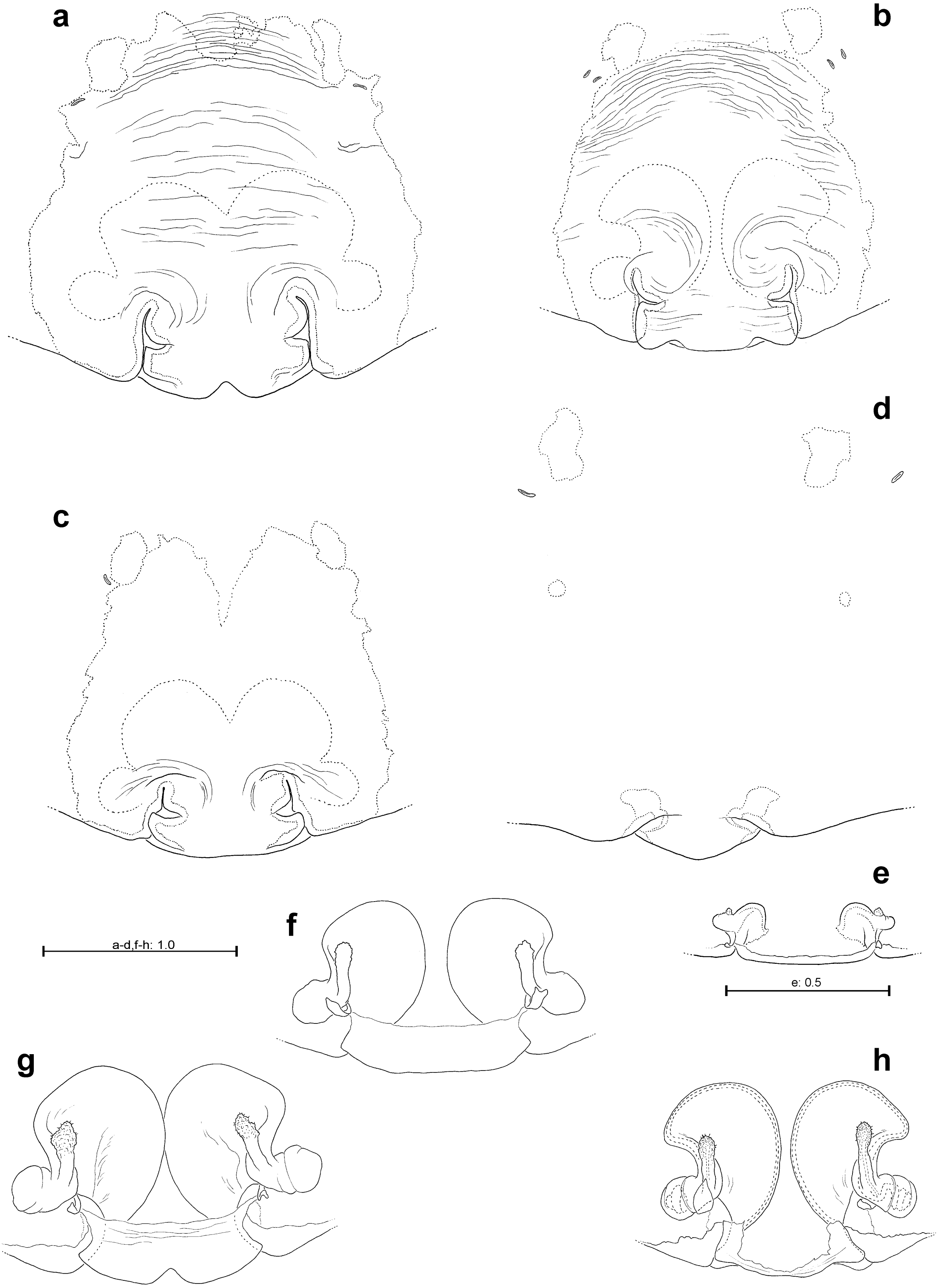
FIGURES 3a–i. *Psechrus argentatus* from Indonesia, Papua Prov. a–c, g ♂ SB 225, h–i ♀ SB 224 (both syntypes of *P. castaneus*). d–f ♂ SB 259. a–c, d–f ♂ palp (a, d prolateral, b, e ventral, c, f retrolateral view). g ♂ left palpal femur, retrolateral view. i Epigyne, ventral view. h Vulva, dorsal view.

Females with median septum (MS) at most half as long as broad and with notches laterally (Fig. 2g). Epigynal field (EF) more than three times longer than MS.

Description. Male:

Body and eye measurements. Carapace length 5.3–9.4, carapace width 3.8–6.7, anterior width of carapace 1.9–3.3, opisthosoma length 8.2–14.0, opisthosoma width 2.0–3.8. Eyes: AME 0.34–0.52, ALE 0.39–0.56, PME 0.40–0.53, PLE 0.41–0.54, AME–AME 0.15–0.28, AME–ALE 0.09–0.12, PME–PME 0.21–0.37, PME–PLE 0.32–0.51, AME–PME 0.38–0.60, ALE–PLE 0.36–0.73, clypeus height at AME 0.63–1.12, clypeus height at ALE 0.50–0.91.

Cheliceral furrow with three promarginal and four to five retromarginal teeth.



FIGURES 4a–h. *Psechrus argentatus*, ♀ primordial and adult copulatory organ. a, g ♀ SB 174 from Papua New Guinea, Morobe Prov. b, h ♀ SB 257 from Papua New Guinea, New Britain. d–e s.a. ♀ SB 593 from Indonesia, Ambon. c ♀ SB 171, f ♀ SB 571 both from Indonesia, Sulawesi. a–c Epigyne, ventral view. f–h Vulva, dorsal view. d Pre-epigyne, ventral view. e Pre-vulva, dorsal view.

Measurements of palp and legs. Leg formula: mostly 1423 (rarely 1243). Palp 7.1–11.6 [2.4–4.0, 1.0–1.7, 1.0–1.3, 2.7–4.6] , I 70.9–90.2 [19.2–24.1, 2.7–4.5, 19.5–25.1, 21.4–26.8, 8.1–9.7], II 51.4–69.7 [14.4–19.8, 2.3–3.8, 13.0–17.7, 15.4–20.1, 6.3–8.3], III 33.1–52.1 [9.8–14.6, 1.7–2.7, 8.2–13.6, 9.3–14.8, 4.1–6.4], IV 53.0–70.3 [14.7–20.0, 2.1–3.6, 13.0–17.7, 16.3–20.5, 6.9–8.5].

Spination. Palp: 131 (rarely 141), 110, 1101; legs (—except for patella— variable, only most common states noted): femur I 767, II 767 (766) III 756, IV 766 (755); patella I–IV 000; tibia I–II 3038 (4038), III 3136 (3134), IV 3138 (3137); metatarsus I–II 3037, III 3035 (3036), IV 3035 (3036). MC-I–II and MT-I in one specimen (SB 259) completely absent.

Palpal femur modified with ventral extension. The latter rather pointed, but sometimes less distinct as in *P. libelti* (Fig. 6e), some specimens with a rather blunt tip (Fig. 2d).

Copulatory organ. As in diagnosis and general description for *argentatus*-group.

Female:

Body and eye measurements. Carapace length 5.7–10.7, carapace width 4.1–7.7, anterior width of carapace 2.4–4.5, opisthosoma length 10.0–17.8, opisthosoma width 3.6–7.1. Eyes: AME 0.35–0.56, ALE 0.37–0.63, PME 0.39–0.58, PLE 0.38–0.60, AME–AME 0.20–0.42, AME–ALE 0.09–0.15, PME–PME 0.24–0.44, PME–PLE 0.33–0.58, AME–PME 0.47–0.72, ALE–PLE 0.43–0.82, clypeus height at AME 0.76–1.34, clypeus height at ALE 0.64–1.25.

Cheliceral furrow with three promarginal and four to five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.3–12.5 [2.5–4.2, 1.0–1.9, 1.3–2.3, 2.5–4.1]; Legs: I 47.2–72.3 [13.4–20.5, 2.5–4.9, 13.1–19.8, 12.5–20.0, 5.7–7.1], II 35.0–55.1 [10.4–16.2, 2.0–4.3, 9.2–14.1, 9.4–14.8, 4.0–5.7], III 24.5–38.8 [7.7–12.3, 1.6–3.2, 5.9–9.4, 6.3–10.1, 3.0–3.8], IV 36.4–56.4 [10.8–16.7, 2.0–4.0, 9.5–14.0, 9.6–15.6, 4.5–6.1].

Palpal claw with 13–16 teeth.

Spination. Palp: 131 (rarely 141), 110, 1101, 1014; legs (—except for patella— variable, only most common states noted): femur I 767 (877), II 667 (665) III 656, IV 655 (755); patella I–IV 000; tibia I 3038 (4038), II 3038, III 3136 (3134), IV 3134; metatarsus I–II 3037, III 3037 (3035), IV 3036 (3034,3035).

Copulatory organ (see also diagnosis and general description of *argentatus*-group). Slit sense organs and epigynal muscle sigilla mostly within EF or associated with EF, respectively.

Primordial copulatory organ. Pre-epigyne: Short pre-MS (Fig. 4d), pre-EF separated in two parts.

Pre-vulva: Pre-copulatory ducts already distinctly large, larger than pre-spermathecae (Fig. 4e). Pre-spermathecal heads (SH) still without stalks.

Colouration of male and female. See description for *argentatus*-group and *Psechrus*.

Variation of copulatory organs. Male pedipalp with little variation. In some specimens embolus and conductor in relation to tegulum somewhat shorter (Figs 3d–f) or subtegulum in ventral view more clearly visible than in others (Figs 2a–c cf. Figs 3a–c). Female copulatory organ more variable. MS in rare cases with broad posterior notch (Fig. 4a). Shape of lateral notches of MS differs (Figs 2g, 3i, 4a–c). Anterior boundary of EF variable (Figs 4b cf. 4c). Direction of spermathecal base (SBA) and SH differing slightly (Figs 2h, 3h, 4f–h), the same with the size of copulatory ducts (CD) (Figs 4f cf. 4h).

Distribution. Indonesia [Sulawesi, Flores, Moluccas, Aru Islands, West-Papua], Papua New Guinea (incl. New Britain and New Ireland), Australia (Northern part of Queensland; see Platnick 2011) (Figs 100–101).

Remarks. Deeleman-Reinhold (2001: p. 38, fig. 17) illustrated the tip of a tarsus of one of the legs of *P. argentatus*. The shape of the superior claws is well depicted (though the size of the superior claws and the claw tufts in relation to the width of the tarsus is a bit too small), but not so for the inferior claw (middle-hook), which appears longer, less curved than naturally, and the additional, proximal tooth (see Levi 1982, fig. 6) is not depicted. Basally at the tip of the tarsus she also depicts modified setae beneath the middle-hook, which are not serrated in *Psechrus*. In my opinion, the gap between the middle-hook and those setae was a bit too large in her illustration. However, this is a helpful illustration to understand one of the diagnostic characters for Psechridae, the three tarsal claws plus claw tufts. Generally, in all *Psechrus* species the tarsus tip looks like in *P. argentatus*. Griswold *et al.* (2005: p. 240, fig.139c) provided a SEM photo of the tarsal tip of *P. argentatus* from orthogonal view.

Psechrus libelti Kulczyński, 1908, stat. nov.

Figs 5a–e, 6a–e, 82a, 84b–c, 87b, 90b

Psechrus libeltii Kulczyński 1908: 561, pl. 23, fig. 31 (Description and illustration of ♀). [Syntypes: 2 ♀♀ (light one SB 337, dark one SB 338), 2 s.a. ♂♂ (the one just before final moult SB 339, other one SB 340), all from INDONESIA: Sumatra, Sumatera Selatan Province: Palembang; Dr. S. Libelt leg. before 1908; 46/51U; MIZ, all type material examined]. Berland and Berland 1914: 133. Hogg 1914: 56; 1915: 436. Fage 1929: 360. Reimoser 1929: 132. Lehtinen 1967: 261. Levi 1982: 125 (Syn. with *P. singaporensis*, rejected).

Psechrus argentatus — Simon 1901: 47, misidentified.

Psechrus libelti — Bonnet 1958: 3804 (Emendation). Platnick 1989: 428.

Psechrus singaporensis — Levi 1982: 125, figs 40–53, ad part, figs 42–43, 48–53 misidentified (figs 48–51: illustration of ♀♀). Jocque and Dippenaar-Schoeman 2006: 219, figs 86a–f (Illustration of ♂ and ♀, misidentified).

Additional material examined (2 ♂♂, 8 ♀♀)**. THAILAND: Phuket Province:** Phuket, Ton Sai waterfall, N 8°01', E 98°25', forest; M. Andersen, O. Martin & N. Scharff leg. 12.X.1991; 1 ♀ (SB 611), ZMUC 4537. **Songkhla Province:** Hat Yai, Khao Khor Hong, small mountainous area behind Prince of Song Khla University campus, ca. N 7°00'30", E 100°30'40", ca. 140 m; B. Phongsee leg. 15.IX.2005; 1 ♂ (SB203, deformed, presumably died immediately after final moult), SMF. **MALAYSIA: Pahang Province:** No further details; Coll. Sherriffs; Tilg. 27-9-1962; 1 ♀ (SB 1004), ZMUC 5726. **Selangor Province:** Templer's Park, secondary forest, under roof of hut; C.L. Deeleman leg. 03.XII.1990; 1 ♀ (SB130), Deeleman Coll. in RMNH. **Borneo: Sabah Province:** Danum Valley (ca. 70 km W of Lahad Datu), ca. N 5°02', S 117°45', primary lowland rainforest; [observation no. 905]; P. Koomen leg. 13.IV.2003; 1 ♀ (SB 1141, checked via photos of dorsal and ventral habitus and epigyne kindly provided by Peter Koomen), [Photos were made in the field, specimen was released afterwards]. **INDONESIA: Sumatra:** 'Kouan Dam'; Burbon leg. 1913–1916; 1 ♀ (SB 330), MNHN AR20193. **Nanggroe Aceh Darussalam Province:** Gunung Leuser National Park, in tunnel next to cacao plantation; P.R. & C.L. Deeleman leg. 03.I.1984; 1 ♀ (SB 109), Deeleman Coll. in RMNH. **Sumatera Barat Province:** Mentawei Islands, Sipora; Coll. Roewer; C.F. Roewer det.; 1 ♀ (SB 87), SMF 2565. **BRUNEI DARUSSALAM: Tutong District:** Tasek Merimbum Heritage Park, area C1, 45 km W of Bandar Seri Bagawan, N 4°35'39", E 114°40'25", 30 m, secondary peat forest; C. Griswold & J.K.H. Koh leg. 13.–14.X.2009, at night; TM 002; 1 ♀ (SB 969), CAS 9036347.

Doubtful locality: INDIA? [sic; Remark: If really India, then **Nicobar Islands**; Up to now representatives of *argentatus*-group have never been recorded in (continental-) India or on Sri Lanka]; Hassan leg.; 1 ♂ (SB 612), ZMUC 5720.

Doubtful material examined. MALAYSIA: Borneo: Sarawak Province: Gunung Pueh (Mt. Poi); E. Mjöberg leg. 1920–1925; 1 juv. (SB 1160), AMNH. **PHILIPPINES: Palawan Province:** Balabac Island; Dalawan Bay; 'Noona Dan Expedition 61–62', leg. 09.X.1961; 1 ♂ (SB 1006), ZMUC 5723.

Revised diagnosis. Males and females similar to *P. argentatus* (Doleschall, 1857) (see diagnostic character states described for *argentatus*-group above). Males with conductor (C) more than half as long as embolus (E) (Figs 6b–d). Females with median septum (MS) almost as long as broad and with continuous lateral margins (Figs 5a–b). Epigynal field (EF) less than three times longer than MS.

Description. Male:

Body and eye measurements. Carapace length 4.8–6.9, carapace width 3.5–5.2, anterior width of carapace 2.2–3.5, opisthosoma length 5.7–10.2, opisthosoma width 1.7–3.3. Eyes: AME 0.31–0.47, ALE 0.33–0.45, PME 0.33–0.45, PLE 0.32–0.45, AME–AME 0.17–0.24, AME–ALE 0.06–0.14, PME–PME 0.19–0.27, PME–PLE 0.27–0.31, AME–PME 0.44–0.46, ALE–PLE 0.41–0.43, clypeus height at AME 0.84–0.86, clypeus height at ALE 0.68–0.77.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423 or 1243. Palp 8.2–9.0 [2.7–3.0, 1.1–1.3, 1.1–1.2, 3.3–3.5] , I 68.0–81.0 [17.8–20.9, 2.7–3.3, 18.0–21.3, 20.7–25.4, 8.8–10.1], II 46.9–56.7 [11.9–15.6, 2.4–2.9, 12.1–14.3, 13.8–16.9, 6.7–7.0], III 29.9–36.1 [8.5–10.4, 1.7–2.1, 7.3–8.8, 8.5–10.3, 3.9–4.5], IV 47.5–55.5 [12.0–13.7, 2.0–2.6, 12.0–13.9, 14.4–17.2, 7.1–8.1].

Spination. Palp: 131 (141), 110, 1101; legs: femur I 667 (878), II 767 (766) III 545 (656), IV 655 (665); patella I–IV 000; tibia I–II 3036 (3038), III 3134 (3136), IV 3036 (3136); metatarsus I 3037 (3035), II–III 3035, IV 3034. Palpal femur modified with ventral extension. The latter rather pointed (Fig. 6e).

Copulatory organ. As in diagnosis and general description for *argentatus*-group.

Female:

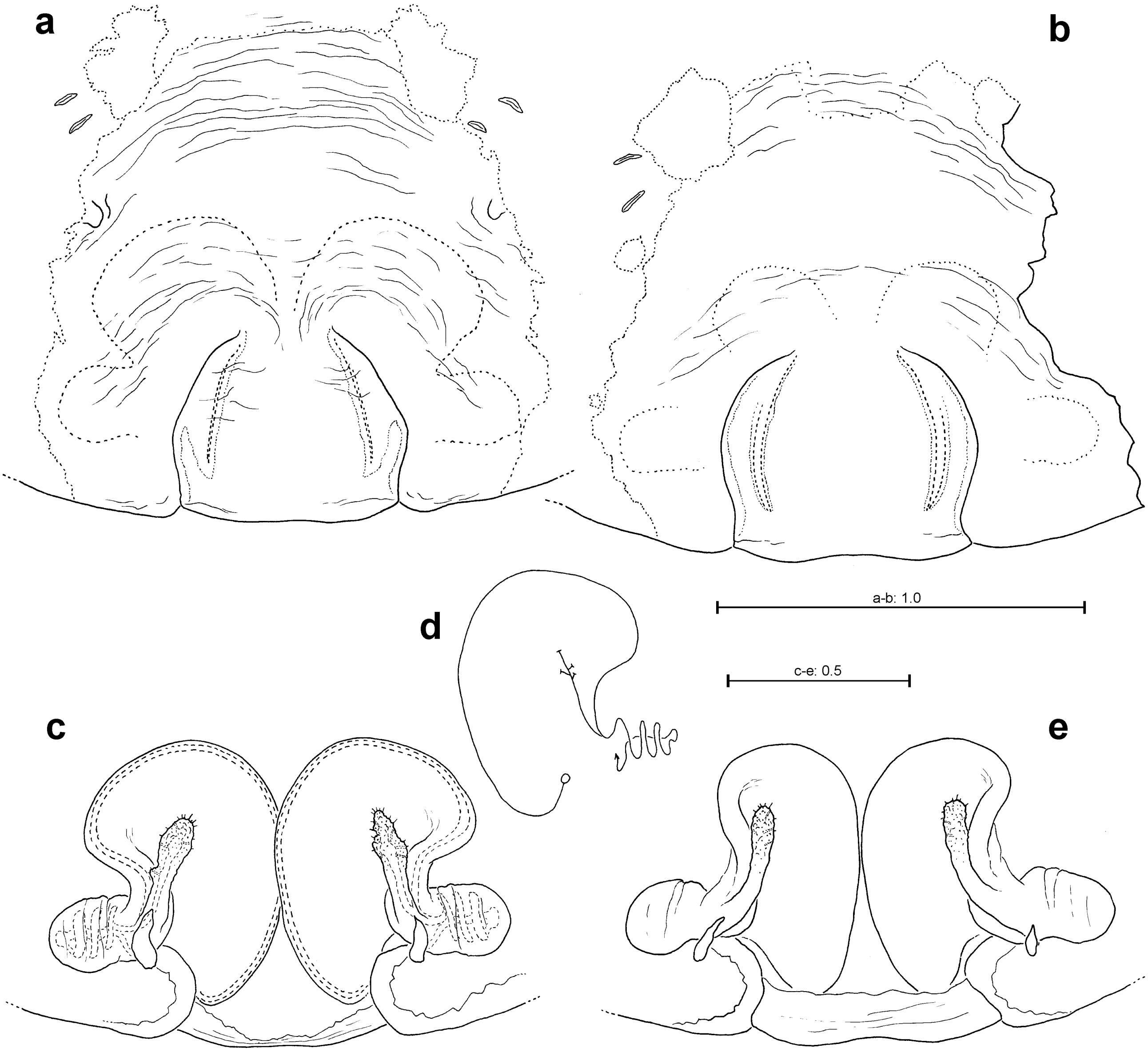
Body and eye measurements. Carapace length 6.3–9.2, carapace width 4.1–6.5, anterior width of carapace 2.3–3.9, opisthosoma length 8.1–15.9, opisthosoma width 3.5–7.7. Eyes: AME 0.41–0.46, ALE 0.41–0.50, PME 0.43–0.50, PLE 0.42–0.50, AME–AME 0.27–0.37, AME–ALE 0.07–0.14, PME–PME 0.32–0.37, PME–PLE 0.30–0.52, AME–PME 0.46–0.71, ALE–PLE 0.47–0.71, clypeus height at AME 0.94–1.78, clypeus height at ALE 0.78–1.49.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 8.1–11.0 [2.8–3.9, 1.1–1.5, 1.5–2.0, 2.7–3.6]; Legs: I 54.5–69.6 [14.5–18.9, 2.9–4.1, 15.2–19.6, 15.2–19.5, 6.7–7.5], II 38.2–49.5 [10.8–14.4, 2.6–3.5, 10.3–12.8, 10.4–13.4, 4.1–5.4], III 25.8–34.2 [7.4–10.3, 1.8–2.7, 6.4–8.5, 7.0–8.8, 3.2–3.9], IV 39.1–52.2 [11.2–15.0, 2.3–3.2, 10.3–13.6, 10.8–14.2, 4.5–6.2].

Palpal claw with 12–14 teeth.

Spination. Palp: 141 (rarely 131), 110, 1101, 1014; legs (—except for patella— variable, only most common states noted): femur I 768 (667), II 767 (777) III 656 (756), IV 765 (856); patella I–IV 000; tibia I–II 3036, III 3134 (3136,3035), IV 3034 (3134); metatarsus I 3035, II 3035 (3037), III 3035, IV 3034 (3035).



FIGURES 5a–e. *Psechrus libelti*, ♀ syntypes from Indonesia, Sumatera Selatan Prov. a, c–d ♀ SB 338. b, e ♀ SB 337. a–b Epigyne, ventral view. c, e Vulva, dorsal view. d Schematic course of internal duct system.

Copulatory organ (see also diagnosis and general description of *argentatus*-group). Lateral margins of MS converging anteriorly (Figs 5a–b, 87b). Slit sense organs (SO) may be within or outside EF, epigynal muscle sigilla generally associated with EF.

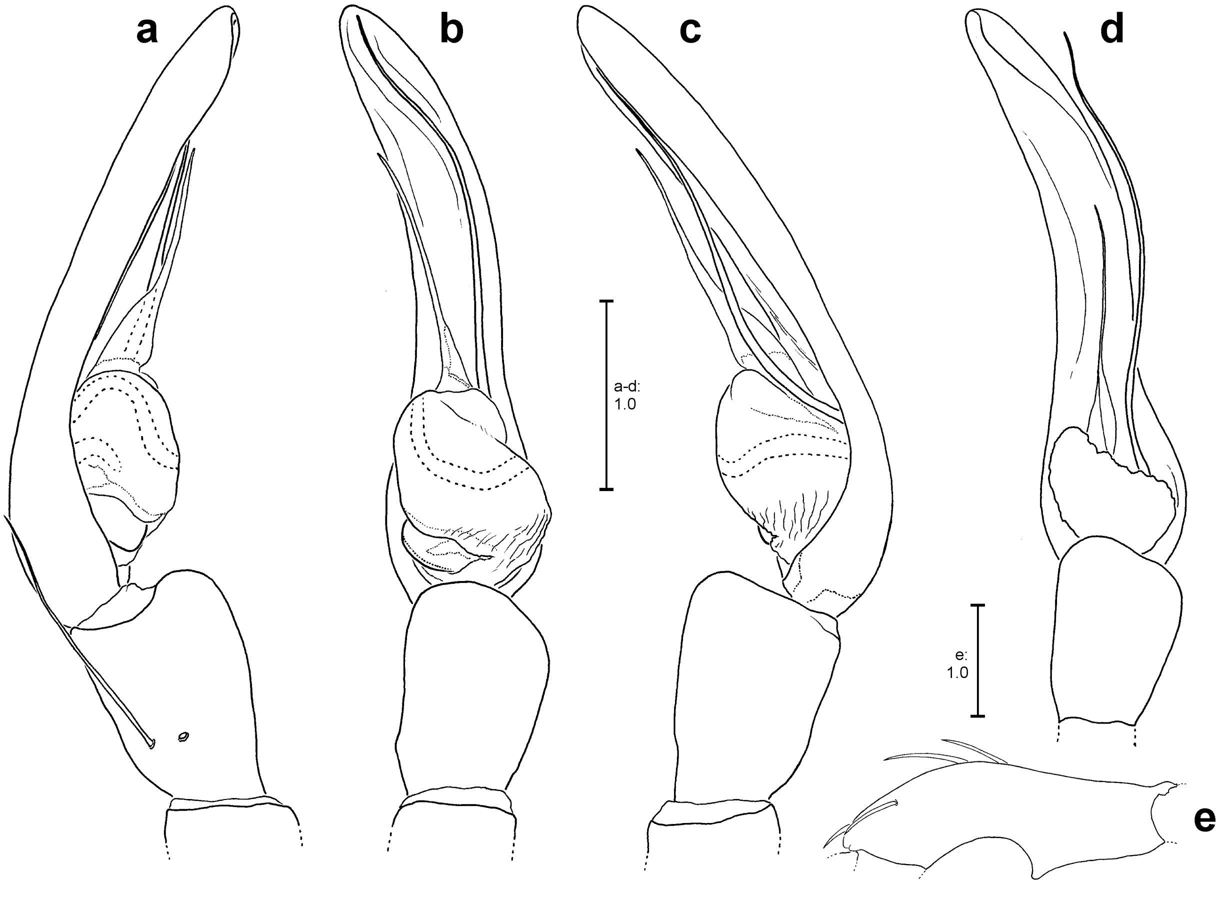
Colouration of male and female. See description for *argentatus*-group and *Psechrus*.

Variation of copulatory organs. Males: No statement possible, because only two individuals have been examined. One of which with deformed tegulum (T). In females the shape of MS varies. In some specimens the lateral margins are slightly more curved (Fig. 5b). Further, in some specimens the spermathecae and the lateral parts of CD are shifted somewhat in dorsal direction (Fig. 5e). Directions of SH may differ slightly (Figs 5c,e, 90b).

Remarks: The two adult males (SB 203, SB 612) examined herein were assigned to *P. libelti* because their palps show the same diagnostic character states as the subadult male syntype SB 339. This latter specimen must have been collected just a few hours before adult moult. The bulb structures, including the long C, are visible through the cuticle (Fig. 84b).

This species is removed from synonymy with *P. singaporensis* Thorell, 1894 because it shows clear differences in copulatory organs, which indicate that it does not even belong to the same species-group (*singaporensis*-), but to the *argentatus*-group. Levi (1982) synonymised this species with *P. singaporensis*, possibly based his decision on cursory similarities of MS of both species. He in fact illustrated the clear differences in vulvae (figs 44, 46 cf. figs 48, 50), but misinterpreted them. He probably had overseen the bulb structures of the s.a. male syntype (SB 339) visible through the cuticle, which additionally indicate that this species is more closely related to *P. argentatus* than to *P. singaporensis*. In the paragraph of his note concerning the synonymy he states that his decision “may be wrong” and that the females in his figs 48–51 “possibly belong to *P. argentatus*” (Levi 1982).

The male from Balabac, Philippines (SB 1006, details see above) has a distinctly shorter cymbium (in relation to T) than the other males (and the males of *argentatus* examined herein). Its C is only slightly more than half as long as E. As long as there are no females available from that island, the identification of this specimen remains doubtful.



FIGURES 6a–e. *Psechrus libelti*, ♂ palp and palpal femur. a–c, e ♂ SB 612 from India?, Nicobar Islands? d ♂ SB 203 from Thailand, Songkhla Prov. a–d ♂ palp (a prolateral, b, d ventral, c retrolateral view). e ♂ left palpal femur, retrolateral view. Remark: In Fig. 6d tegulum deformed (specimen presumably died directly after final moult).

Distribution. Thailand [Southern part], Malaysia, Indonesia [Sumatra], Brunei Darussalam (Figs 99–100).

mulu-group

Diagnosis. Males similar to those of the *argentatus*-group in having a somewhat pointed extension ventrally on palpal femur. They are distinguished by the complete reduction of conductor (C). The embolus (E) is quite short (at most ½ the width of tegulum [T]), rather broad and strongly sclerotised (Figs 7b, 10b, 84d–f).

Females with a very rigid and strongly sclerotised epigyne and epigynal field; the latter dark red-brown (Figs 87c–d).

Description. Median bands on carapace may be serrated or only slightly serrated. Width of lateral bands > diameter of PME, but at most 1.5x and not or only slightly serrated. Sternum yellowish brown at lateral margins and with light brown tapered patch centrally. Light longitudinal line ventrally on opisthosoma mostly continuous and narrow, in some specimens with one to three gaps in distal half. If measured centrally on opisthosoma, its width is less than ½ the width of one half of the cribellum. Dorsal spines on tibia III and IV present, in some specimens small. Legs longer than in most other species groups: FEM-I+MTT-I/CL: Males: ca. 7; Females: ca. 4.

Males with relatively long T, about two times longer than broad. Sperm duct in ventral view more or less U-shaped. Cymbium dorsally with very dense scopula (Fig. 83e). Palpal tibia mostly short, distally (slightly) broader than proximally and in some species with process carrying a bunch of bristles (Figs 7b–c, 8b–c, 10b). Palpal femur modified with at least one ventral extension. In some species with additional basal extension (Fig. 7d); "tooth" in Levi (1982). Macrosetae ventrally on coxae of leg I (MC-I) and trochanterae of leg I (MT-I) present (Fig. 82n), but only as apical row. In one species (*P. kinabalu*) MC-I–II & MT-I completely absent.

Females with median septum (MS) broader than long. Epigyne with many wrinkles and with swelling anterior to each copulatory opening (CO). Spermathecae located (posterio-) laterally. Spermathecal heads (SH) distinctly developed (Fig. 7e, 9b).

Psechrus mulu Levi, 1982

Figs 7a–f, 8a–h, 82n, 84e, 87c, 90c

Psechrus mulu Levi 1982: 128, figs 58–61 (Description and illustration of ♂ and ♀). [Holotype ♂ (SB 242) from MALAYSIA: Borneo, Sarawak Province: Mulu National Park, Deer cave, Gua Payau; P. Chapman leg. 25.IV.1978, 'R. Geogr. Soc. - Sarawak Govt. Gunung Mulu Expedition'; NHM 1981·4·10·1–4; Paratypes: 1 ♂ (SB 241), 2 ♀♀ (SB 239–240), same data as for holotype; NHM 1981·4·10·1–4, all type material examined].

Additional material examined (4 ♂♂, 8 ♀♀)**. MALAYSIA: Borneo, Sarawak Province:** Mulu National Park, Deer cave, Gua Payau; P. Chapman leg. 07.III.1978, 'R. Geogr. Soc. - Sarawak Govt. Gunung Mulu Expedition'; Wanless det. *Psechrus* sp.; 2 ♂♂ (SB 243–244), 2 ♀♀ (SB 245–246), NHM. Deer cave, boulder & way up, Main Arexenia bat guano pile; P. Chapman leg. 25.IV.1978; 2 ♂♂ (SB 251–252), 6 ♀♀ (SB 247–249, 253–255), NHM.

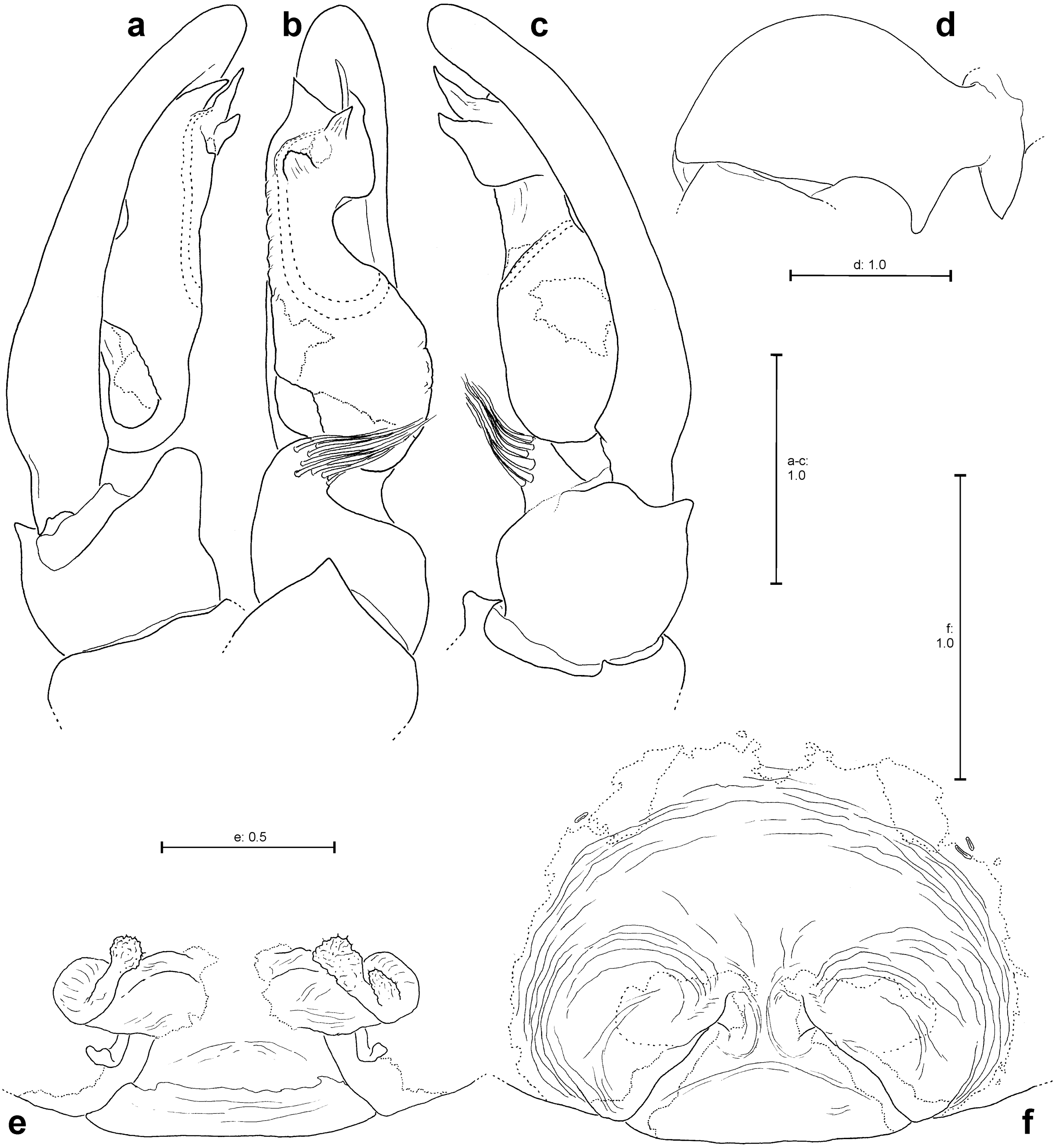
Revised diagnosis (see also diagnosis for *mulu*-group above)**.** Males with three apophyses close to embolus (E). One at embolus base (EB), another more basally in the area of EB and one apically at tegulum (T), next to E. Females similar to *P. borneo* Levi, 1982 in diagnostic character states described for *mulu*-group (see above). Distinguished by the lateral margins of median septum (MS) running less steep than in *borneo* and by the copulatory openings (CO), which are larger than in *borneo* and facing each other medially (Fig. 7f, 8g–h). Consequently, copulatory duct (CD) of vulva running transversally and straight (Figs 7e, 8d–e).

Description. Male (measurements of holotype first, those of other specimens given as ranges in parentheses)**:** Body and eye measurements. Carapace length 5.7 (5.0–6.3), carapace width 4.3 (3.5–4.5), anterior width of carapace 2.0 (1.8–2.2), opisthosoma length 7.6 (7.2–8.5), opisthosoma width 3.6 (3.0–3.6). Eyes: AME 0.30 (0.29–0.36), ALE 0.32 (0.31–0.39), PME 0.32 (0.32–0.37), PLE 0.35 (0.34–0.42), AME–AME 0.18 (0.17–0.18), AME–ALE 0.08 (0.06–0.08), PME–PME 0.24 (0.23–0.24), PME–PLE 0.29 (0.28–0.31), AME–PME 0.34 (0.27–0.40), ALE–PLE 0.29 (0.26–0.32), clypeus height at AME 0.76 (0.53–0.76), clypeus height at ALE 0.48 (0.44–0.60).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp 6.7 (6.7–7.6) [2.0 (2.0–2.2), 1.5 (1.4–1.8), 0.9 (0.8–0.9), 2.3 (2.3–2.8)] , I 61.8 (58.8–88.8) [16.4 (15.6–23.6), 2.5 (2.2–3.1), 16.6 (16.0–23.4), 17.6 (16.7–26.6), 8.7 (8.3–12.1)], II 49.6 (45.9–68.3) [13.9 (12.5–18.9), 2.3 (2.1–2.7), 12.8 (11.9–17.1), 13.9 (12.9–20.4), 6.7 (6.5–9.2)], III 34.1 (31.6–44.2) [9.9 (9.3–12.8), 1.8 (1.6–2.0), 8.4 (7.7–11.1), 9.4 (8.9–12.5), 4.6 (4.1–5.8)], IV 52.3 (48.4–70.7) [14.5 (12.7–19.4), 2.2 (1.9–2.4), 13.1 (12.3–17.6), 15.0 (14.3–21.3), 7.5 (7.2–10.0].

Spination. Palp: 021 (021), 110 (110), 1101 (0100); legs (—except for patella— variable, in parentheses only most common states noted): femur I 747 (646,655), II 656 (646) III 556 (656), IV 545 (555); patella I–IV 000; tibia I–II 3036 (3036,3038), III 3136 (3135), IV 3135 (3136); metatarsus I–III 3035 (3035), IV 3034 (3035).



FIGURES 7a–f. *Psechrus mulu* from Malaysia, Borneo, Sarawak Prov. a–d ♂ holotype SB 242. e–f ♀ paratype SB 240. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e Vulva, dorsal view. f Epigyne, ventral view.

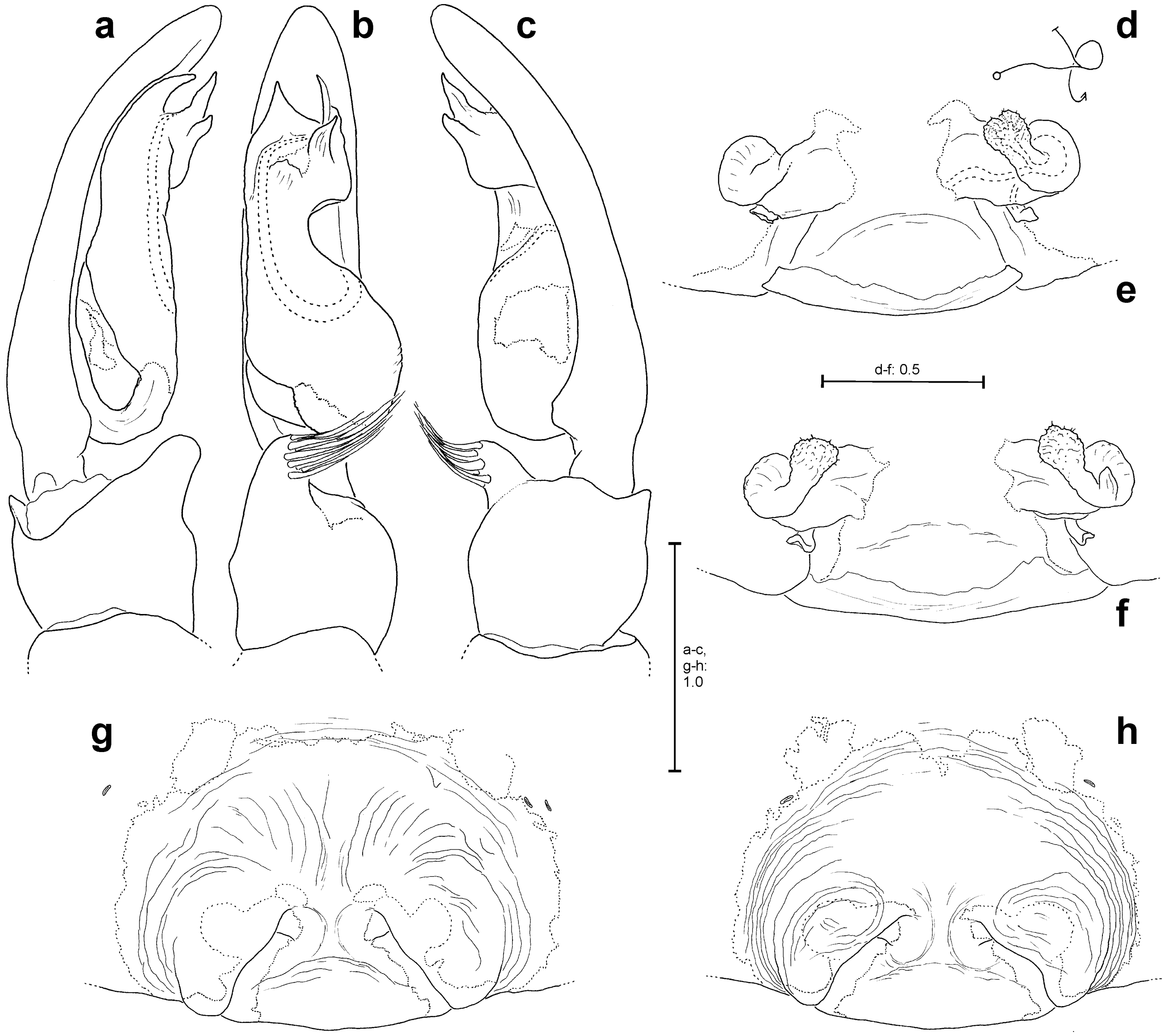
Palpal femur extremely bulky and modified with two ventral extensions. Distal femur extension (actually located centrally) quite pointed, with its tip slightly shifted distally (Fig. 7d). Proximal femur extension broader, also pointed and more strongly sclerotised. Palpal patella also very bulky. Palpal tibia distinctly short and with ventral process. The latter with long bristles directed retrolaterally (Fig. 7b).

Copulatory organ (see also diagnosis and general description for *mulu*-group). T more than two times longer than broad and distinctly constricted in apical half. Cymbium dorsally with very dense scopula, covering almost ½ of cymbium.

Female:

Body and eye measurements. Carapace length 5.6–6.5, carapace width 4.1–4.9, anterior width of carapace 2.4–2.7, opisthosoma length 9.8–11.1, opisthosoma width 4.3–5.9. Eyes: AME 0.32–0.35, ALE 0.38–0.39, PME 0.39–0.40, PLE 0.40–0.42, AME–AME 0.18–0.23, AME–ALE 0.08–0.09, PME–PME 0.21–0.26, PME–PLE 0.28–0.36, AME–PME 0.39–0.48, ALE–PLE 0.32–0.38, clypeus height at AME 0.97–1.23, clypeus height at ALE 0.71–0.94.

Cheliceral furrow with three promarginal and four retromarginal teeth.



FIGURES 8a–h. *Psechrus mulu* from Malaysia, Borneo, Sarawak Prov. a–c ♂ paratype SB 241. d–e, g ♀ paratype SB 239. f, h ♀ SB 253. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). e–f Vulva, dorsal view. g–h Epigyne, ventral view.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.8–8.4 [2.5–2.8, 1.1–1.2, 1.5–1.6, 2.7–2.9]; Legs: I 42.4–48.4 [11.4–13.3, 2.4–2.8, 11.3–13.1, 11.1–12.4, 6.2–6.8], II 33.5–37.8 [9.5–11.1, 2.2–2.5, 8.4–9.8, 8.6–9.3, 4.8–5.1], III 24.8–28.3 [7.2–8.5, 1.7–2.0, 6.0–6.8, 6.4–7.2, 3.5–3.8], IV 35.2–39.0 [9.8–11.4, 2.0–2.3, 8.9–10.1, 9.3–9.8, 5.2–5.4].

Palpal claw with 12–14 teeth.

Spination. Palp: 121 (131), 110 (120), 1101, 1013 (1014); legs (except for variable patella length, only most common states noted): femur I 757 (747,657), II 656 (736,647) III 646 (656), IV 556 (645,665); patella I–IV 000; tibia I–II 3036, III 3134, IV 3136 (3134,3133); metatarsus I–III 3035, IV 3034 (3035).

Copulatory organ (see also diagnosis and general description of *mulu*-group). MS posteriorly ca. three times broader than anteriorly, transversally generally with slightly curved ridge (Fig. 7f, 8g–h, 87c). MS-section posterior to that ridge generally lighter than anterior section. Epigynal muscle sigilla within or associated with epigynal field (EF), slit sense organs within EF or close by. Spermathecal heads (SH) with 'stalks' distinctly shorter than those of females belonging to *argentatus*-group.

Colouration of male and female. See description for *mulu*-group and *Psechrus*.

Variation of copulatory organs. In males the two apophyses proximal to E may vary in length (Figs 7a–c, 8a–c). In females the size of anterior width of MS may differ (Figs 7f, 8g–h). In some specimens an additional SH arises at base of SH-stalk (Figs 7e, 8f). Mostly this applies to only one vulva-half. Lengths of SH-stalks may differ slightly (Figs 7e, 8d).

Distribution. Malaysia [Borneo, Sarawak Province] (Fig. 100).

***Psechrus borneo* Levi, 1982**

Figs 9a–c, 87d, 90d

Psechrus borneo Levi 1982: 126, figs 56–57 (Description and illustration of ♀). [Holotype ♀ (SB 279) from INDONESIA: Borneo, Kalimantan Timur Province: Birang river (in the region of Berau), ca. N 12°11', E 117°28'; Dr. Erik Georg Mjöberg leg. 1920–1925; NRS; Paratype: 1 s.a. ♀ (SB 280), INDONESIA: Borneo, Kalimantan Timur Province: Mt. Tibang, 1300 m; Dr. E.G. Mjöberg leg. 1920–1925; NRS, all type material examined].

Revised diagnosis (see also diagnosis for *mulu*-group above)**.** Females similar to *P. mulu* Levi, 1982 in diagnostic character states described for *mulu*-group (see above). Distinguished from the similar *P. mulu* by the lateral margins of median septum (MS) running steeper and by the copulatory openings (CO) more hidden, slit-like (Fig. 9a) and not as close together as in *mulu.* CD of vulva curved and running into receptaculum from anterior (Fig. 9b).

Description. Male: unknown.

Female:

Body and eye measurements. Carapace length 5.5, carapace width 3.8, anterior width of carapace 2.3, opisthosoma length 8.9, opisthosoma width 4.1. Eyes: AME 0.33, ALE 0.41, PME 0.38, PLE 0.38, AME–AME 0.18, AME–ALE 0.09, PME–PME 0.28, PME–PLE 0.31, AME–PME 0.43, ALE–PLE 0.38, clypeus height at AME 0.93, clypeus height at ALE 0.70.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.0 [2.3, 1.0, 1.3, 2.4]; Legs: I 48.3 [13.3, 2.3, 13.8, 12.7, 6.2], II 35.9 [10.3, 2.0, 9.7, 9.2, 4.7], III 24.9 [7.6, 1.6, 6.2, 6.3, 3.2], IV 37.9 [11.1, 1.9, 9.9, 9.7, 5.3].

Palpal claw with 15 teeth.

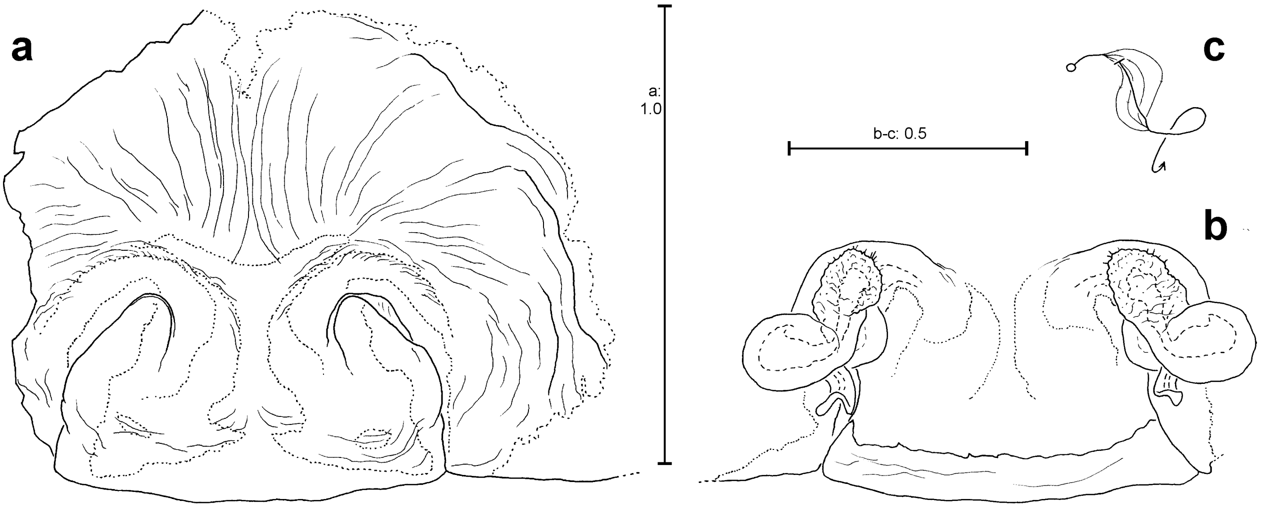
Spination. Palp: 131, 110, 1101, 1014; legs: femur I 666, II 656 III 556{655}, IV 555; patella I–IV 000; tibia I–II 3038, III 3134, IV 3136; metatarsus I–III 3035, IV 3034.

Copulatory organ (see also diagnosis and general description of *mulu*-group). MS posteriorly ca. 1.5x broader than anteriorly (Fig. 9a). No statements about epigynal muscle sigilla and slit sense organs possible, because parts of epigynal field and surroundings were unfortunately cut along with dissection (presumably for the study in Levi 1982). Spermathecal heads (SH) without 'stalks', but relatively large in comparison to receptacula (Fig. 9b, 90d).

Colouration. See description for *mulu*-group and *Psechrus*.

Remark. It is uncertain, if the paratype (s.a. ♀, SB 280, not illustrated), indeed belongs to *P. borneo*. It may just as well belong to a different species. There is no further adult material from its recording locality, which is about 230 km away from the type locality.

Distribution. Indonesia [Eastern Borneo] (Fig. 100).



FIGURES 9a–c. *Psechrus borneo*, ♀ holotype SB 279 from Indonesia, Borneo, Kalimantan Timur Prov. a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system.

Psechrus ulcus **sp. nov.**
Figs 10a–e, 84f

Type material: Holotype ♂ (SB 141), **INDONESIA: Borneo, Kalimantan Selatan Province:** ca. 25 km E of Banjarbaru, near Riamkanan Dam, S 3°30'59", E 115°01'00", 50 m, primary forest; P. Schwendinger leg. 29.–31.X.2008; MHNG.

Etymology. The specific name refers to the striking retrolateral process on palpal tibia (Latin "ulcus" means "excrescense, branch"); term (noun) in apposition.

Diagnosis (see also diagnosis for *mulu*-group above)**.** Male with impressive bulky embolus base (EB) and embolus (E) (Figs 10a–c) apically on tegulum (T), both with several ridges. E directed retrolaterally.

Description. Male:

Body and eye measurements. Carapace length 4.9, carapace width 3.1, anterior width of carapace 1.6, opisthosoma length 7.5, opisthosoma width 2.3. Eyes: AME 0.29, ALE 0.34, PME 0.35, PLE 0.34, AME–AME 0.20, AME–ALE 0.06, PME–PME 0.21, PME–PLE 0.26, AME–PME 0.42, ALE–PLE 0.36, clypeus height at AME 0.71, clypeus height at ALE 0.50.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 5.8 [2.1, 1.0, 0.9, 1.8]; Legs: I 65.8 [17.0, 2.0, 17.7, 20.0, 9.1], II 47.5 [12.7, 1.8, 11.7, 14.2, 7.1], III 32.6 [9.0, 1.4, 8.0, 9.6, 4.6], IV 50.6 [13.7, 1.6, 11.8, 15.7, 7.8]. Spination. Palp: 131, 110{000}, 1101{0000}; legs: femur I 667, II 666, III 656, IV 556; patella I–IV 000; tibia I 4048, II 3038, III 3136, IV 4146; metatarsus I–IV 3035.

Palpal femur bulky —but less distinct than in *P. mulu*— and modified with a rather pointed ventral extension. Its tip slightly pointing distally (Fig. 10d). Palpal trochanter distally with 10–15 macrosetae (Fig. 10e). Palpal tibia short, distally broader than proximally and with retrolateral process. The latter with long bristles (Fig. 10b).

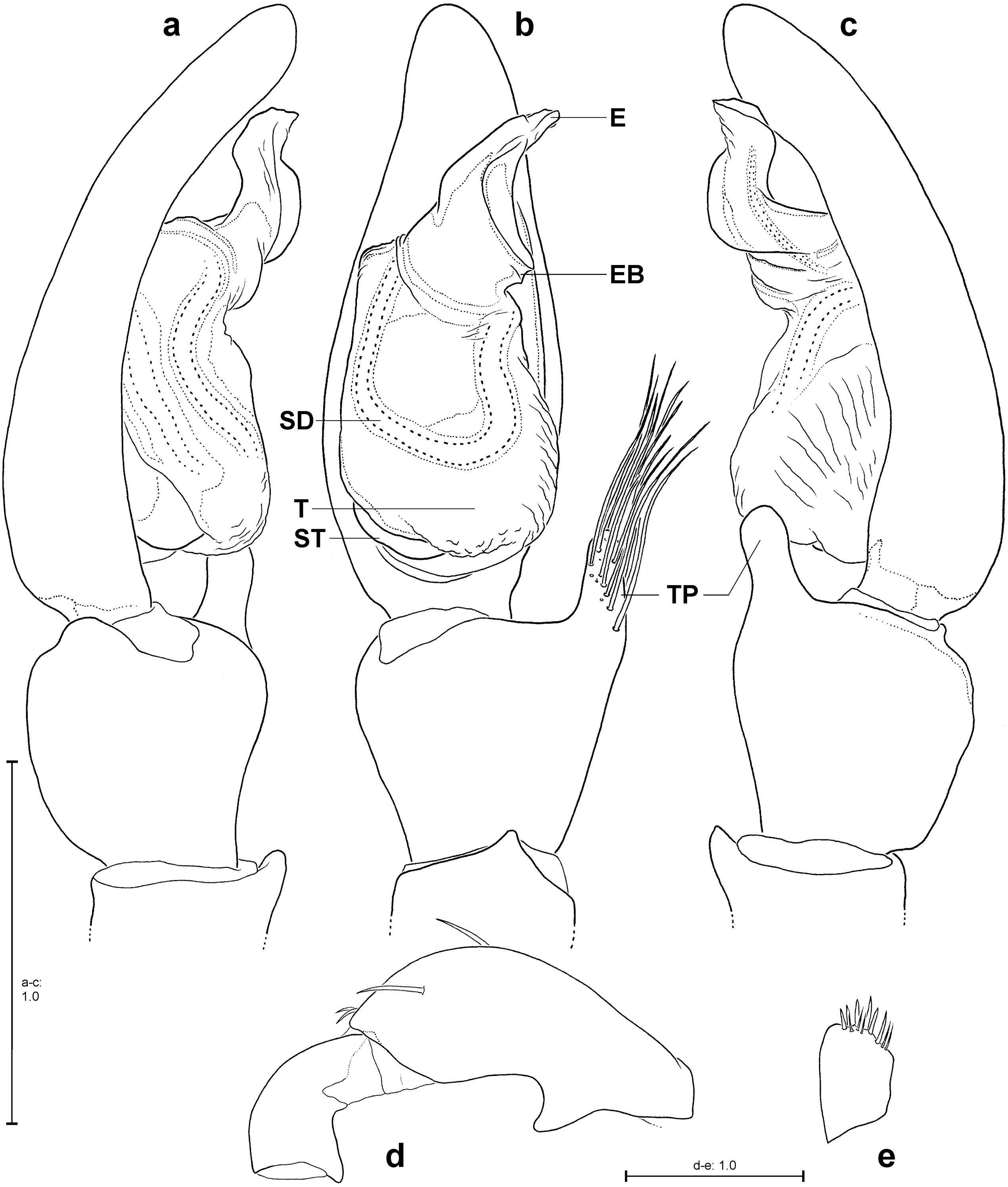
Copulatory organ (see also diagnosis and general description for *mulu*-group). T shorter than in *P. mulu*, centrally with distinctly light area, which is surrounded by sperm duct (Figs 10b, 84f) and prolatero-distally with 'corner' (Figs 10b, 84f). Cymbium dorsally with very dense scopula, covering ca. 1/3 of cymbium.

Female: unknown.

Colouration (see also description for *mulu*-group and *Psechrus*). Median bands on carapace serrated. Lateral bands medium-sized to broad (1.5x diameter of PME) and not serrated. Sternum yellowish brown posteriorly and at lateral margins and with light brown tapered patch centrally. These two sections are not easy to discriminate due to the small colour differences.

Distribution. Indonesia [Southern Borneo] (Fig. 100).

Remarks: For the following reasons it is unlikely that the male holotype represents the conspecific male of *P. borneo*: 1) The type localities are ca. 700 km away from each other; 2) The females of *P. mulu* and *P. borneo* are similar. Consequently, for *P. borneo* I would anticipate a male that is similar to *P. mulu*. However, this does not apply to *P. ulcus* **sp. nov.**, as its bulb differs clearly from the one of *P. mulu*.



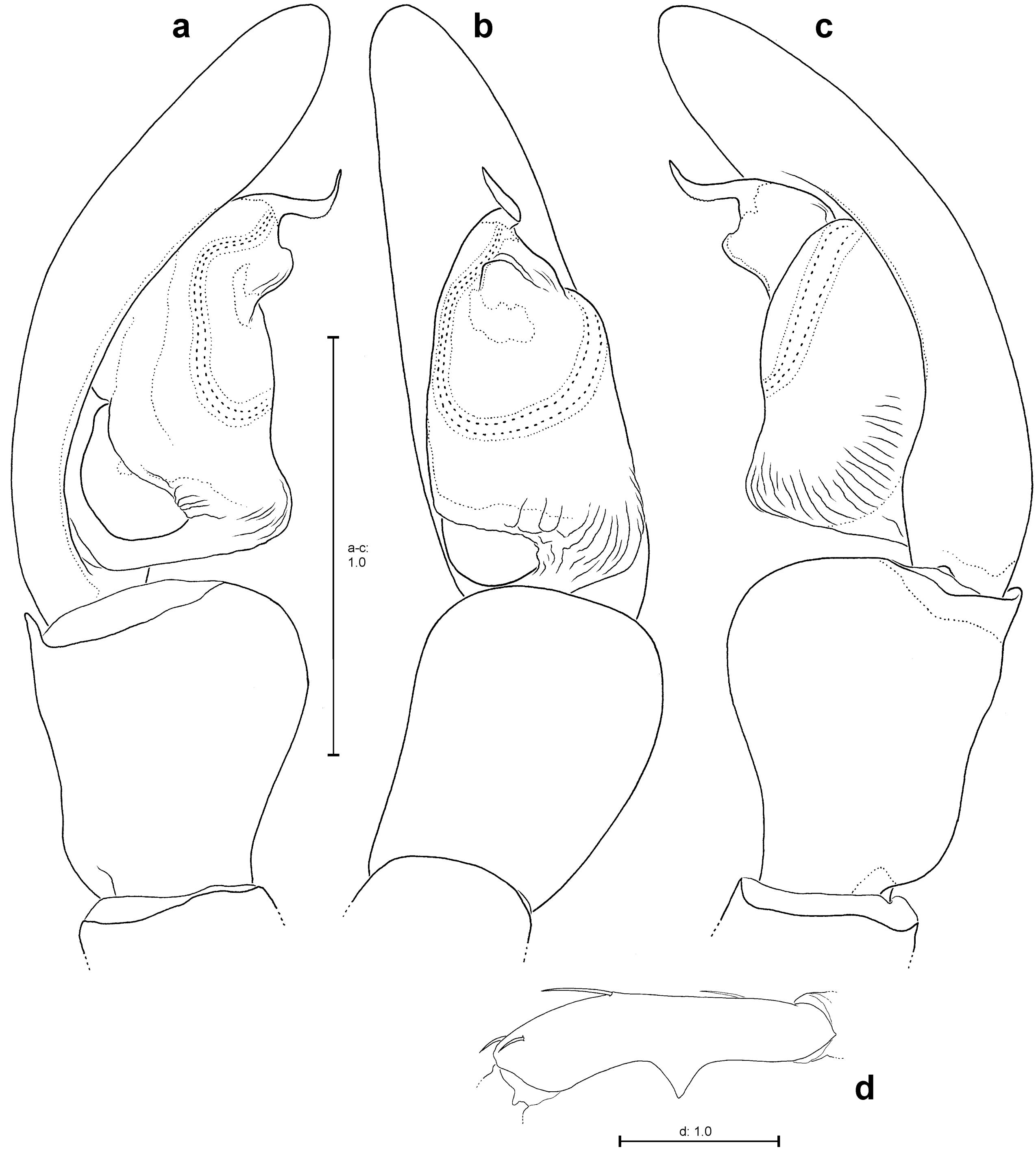
FIGURES 10a–e. *Psechrus ulcus* **sp. nov.**, ♂ holotype SB 141 from Indonesia, Borneo, Kalimantan Selatan Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e ♂ palpal trochanter, ventral view. E: Embolus; EB: Embolus base; SD: Sperm duct; ST: Subtegulum; T: Tegulum; TP: (Palpal) tibial process.

Psechrus kinabalu Levi, 1982

Figs 11a–d, 83e, 84d

Psechrus kinabalu Levi 1982: 126, figs 54–55 (Description and illustration of ♂). [Holotype ♂ (SB 237) from MALAYSIA: Borneo, Sabah Province: Mt. Kinabalu, 5500 ft. (1680 m); Field-Coll.-No. 5238; E.W. Classey leg. 20.–24.I.1976; NHM 1981·4·10·11, examined].

Revised diagnosis (see also diagnosis for *mulu*-group above)**.** Male with tegulum (T) converging strongly at (centro-)apical section and merging into embolus base (EB) (Fig. 11b). Embolus (E) curved and very slightly serrated ventrally (Figs 11a,c). With peculiar bulge proximal to EB (Figs 11a–b).



FIGURES 11a–d. *Psechrus kinabalu*, ♂ holotype SB 237 from Malaysia, Borneo, Sabah Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

Description. Male:

Body and eye measurements. Carapace length 4.9, carapace width 3.6, anterior width of carapace 1.9, opisthosoma length 5.3, opisthosoma width 2.1. Eyes: AME 0.28, ALE 0.36, PME 0.37, PLE 0.38, AME–AME 0.13, AME–ALE 0.04, PME–PME 0.23, PME–PLE 0.25, AME–PME 0.39, ALE–PLE 0.35, clypeus height at AME 0.54, clypeus height at ALE 0.42.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 5.7 [2.2, 0.9, 0.9, 1.7]; Legs: I 52.2 [14.0, 2.1, 14.3, 15.6, 7.6], II 39.0 [10.6, 1.7, 10.0, 11.1, 5.6], III 26.7 [7.7, 1.4, 6.4, 7.3, 3.9], IV 43.5 [11.7, 1.7, 10.3, 12.8, 7.0]. Spination. Palp: 131, 110{010}, 0100 (very small); legs: femur I 556, II 556, III 545, IV 545; patella I–IV 000; tibia I 3038, II 3036, III–IV 3136(dorsal one small); metatarsus I–IV 3035.

Palpal femur slim and modified with a ventral, pointed extension (Fig. 11d). Palpal tibia relatively short, distally broader than proximally (Figs 11a–c). MC-I–II and MT-I absent.

Copulatory organ (see also diagnosis and general description for *mulu*-group). T shorter than in *P. mulu*. If viewed from retrolateral (Fig. 11c) it seems divided into a narrow distal part, which merges into to EB apically, and a broad and large basal part. Cymbium dorsally with very dense scopula, covering ca. 2/3 of cymbium (Fig. 83e).

Female: unknown.

Colouration (see also description for *mulu*-group and *Psechrus*). Median bands on carapace just slightly serrated.

Distribution. Malaysia [Borneo, Sabah Province] (Fig. 100).

Remarks: For the following reason it is unlikely that the male holotype represents the conspecific male of *P. borneo*: The females of *P. mulu* and *P. borneo* are similar. Consequently, for *P. borneo* I would anticipate a male that is similar to *P. mulu*. However, this does not apply to *P. kinabalu*, as its bulb as well as palpal tibia, -patella and -femur differ clearly from those of *P. mulu*.

***annulatus*-group**

Diagnosis. Males difficult to characterise, because they are known only from one species: Embolus (E) with pedestal-like base (Fig. 14b). Membranous to fleshy conductor (C) present (Figs 14a–c).

Females with protruding epigyne. The latter with large copulatory openings (CO) (Figs 12a–b, 14f). Copulatory ducts (CD) meeting spermathecae from posterior (Fig. 12c).

Description. Median bands on carapace not or just slightly serrated. Width of lateral bands > diameter of PME, but at most 1.5x, in some species > 1.5x diameter PME (see each species description) and not or just slightly serrated. Sternum yellowish brown at narrow lateral margins and with broad, brown, tapered patch centrally (Fig. 82i). Light longitudinal line ventrally on opisthosoma continuous and noticeably narrow (Fig. 81f). If measured centrally on opisthosoma, its width is less than 1/4 the width of one half of the cribellum. Dorsal spination on tibia III and IV differs between species: *P. annulatus* Kulczyński, 1908: III: 2, IV: 2; *P. aluco* **sp. nov.**: III: 1(+ 1 small distal one), IV: 1; *P. decollatus* **sp. nov.**: III: 0 (or 1 very small one), IV: 0. Legs long in relation to other species-groups: FEM-I+MTT-I/CL : Males: 5–6; Females: almost 4.

Males with more or less oval T. Sperm duct in ventral view (very) broad U-shaped. Due to the lack of male specimens in good condition no statements about scopula dorsally on cymbium possible. Palpal femur modified with very flat ventral bulge (Fig. 14d). Macrosetae ventrally on coxae of leg I and II (MC-I–II) and trochanter of leg I (MT-I) absent (but only one, adult male examined, very old material).

Females with median septum (MS) broader than long (Fig. 12a). Epigyne may be with peculiar, flattened field anterior to copulatory openings (CO) (asterisk in Fig. 14f). Spermathecae located dorsal to copulatory ducts (CD) (Fig. 12c, 13b). Spermathecal heads (SH) may be present or absent. In the latter case SH are replaced by a flat layer with many pores in anterior half. This layer is located upon receptaculum (Figs 14e,h).

Psechrus annulatus Kulczyński, 1908, stat. nov.

Figs 12a–d, 81f, 82i, 87e, 90e

Psechrus annulatus Kulczyński 1908: 565, pl. 23, fig. 21 (Description and illustration of ♀). [Lectotype ♀ (SB 829, light one), here designated, from INDONESIA: Java, Jawa Tengah Province: Nusa Kembangan; present from Dr. M. Raciborski; MIZ F·790; Paralectotype: 1 ♀ (SB 830, dark one) from INDONESIA: Java, Jawa Barat Province: Nyalindung; "ciemny" (note by Kulczyński to differentiate this specimen from the other specimen in this series; "ciemny" means 'dark one'); present from Dr. M. Raciborski; MIZ F·790, all type material examined]. Berland and Berland 1914: 133. Hogg 1914: 56; 1915: 436. Fage 1929: 360. Lehtinen 1967: 260. Levi 1982: 125 (Syn. with *P. singaporensis*, rejected).

Psechrus singaporensis — Levi 1982: 125, figs 40–53, ad part, figs 42–43, 48–53 misidentified, figs 52–53 (Illustration of ♀).

Additional material examined. INDONESIA: Java, Jawa Barat Province: Pananjung, Pasir Paninjoan ('Penandjoeng'); 'Akquisitions-Datum: 15.X.1938'; Reimoser det.; 1 juv. (SB 1094), NHMW 12·385.

Additional doubtful material. INDONESIA: Java, Jawa Barat Province: Cibodas ('Tjibodas'); K. Kraepelin leg. 23.–28.III.1904 and ded.; E. Simon det. *Psechrus* sp. VIII. 1904; acquisition 08.VI.1904; 1 juv. (SB 1073), ZMH.

Revised diagnosis (see also diagnosis for *annulatus*-group above)**.** Females similar to *P. aluco* **sp. nov.** in having rounded copulatory ducts (CD). Distinguished by the distinctly larger CD and by the spermathecal heads (SH), which are located anterio-medially at spermathecae (Fig. 12c). The latter —if vulva is viewed from dorsal— not extending beyond CD, in none direction. Moreover, median septum (MS) (Fig. 12a–b, 87e) not as strongly protruding as in *P. aluco.*

Description. Male: unknown.

Female: (Measurements of lectotype first, those of paralectotype in parentheses).

Body and eye measurements. Carapace length 4.8 (5.3), carapace width 3.2 (3.5), anterior width of carapace 2.1 (2.2), opisthosoma length 8.5 (8.9), opisthosoma width 3.0 (3.2). Eyes: AME 0.31 (0.32), ALE 0.37 (0.40), PME 0.35 (0.41), PLE 0.36 (0.40), AME–AME 0.22 (0.21), AME–ALE 0.04 (0.07), PME–PME 0.26 (0.26), PME–PLE 0.27 (0.28), AME–PME 0.43 (0.49), ALE–PLE 0.40 (0.45), clypeus height at AME 0.87 (0.81), clypeus height at ALE 0.61 (0.55).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 5.5 (6.2) [1.9 (2.1), 0.7 (0.9), 1.0 (1.1), 1.9 (2.1)]; Legs: I 42.3 (38.6) [11.2 (10.1), 2.0 (2.2), 12.6 (10.6), 10.8 (10.0), 5.7 (5.7)], II 30.4 (29.6) [8.6 (8.3), 1.8 (2.0), 7.9 (7.5), 7.5 (7.5), 4.2 (4.3)], III 21.1 (20.3) [6.1 (6.1), 1.4 (1.4), 5.1 (4.9), 5.5 (5.0), 3.0 (2.9)], IV 32.2 (31.9) [9.1 (9.0), 1.6 (1.9), 8.3 (8.1), 8.4 (8.2), 4.8 (4.7)].

Palpal claw with 14 (14) teeth.

Spination. Palp: 141 (131), 110 (110), 1101 (1101), 1014 (1014); legs: femur I 656 (656), II 555 (656) III 555 (545), IV 555 (555); patella I–IV 000 (000); tibia I–II 3036 (3036), III 3236 (3234, distal, dorsal spine small), IV 3234,3235 (3134); metatarsus I–III 3035 (3035), IV 3034, 3035 (3035).

Copulatory organ (see also diagnosis and general description of *annulatus*-group). MS posteriorly ca. 1.5x broader than in between the two copulatory openings (CO) (Fig. 12a–b). Epigynal muscle sigilla (EM) and slit sense organs outside epigynal field. Spermathecae cross-oval (Fig. 12c).

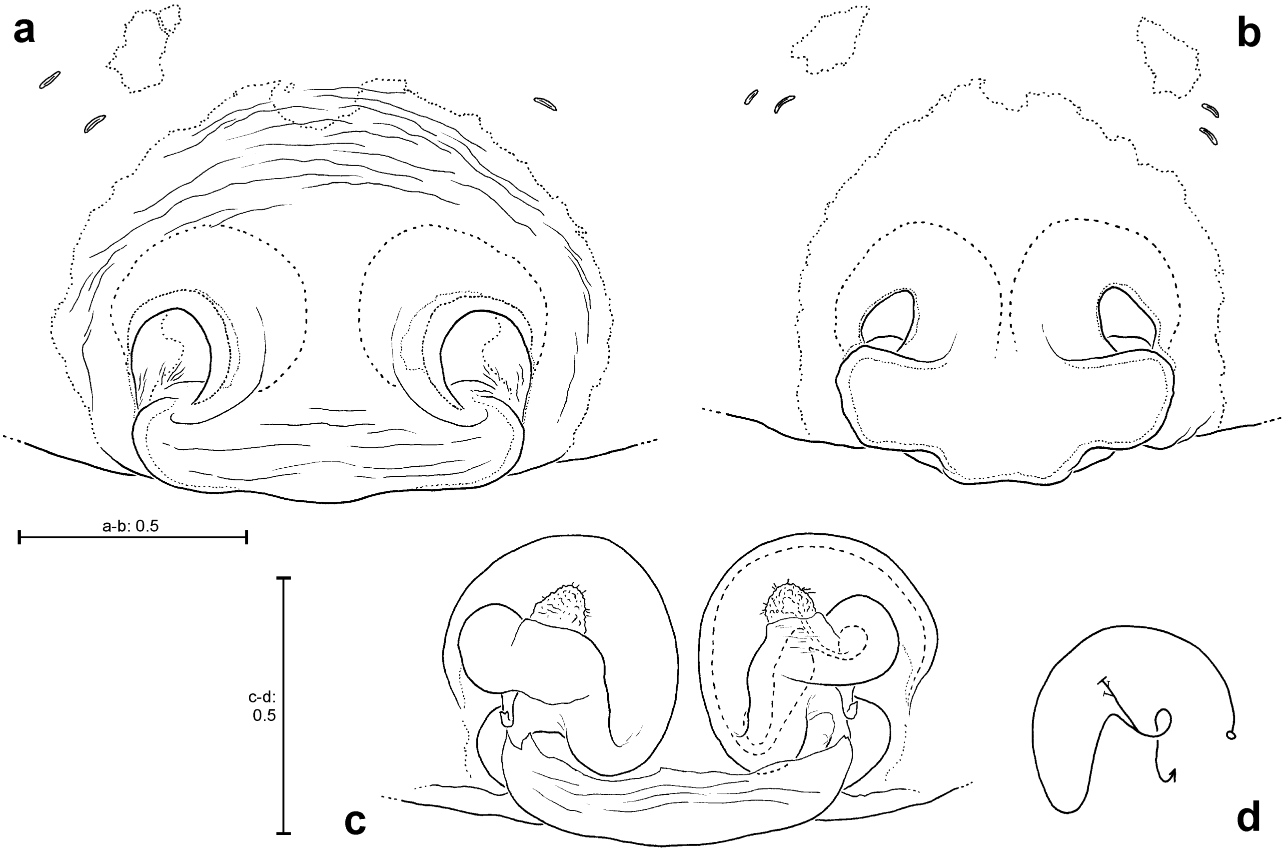
Colouration (see also description for *annulatus*-group and *Psechrus*). Width of lateral bands on carapace medium-sized (ca. 1.3x diameter of PME) and hardly serrated.

Variation of copulatory organs. In paralectotype (SB 830) MS and CO differ (Fig. 12b). In SB 830 CO a bit smaller than in lectotype. However, vulva (not illustrated) matches that of lectotype.

Remark. This species is removed from synonymy with *P. singaporensis* Thorell, 1894 because the copulatory organs differ distinctly from *P. singaporensis*. Also a few somatic characters differ. *Psechrus annulatus* is not only a different species to *P. singaporensis*, it also belongs to a different species-group.

The juvenile specimens SB 1094 from Pasir Paninjoan, Jawa Barat and SB 1073 from Cibodas, Jawa Barat show the same spination pattern at tibia III & IV like the lectotype (SB 829). As the recording locality of SB 1073 matches the type locality of *P. aluco* **sp. nov.**, it may belong to *P. aluco*, which differs from *P. annulatus* in spination pattern of tibia III & IV. As from *P. aluco* only one single ♀ was available and from *annulatus* only two ♀♀ the difference in dorsal spination of tibia III & IV may be artificial. So, without checking more material, the identification of SB 1073 remains unclear. Eugène Simon examined this specimen for his study on spiders of Java (Simon 1905a) and identified it as *Psechrus* sp.

Distribution. Indonesia [Java] (Fig. 100).



FIGURES 12a–d. *Psechrus annulatus*, ♀ copulatory organ. a, c–d ♀ lectotype SB 829 from Indonesia, Java, Jawa Tengah Prov. b ♀ paralectotype SB 830 from Indonesia, Java, Jawa Barat Prov. a–b Epigyne, ventral view. c Vulva, dorsal view. d Schematic course of internal duct system.

Psechrus aluco sp. nov.

Figs 13a–c, 87f, 90f

Type material: Holotype ♀ (SB 123), **INDONESIA: Java, Jawa Barat Province:** Cibodas, Gunung Gedeh Nature Reserve, 1450 m; S. Djojosudharmo leg. 06.XII.1986; Deeleman Coll. in RMNH.

Etymology. The specific name refers to the copulatory openings including the surrounding area, which are reminiscent of the eyes of the tawny owl (*Strix aluco* Linnaeus); term “aluco” in apposition.

Diagnosis (see also diagnosis for *annulatus*-group above)**.** Females similar to *P. annulatus* in having rounded copulatory ducts (CD). Distinguished by the distinctly smaller CD and by the spermathecal heads (SH), which are located posteriorly at spermathecae (Fig. 13b). Moreover, median septum (MS) protruding more strongly (Fig. 13a).

Description. Male: unknown.

Female (Note: both legs IV missing)**:**

Body and eye measurements. Carapace length 5.1, carapace width 3.4, anterior width of carapace 2.2, opisthosoma length 7.3, opisthosoma width 3.8. Eyes: AME 0.32, ALE 0.37, PME 0.37, PLE 0.36, AME–AME 0.22, AME–ALE 0.06, PME–PME 0.21, PME–PLE 0.33, AME–PME 0.43, ALE–PLE 0.37, clypeus height at AME 0.75, clypeus height at ALE 0.55.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula:—. Palp: 6.2 [2.1, 0.8, 1.2, 2.1]; Legs: I 34.3 [9.5, 1.9, 9.5, 8.6, 4.8], II 27.0 [7.7, 1.7, 7.2, 6.6, 3.8], III 18.7 [5.7, 1.3, 4.4, 4.7, 2.6].

Palpal claw with 14 teeth.

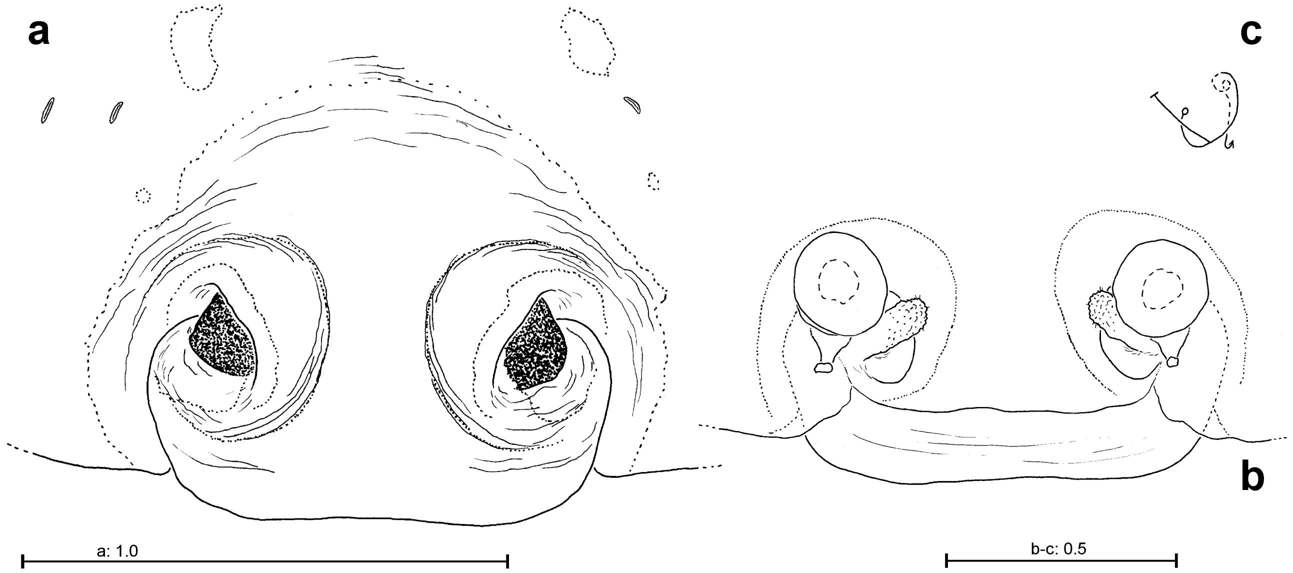
Spination. Palp: 131, 110, 1101, 1013; legs: femur I 556, II 546 III 545; patella I–III 000; tibia I–II 3038, III 3124; metatarsus I–III 3035.

Copulatory organ (see also diagnosis and general description of *annulatus*-group). MS very large in comparison to epigynal field (EF), posteriorly ca. 1.5x broader than between the two copulatory openings (CO) (Fig. 13a). Slit sense organs and epigynal muscle sigilla outside EF. SH upon relatively short stalks (Fig. 13b).

Note: It can not be excluded, that the dark parts at or in CO (Figs 13a, 87f) are mating plugs. I carefully tried to remove them, but they were very rigid. In order to avoid damage of epigynal structures I did not try harder. However, equally possible that these structures are part of the copulatory organ.

Colouration (see also description for *annulatus*-group and *Psechrus*). Width of lateral bands medium-sized (ca. 1.3x diameter of PME) and not serrated.

Distribution. Indonesia [Java] (Fig. 100).



FIGURES 13a–c. *Psechrus aluco* **sp. nov.**, ♀ holotype SB 123 from Indonesia, Java, Jawa Barat Prov. a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system.

Psechrus decollatus sp. nov.

Figs 14a–h, 84g, 87g, 90g

Psechrus torvus — Simon 1906: 287 (Sub ‘*Nota*’: Record of a ♀ from Java, misidentified). Lehtinen 1967: 462, fig. 476 (Illustration of ♀, misidentified).

Type material: Holotype ♀ (SB 501), **INDONESIA: Java, Jawa Timur Province:** Bromo Tengger Semeru National Park, in surrounding area of Bromo Vulcano (‘Mt. Tengger’); H. Fruhstorfer leg. 1891–1893; E. Simon det. *P. torvus*; P. Lehtinen vid.; Simon-Coll.-No. 15048; MNHN AR173. **Paratype** ♂ (SB 857, poor condition, opisthosoma lost), with same data as for holotype, except: H. Levi det. “fragments of *Psechrus* male, n. sp. ?“ 1982; ZMB 19241.

Additional material examined. INDONESIA: Java, Jawa Timur Province: Bromo Tengger Semeru National Park, in surrounding area of Bromo Vulcano (‘Mt. Tengger’); H. Fruhstorfer leg. 1891–1893; 1 juv. (SB 859, poor condition, opisthosoma lost), ZMB 19241.

Additional doubtful material examined. In the same series like paratype and SB859; 1 s.a. ♀ or ♀ ? (SB 858, poor condition, opisthosoma lost), ZMB 19241.

Etymology. The specific name refers to the vulva of this species, which lacks spermathecal heads (Latin “decollare” means “behead”); past participle passive.

Diagnosis (see also diagnosis for *annulatus*-group above)**.** In males embolus (E) long (almost as long as tegulum [T]) and almost straight (in lateral view at most slightly S-curved) (Figs 14a–c), running along longitudinal axis of cymbium and arising prolaterally at embouls base (EB). Distal half of conductor (C) ca. 2x broader than basal one. Females similar to *P. annulatus* in basic shape of median septum (MS). Distinguished by the spermathecae lacking heads (SH), the relatively small copulatory ducts (CD) running mainly in dorso-ventral direction (Figs 14e,h) and the narrower MS.

Description. Male:

Body and eye measurements. Carapace length 5.1, carapace width 3.4, anterior width of carapace 1.9, opisthosoma length—, opisthosoma width—. Eyes: AME 0.31, ALE 0.36, PME 0.35, PLE 0.36, AME–AME 0.18, AME–ALE 0.06, PME–PME 0.24, PME–PLE 0.28, AME–PME 0.46, ALE–PLE 0.34, clypeus height at AME 0.64, clypeus height at ALE 0.49.

Cheliceral furrow with three promarginal and four (five, right) retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 6.4 [2.3, 1.1, 0.9, 2.1]; Legs: I 53.9 [14.2, 2.3, 14.4, 15.0, 8.0], II 39.8 [10.8, 2.0, 10.2, 11.2, 5.6], III 27.3 [7.7, 1.6, 6.7, 7.4, 3.9], IV 42.3 [12.1, 1.8, 10.4, 11.7, 6.3]. Spination. Palp: 141, 110{010}, 1101 (all palpal tibia spines very small); legs: femur I 565, II 555, III 545, IV 534; patella I–IV 000; tibia I 3038, II 4038, III 3034, IV 3036; metatarsus I 4035, II–IV 3035.

Palpal femur slim, modified with a flat ventral bulge (Fig. 14d), distinctly flatter than e.g. in *Psechrus singaporensis*. Palpal tibia relatively short, distally broader than proximally (Figs 14a–c). MC-I–II and MT-I absent.

Copulatory organ (see also diagnosis and general description for *annulatus*-group). T slightly longer than broad. C in lateral view slightly curved (Figs 14a,c).

Female:

Body and eye measurements. Carapace length 5.8, carapace width 4.0, anterior width of carapace 2.4, opisthosoma length 8.9, opisthosoma width 3.3. Eyes: AME 0.34, ALE 0.43, PME 0.43, PLE 0.42, AME–AME 0.18, AME–ALE 0.09, PME–PME 0.27, PME–PLE 0.34, AME–PME 0.49, ALE–PLE 0.47, clypeus height at AME 0.85, clypeus height at ALE 0.63.

Cheliceral furrow with three promarginal and four (+ 1 very small tooth proximally with less than one third the size of the others) retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.2 [2.4, 1.0, 1.4, 2.4]; Legs: I 39.6 [10.6, 2.3, 11.1, 9.9, 5.7], II 30.6 [8.6, 2.1, 7.9, 7.7, 4.3], III 21.7 [6.4, 1.7, 5.2, 5.3, 3.1], IV 32.4 [9.2, 2.0, 8.3, 8.3, 4.6].

Palpal claw with 14 teeth.

Spination. Palp: 141, 110, 1101, 1014; legs: femur I 536, II 546{556} III 555, IV 545; patella I–IV 000; tibia I–II 3035, III 3134 (dorsal spine very small), IV 3034; metatarsus I–IV 3035.

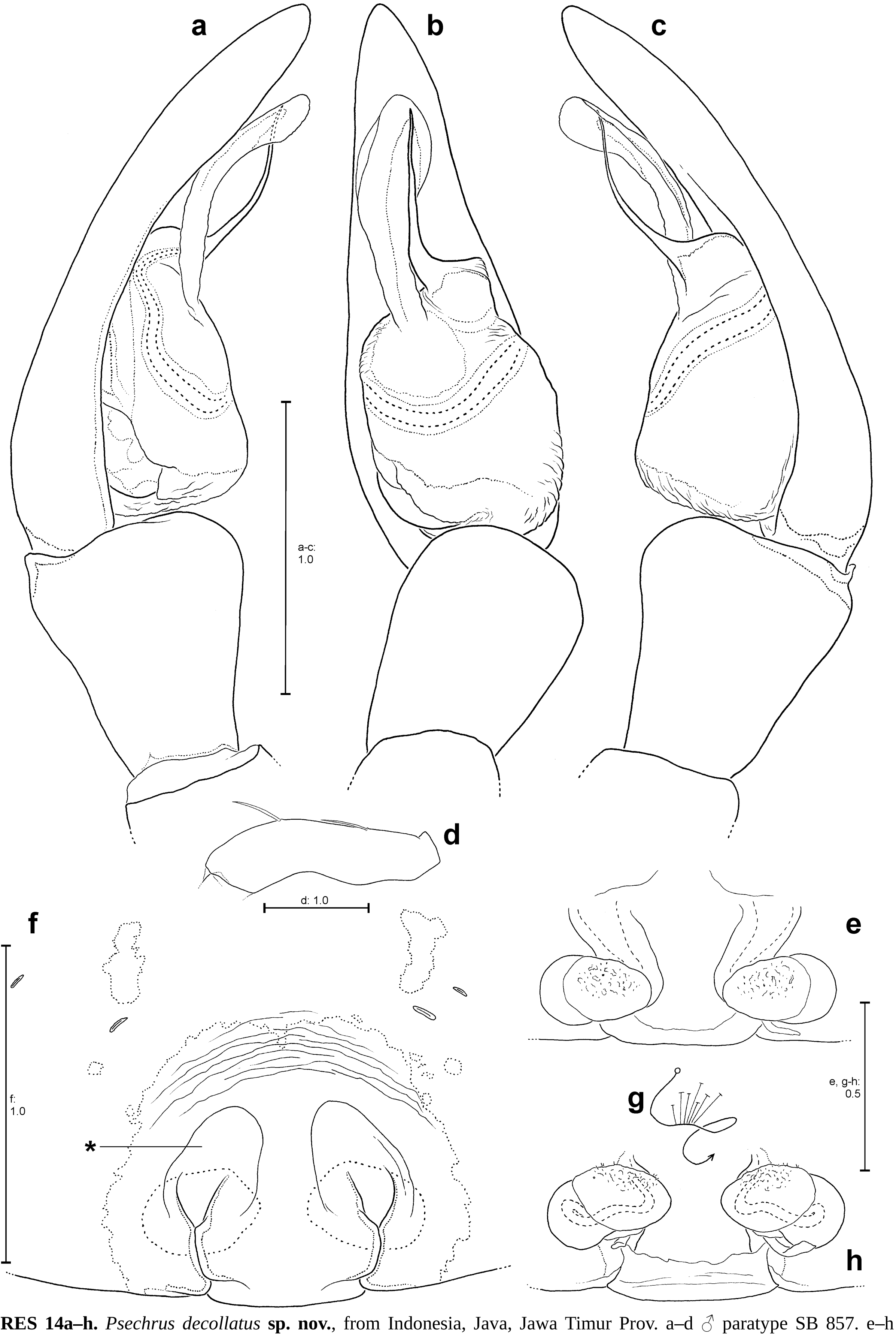
Copulatory organ (see also diagnosis and general description of *annulatus*-group). Epigyne with peculiar, flattened field anterior to copulatory openings (CO) (asterisk in Fig. 14f). MS posteriorly just a bit broader than anteriorly (Fig. 14f). Epigynal muscle sigilla (EM) rather elongated. Slit sense organs and EM outside epigynal field. Spemathecae cross-oval and covering most parts of CD if vulva is viewed from dorsal (Fig. 14h). In frontal view course of CD becomes clear (Fig. 14e).

Colouration of male and female (see also description for *annulatus*-group and *Psechrus*). Lateral bands broad (ca. 1.6x diameter PME) and slightly serrated.

Remark. It is highly likely that the adult female (SB 501) originated from the same series as the specimens from ZMB, Berlin. Presumably already in the beginning of the 20th century it had reached MNHN, Paris (possibly in exchange). The specimens, which remained in ZMB unfortunately got into poor condition over time (possibly during confusion of the World War[s]). All the specimens from ZMB 19241 are lacking their opisthosomas. I consider SB 859 to be a juvenile ♀ (younger than a subadult).

Concerning SB 858, I assume that it is either an adult or a subadult ♀. However, I have major doubts if this specimen belongs to *P. decollatus* **sp. nov.** The colouration of carapace as well as sternum clearly differ from general pattern of *annulatus*-group. The tapered patch centrally on sternum is rather narrow. The lateral bands on carapace are very narrow (like in representatives of *sinensis*-group, see below). Apparently this specimen was added to the series 19241 at a later date, without any note.

Distribution. Indonesia [Java] (Fig. 100).



FIGURES 14a–h. *Psechrus decollatus* **sp. nov.**, from Indonesia, Java, Jawa Timur Prov. a–d ♂ paratype SB 857. e–h ♀ holotype SB 501. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. f Epigyne, ventral view. h Vulva, dorsal view. e Vulva, frontal view. g Schematic course of internal duct system. The asterisk indicates the peculiar, flattened, glossy field anterior to copulatory openings.

singaporensis-group

Diagnosis. Males with elongated tegulum (T) (at least 1.5x longer than broad). The latter with broad basal half, turning abruptly into a narrower distal half (Fig. 15b). Conductor (C) membranous and almost hyaline, thus may be difficult to recognise (Figs 84 h–i). Embolus (E) with more or less round, platform-like, broad and flat base (Figs 15b, 17b).

Females with remarkably round receptacula (Figs 15f,h, 17e, 20b). Copulatory ducts (CD) medially curved.

Description. Median bands on carapace not, slightly or clearly serrated. Width of lateral bands > diameter of PME, but at most 1.5x, in some species broad (> 1.5x) and not, slightly or clearly serrated. Sternum yellowish brown at lateral margins and with brown, tapered patch centrally. Light longitudinal line ventrally on opisthosoma continuous and narrow (Fig. 81e). If measured centrally on opisthosoma, its width is ca. 1/3 the width of one half of the cribellum. Dorsal spines on tibia III and IV present. Legs long in relation to other species-groups: FEM-I+MTT-I/CL : Males: 6–7; Females: ca. 4.

Males generally with quite short E (ca. 1/4 the width of T), sperm duct in ventral view more or less broad U-shaped. Cymbium dorsally with very dense scopula, covering almost ½ of cymbium (Fig. 83d). Palpal femur modified with rounded ventral bulge (Fig. 15d). Macrosetae ventrally on coxae of leg I (MC-I) and trochanter of leg I (MT-I) present (but not as distinct as in *himalayanus*-group), mostly as apical row.

Females with median septum (MS) about as broad as long (Figs 15e, i, 19a). Spermathecal heads (SH) may be located dorsally on copulatory ducts (CD) (Fig. 15f) or directly on spermathecae (Fig. 19b).

Psechrus singaporensis Thorell, 1894

Figs 15a–i, 16a–f, 81e, 84h, 87h, 90h

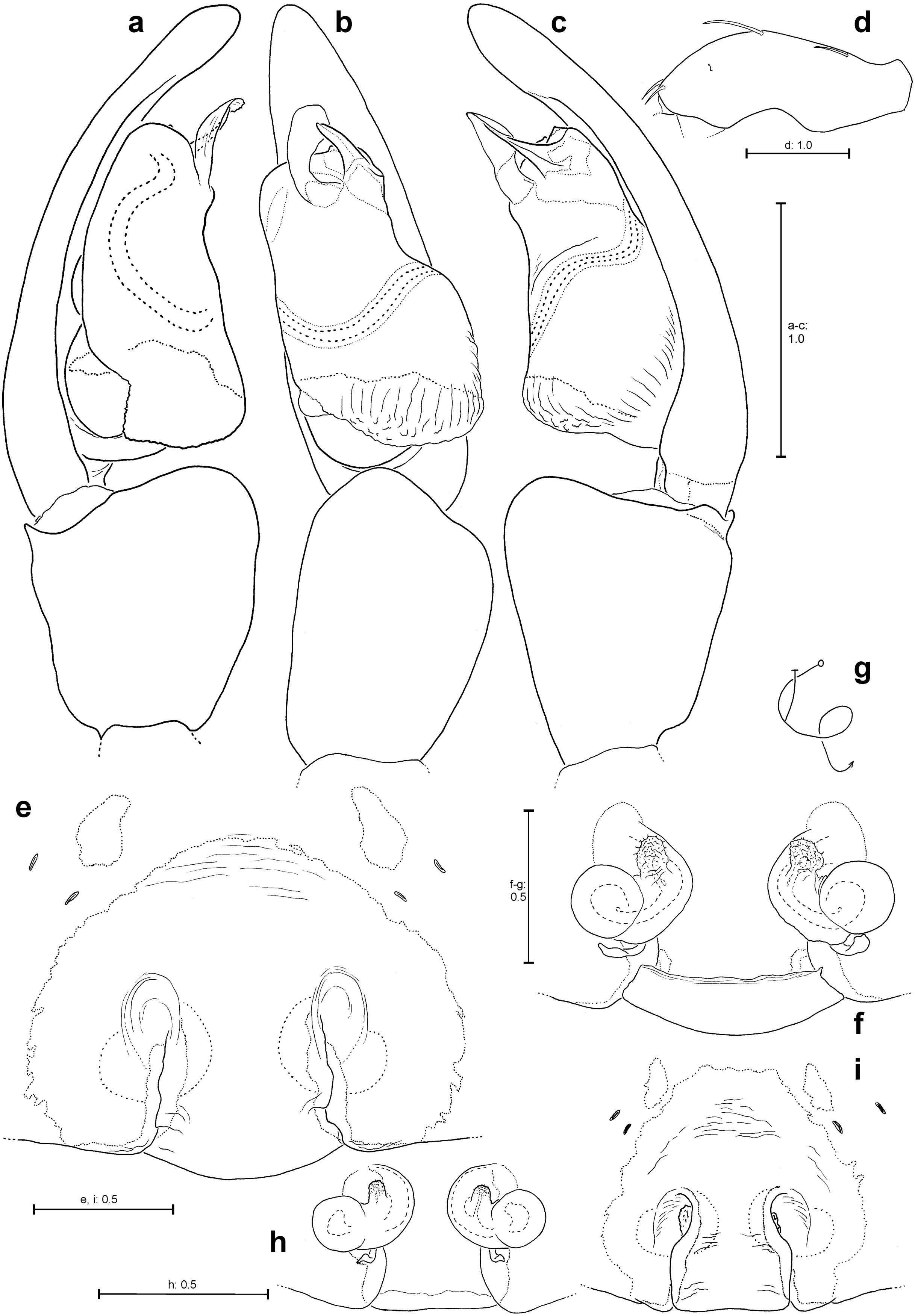
Psechrus singaporensis Thorell 1894: 321 (Description of ♀). [Holotype ♀ (SB 90) from SINGAPORE (No further details); 1890–1891; Workman Collection No. 1052; 222; (Returned by Thorell 13.XI.1894); NMI 1901·144, examined]. Workman 1896: 78, figs 78a–g (Illustration of ♀). Thorell 1897: 103 (Sub '*singoriensis*', presumably typo and not on purpose). Flower 1901: 45. Simon 1901: 47. Simon 1906: 287 (Synonymy with *P. torvus* [sub '*Nota*'], not considered by subsequent authors). Kulczyński 1908: 567. Lehtinen 1967: 261. Levi 1982: 125, description and illustration of ♂♂ and ♀♀, ad part, figs 42–43, 48–53 misidentified, figs 42–43 = *Psechrus* sp. *singaporensis*-group excluding *singaporensis* [♂ from MALAYSIA: Pahang Province, Genting; deposited in MC] (figs 40–41, 44–47: Illustration of ♂ and ♀♀). Murphy 1986: 66. Koh 1989: 77. Deeleman-Reinhold 2001: 38, fig. 16 (illustration of habitus of s.a. ♀). Song *et al.* 2002: 373. Bayer and Jäger 2010: 61, figs 24–25 (Illustration of ♀).

Psechrus torvus — Simon 1906: 287 (Record of ♀ from Singapore [sub '*Nota*'], misidentified).

Psechrus curvipalpis Fage 1929: 358, figs 1–4 (Description and illustration of ♂ and ♀). [Syntypes: 2 ♂♂ (SB 506–507), 3 ♀♀ (SB 499–500, 502), 9 s.a. ♀♀ (SB 493–498, 503–505), 4 juvs (SB 489–492), all from MALAYSIA: Selangor Province: Batu caves (N of Kuala Lumpur); C. Dover leg. VII.1926; MNHN AR174/177, all type material examined]. Lehtinen 1967: 261 (Syn. with *P. libelti*, rejected by subsequent authors). Robinson and Lubin 1979: 149. Levi 1982: 125 (Syn.).

Additional material examined (1 ♂, 9 ♀♀, 1 s.a. ♂, 2 s.a. ♀♀, 4 juvs)**. MALAYSIA: Penang Province:** Penang; S.S. Flower leg. 1896; 1 ♂ (SB 223), NHM. **Pahang Province:** Kampung Kuala Tembeling, N 4°04', E 102°19'; V. and B. Roth leg. 21.–24.IV.1990; 2 ♀♀ (SB 977–978), CAS 9032232. **Selangor Province:** Batu caves (N of Kuala Lumpur); Clark leg.; Coll. C.F. Roewer (1962); 1 ♀ (SB 83), 2 s.a. ♀♀ (SB 84–85), 4 juvs (SB 866–869), SMF 13913. Selangor (no further details); Coll. R. Sherriffs; 'Tilg. 27-9-1962'; 1 ♀ (SB 864), ZMUC 5731. **Kuala Lumpur Province:** Kuala Lumpur; collected before 1967; '4576(a)'; 1 s.a. ♂ (SB 1161, with developed bulb structures visible through the cuticle), AMNH. **INDONESIA: Sumatra, Sumatera Utara Province:** Sibolga; Acquisition: 1987; 1 ♀ (SB 334), NHMW. **SINGAPORE:** No further details; Workman Collection No. 532; 1901; 2 ♀♀ (SB 132–133), NMI 1901·144. No further details about locality; no data about collector and collecting date; 1 ♀ (SB 520), MNHN AR172. Bukit Timah Nature Reserve, N 1°21'08", E 103°46'29"; S. Huber leg. 02.IV.2009; Reared from juvenile, dead 21.VII.2009; 1 ♀ (SB 220), SMF.

Doubtful material examined. MALAYSIA: Selangor Province: Gombak Forest Reserve, 15 km N of Kuala Lumpur, 245 m; 12.XI.1960; H. Exline - W. Peck- Collection (donated to CAS 1985); 1 juv. (SB 979), CAS 9032231. **INDONESIA: Sumatra, Sumatera Utara Province:** Bohorok (ca. 60 km W of Medan), Gunung Leuser National Park, primary dipterocarp rainforest, riverside; S. Djojosudharmo leg. 15.–17.XI.1983; 1 ♀ (SB 113), 2 s.a. ♀♀ (SB 559, 561), 3 juvs (SB 560, 562–563), Deeleman Coll. in RMNH.



FIGURES 15a–i. *Psechrus singaporensis*. a–d ♂ SB 507, e–g ♀ SB 499 (both syntypes of *P. curvipalpis*) from Malaysia, Selangor Prov. h–i ♀ holotype SB 90 from Singapore. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e, i Epigyne, ventral view. f, h Vulva, dorsal view. g Schematic course of internal duct system.

Revised diagnosis (see also diagnosis for *singaporensis*-group above)**.** In males embolus (E) in ventral view broader than in *P. elachys* **sp. nov.** and its tip not as clearly pointed (Figs 15b, 16a) as in *P. elachys* **sp. nov.** E erected not as steep as in *elachys* **sp. nov.** and thus pointing less distally, but rather prolaterally (Figs 15b, 16a). Embolus base (EB) in alignment with retrolateral tegulum (T)-margin (Figs 15b, 16a). In retrolateral view E uniformly shaped and continuously converging from basal to distal section (Figs 15c, 16b). Females similar to *P. elachys* **sp. nov.** in having a rather simple median septum (MS) and medium sized copulatory ducts (CD) with spermathecal heads (SH) located upon distal section of CD (Figs 15e–f,h–i, 17d–e). Distinguished by the larger, slightly elongated copulatory openings (CO), leading to a different course of CD (Fig. 15g *cf.* Fig. 17f). CD slightly broader and longer (Figs 15f,h) than in *P. elachys* **sp. nov.**

Description. Male:

Body and eye measurements. Carapace length 4.4–6.6, carapace width 3.4–4.9, anterior width of carapace 1.7–2.3, opisthosoma length 5.7–9.2 , opisthosoma width 2.0–4.0. Eyes: AME 0.26–0.43, ALE 0.31–0.45, PME 0.29–0.46, PLE 0.32–0.42, AME–AME 0.14–0.19, AME–ALE 0.06–0.09, PME–PME 0.16–0.23, PME–PLE 0.25–0.36, AME–PME 0.31–0.44, ALE–PLE 0.33–0.35, clypeus height at AME 0.54–0.72, clypeus height at ALE 0.41–0.55.

Cheliceral furrow with three promarginal and four (five, right) retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 5.4–6.9 [1.9–2.5, 1.0–1.3, 0.8–1.0, 1.7–2.1]; Legs: I 52.5–79.0 [14.6–20.8, 2.1–3.3, 14.4–21.7, 14.7–24.3, 6.7–8.9], II 38.5–60.4 [10.9–16.4, 1.7–3.0, 10.0–15.8, 10.6–18.3, 5.3–6.9], III 25.7–40.3 [7.4–11.7, 1.3–2.1, 6.1–10.2, 7.2–11.5, 3.7–4.8], IV 42.1–63.3 [12.2–17.6, 1.6–2.5, 10.2–16.2, 12.1–19.7, 6.0–7.3].

Spination. Palp: 131 (132), 010, 0010(spine very small); legs: femur I 545 (656), II 556 III 545 (555), IV 544 (554); patella I–IV 000; tibia I–II 3038, III 3236 (3136), IV 3236 (3136); metatarsus I–III 3035, IV 3036 (3035).

Palpal femur modified with rounded ventral bulge (Fig. 15d). MC-I and MT-I: present, but not as distinctly developed as in *P. himalayanus* Simon, 1906.

Copulatory organ (see also diagnosis and general description for *singaporensis*-group). Conductor (C) distally broader than proximally (Fig. 15b), in lateral view narrow, arising subdistally at medial section of T (Figs 15a,b). Palpal tibia in lateral view distally clearly broader than proximally (Figs 15a,c).

Female: (Measurements of holotype first, those of other specimens as range in parentheses; in holotype distal limbs of legs I and III missing).

Body and eye measurements. Carapace length 4.3 (4.3–7.0), carapace width 2.9 (2.9–4.9), anterior width of carapace 1.7 (1.7–2.7), opisthosoma length 6.7 (6.7–11.3), opisthosoma width 2.8 (2.6–6.9). Eyes: AME 0.28 (0.27–0.43), ALE 0.38 (0.36–0.49), PME 0.38 (0.36–0.48), PLE 0.38 (0.36–0.47), AME–AME 0.17 (0.14–0.20), AME–ALE 0.10 (0.04–0.10), PME–PME 0.23 (0.15–0.23), PME–PLE 0.26 (0.25–0.38), AME–PME 0.39 (0.36–0.50), ALE–PLE 0.32 (0.26–0.40), clypeus height at AME 0.68 (0.73–0.81), clypeus height at ALE 0.46 (0.48–0.67).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 5.9 (5.3–7.8) [2.0 (1.8–2.6), 0.8 (0.8–1.1, 1.1 (1.0–1.5), 2.0 (1.8–2.6)]; Legs: I—(34.9–50.1) [10.1 (9.7–13.8), 1.7 (1.7–2.9), 10.3 (9.5–13.7, – (9.2–12.8), – (4.7–6.9)], II 29.5 (27.2–37.4) [7.9 (7.6–10.8), 1.6 (1.6–2.5), 6.8 (6.8–10.0), 8.3 (7.5–9.8), 4.9 (3.6–5.3)], III – (17.4–26.8) [5.7 (5.2–8.0), – (1.1–1.9), – (4.2–6.7), – (4.5–6.8), – (2.4–3.4)], IV 31.7 (27.7–39.9) [8.9 (7.9–11.5), 1.4 (1.4–2.2), 7.6 (7.1–10.2), 8.7 (7.1–10.3), 5.1 (4.5–5.7)].

Palpal claw with 14 (14–15) teeth.

Spination. Palp: 131 (131,141), 110 (110), 1101 (1101), 1014 (1014); legs (—except for patella— variable, only most common states noted): femur I 655 (655,556), II 556 (566,546) III 545 (545,555), IV 554 (554,555,556); patella I–IV 000; tibia I 3038 (3038), II 3036 (3036,3038), III – (3136,3134), IV 3134 (3134,3136); metatarsus I – (3035), II 3035 (3035,3037), III – (3035), IV 3034 (3034).

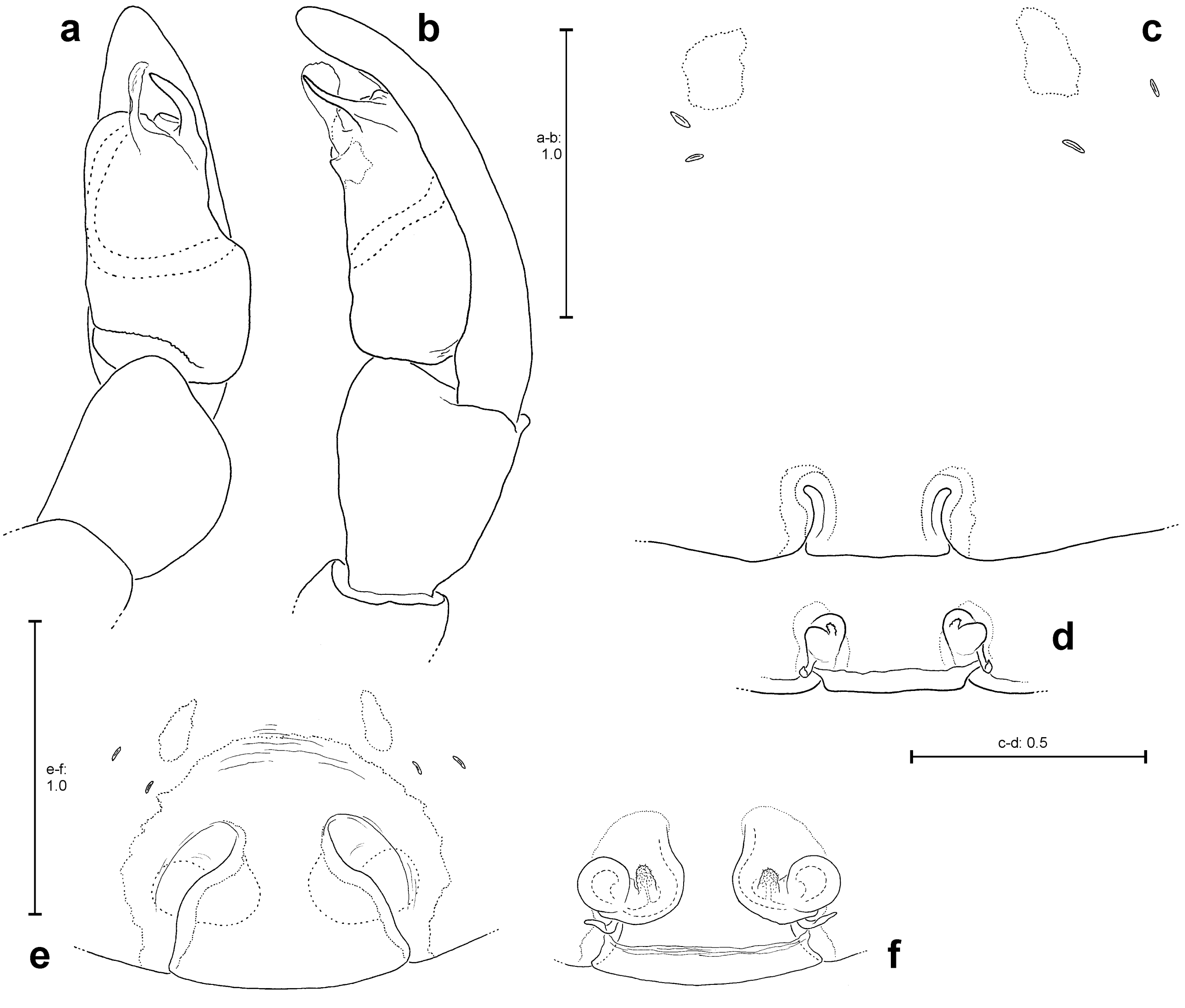
Copulatory organ (see also diagnosis and general description of *singaporensis*-group). MS mostly more or less trapeze-like (Figs 15i, 87h). Slit sense organs and epigynal muscle sigilla outside epigynal field (EF). CD mostly with ½ winding until reaching receptaculum (Figs 15h, 90h), at least two times longer than diameter of receptaculum.

Primordial copulatory organ. Pre-epigyne: Pre-septum ca. 2 times broader than long (Fig. 16c), pre-EF separated in two parts. Long and narrow pre-copulatory openings already recognisable (Fig. 16c).

Pre-vulva: Pre-copulatory ducts anterio-medially curved (Fig. 16d), not larger than pre-receptacula.

Colouration of male and female (see also description for *singaporensis*-group and *Psechrus*). Median bands on carapace not serrated. Width of lateral bands medium-sized (ca. 1.2x diameter of PME) and not (or barely) serrated.

Variation of copulatory organs. Males: E varies slightly in length (Figs 15b–c, 16a–b). Orientation of C may slightly differ (Fig. 16a). Distal part of T in SB 223 larger (in comparison to basal part) (Fig. 16a). In females the shape of MS varies distinctly (Figs 15e,i, 16e). In some specimens lateral margins of MS more or less parallel (Fig. 15e). Moreover, in some specimens MS posteriorly distinctly broader than anteriorly, in between CO (Fig. 16e). Length of EF differs among specimens examined (Figs 15e,i, 16e, 87h). CD may have winding for only 1/3 of length until reaching receptaculum (Fig. 16f). SH in some specimens somewhat larger (Fig. 15f).



FIGURES 16a–f. *Psechrus singaporensis*. a–b ♂ SB 223 from Malaysia, Penang Prov. c–d s.a. ♀ SB 493 (syntype of *P. curvipalpis*) from Malaysia, Selangor Prov. e–f ♀ SB 334 from Indonesia, Sumatra, Sumatera Utara Prov. a–b ♂ palp (a ventral, b retrolateral view). c Pre-epigyne, ventral view. d Pre-vulva, dorsal view. e Epigyne, ventral view. f Vulva, dorsal view.

Remarks: The species *P. libelti*, *P. annulatus* and *P. curvipalpis* were synonymised with *P. singaporensis* by Levi (1982). I do not agree with the synonymies of the two former species (see respective species descriptions herein), but with the synonymy of *P. curvipalpis*. According to copulatory organs the *curvipalpis*-females from Batu Caves, Malaysia (Figs 15e,f) correspond with the females from Singapore, including the holotype of *P. singaporensis* (Figs 15h–i). Differences in MS fall into the range of intraspecific variation (see above). Consequently, Fage (1929) was the first, who (even though unwittingly) described the male of *P. singaporensis*.

Levi (1982: 124, figs 42–43) illustrated a ♂ from Genting, Pahang Province, Malaysia, which he determined as *P. singaporensis*. The respective specimen is deposited in the F. & J. Murphy Collection (MC). According to Levi's very accurate illustrations there are clear differences to the ♂ of *P. singaporensis*. Such differences can not be explained by intraspecific variation. Unfortunately the respective specimen was not available on request. I assume that it is a representative of the *singaporensis*-group. As long as there are no females available from the same locality, it is impossible to ascertain if this male belongs to a new species or if it is conspecific with *P. norops* **sp. nov.**, from which only the female is known.

Deeleman-Reinhold (2001) shows an illustration of the dorsal habitus of a subadult female of *Psechrus* and identifies it as *P. singaporensis* (most likely due to the locality it was recorded). However, the colour pattern of carapace and opisthosoma is the same as similar species of the *singaporensis*-group, so the respective specimen may not necessarily be *P. singaporensis*. Even species of the *annulatus*-, *mulu*- or *argentatus*-group show a very similar colour pattern (of the carapace and legs). It should also be noted that the colour pattern of the opisthosoma of *Psechrus* is variable and dependant on its condition (e.g. before or after feeding). In *Psechrus* an identification to species level (as far as conventional methods are regarded and no other material from the respective locality is available) is only possible by checking the copulatory organs.

Distribution. Malaysia, Singapore, Indonesia [Sumatra] (Fig. 99).

Psechrus elachys sp. nov.

Figs 17a–g, 82f, 83d, 84i, 87i, 90i

Type material: Holotype ♀ (SB 861), **THAILAND: Satun Province:** Thale Ban National Park, N 06°42', E 100°10', 350–400 m, lowland rain forest; M. Andersen, O. Martin and N. Scharff leg. 20.X.1991; ZMUC 4538. **Paratype** ♂ (SB 862), with same data as for holotype; ZMUC 4538.

Etymology. The specific name refers to the small body size of the holotype female (Ancient Greek “elachys” means “little, small, short”); term (adjective) in apposition.

Diagnosis (see also diagnosis for *singaporensis*-group above)**.** In males embolus (E) in ventral view narrower than in *P. singaporensis*, erected steep and its tip more clearly pointed (Figs 17b–c) than in *P. singaporensis*. Embolus base (EB) protruding beyond upper retrolateral margin of tegulum (T) (Fig. 17b). E ventrally with crease-like structure (Figs 17b–c). Females similar to *P. singaporensis* in having a rather simple median septum (MS) and medium sized copulatory ducts (CD) with spermathecal heads (SH) located upon distal section —thus the section close to spermatheca— of CD (Figs 15e–f,h–i, 17d–e). Distinguished by the small copulatory opening (CO) pointing anteriorly (Figs 17d, 87i), leading to a different course of CD (Fig. 17f *cf*. Fig. 15g). CD a bit narrower and shorter (Fig. 17e, 90i) than in *singaporensis*.

Description. Male:

Body and eye measurements. Carapace length 5.1, carapace width 3.3, anterior width of carapace 1.8, opisthosoma length 6.0, opisthosoma width 2.2. Eyes: AME 0.29, ALE 0.35, PME 0.35, PLE 0.33, AME–AME 0.15, AME–ALE 0.06, PME–PME 0.22, PME–PLE 0.22, AME–PME 0.38, ALE–PLE 0.34, clypeus height at AME 0.49, clypeus height at ALE 0.38.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 5.8 [2.1, 1.0, 0.8, 1.9]; Legs: I 56.0 [14.9, 2.3, 14.9, 16.2, 7.7], II 40.9 [11.4, 1.9, 10.3, 11.5, 5.8], III 26.8 [7.6, 1.5, 6.6, 7.3, 3.8], IV 43.7 [12.1, 1.7, 10.5, 13.1, 6.3]. Spination. Palp: 131, 110 (both very small), 1101 (all very small); legs: femur I 656, II 666, III–IV 555; patella I–IV 000; tibia I 3038, II 3036, III–IV 3136; metatarsus I–IV 3035.

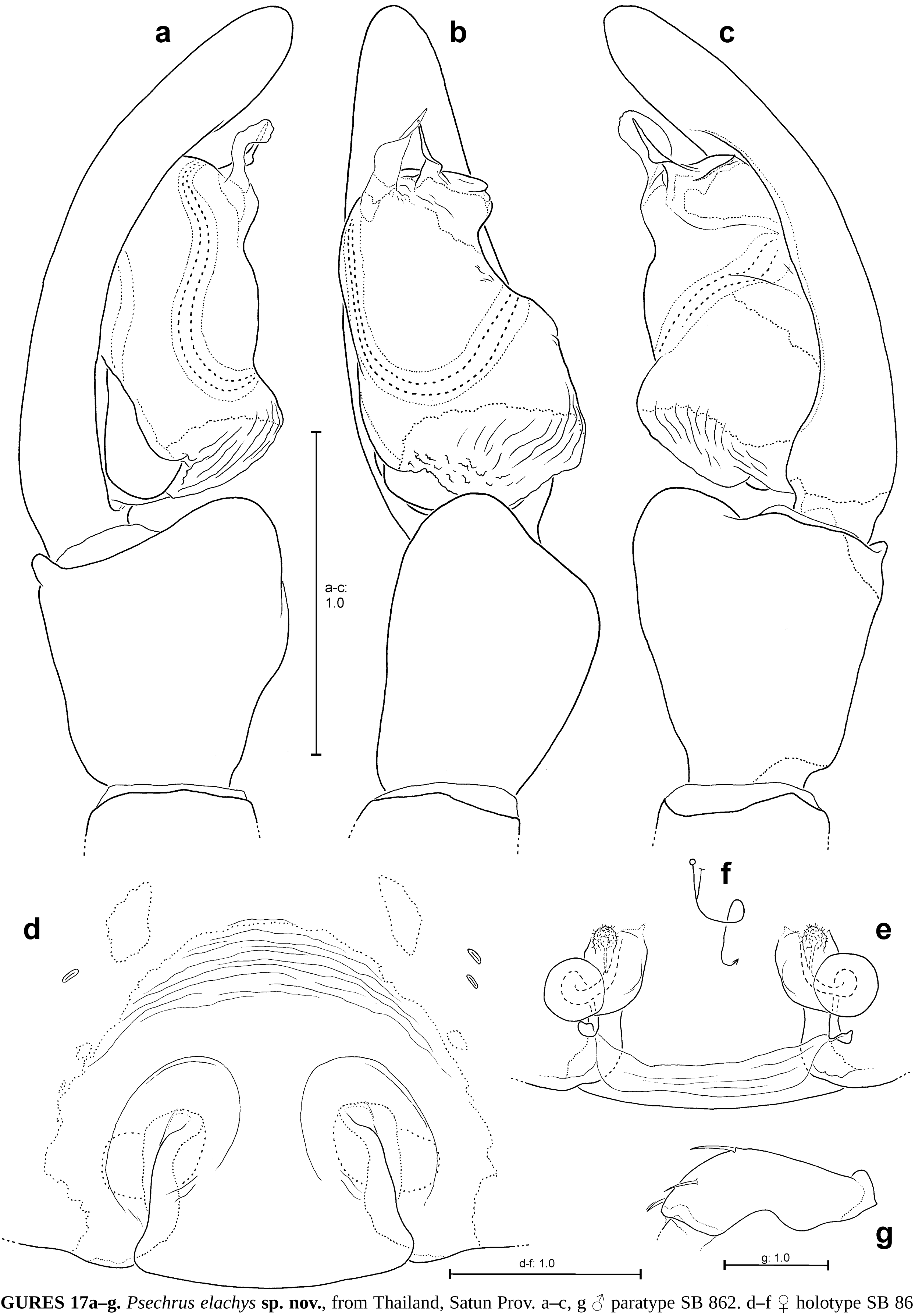
Palpal femur modified with rounded ventral bulge (Fig. 17g). MC-I and MT-I: present, but just as apical row.

Copulatory organ (see also diagnosis and general description for *singaporensis*-group). Conductor (C) shape similar to *P. singaporensis*, but C arising subdistally at prolateral section of T (Figs 17a–b). Palpal tibia (Fig. 17a–c) very similar to *P. singaporensis*.

Female (both legs II are missing)**:**

Body and eye measurements. Carapace length 5.1, carapace width 3.6, anterior width of carapace 2.1, opisthosoma length 8.5, opisthosoma width 3.3. Eyes: AME 0.32, ALE 0.38, PME 0.38, PLE 0.38, AME–AME 0.21, AME–ALE 0.06, PME–PME 0.23, PME–PLE 0.31, AME–PME 0.45, ALE–PLE 0.38, clypeus height at AME 0.81, clypeus height at ALE 0.62.

Cheliceral furrow with three promarginal and four retromarginal teeth.



FIGURES 17a–g. *Psechrus elachys* **sp. nov.**, from Thailand, Satun Prov. a–c, g ♂ paratype SB 862. d–f ♀ holotype SB 861. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). g ♂ left palpal femur, retrolateral view. d Epigyne, ventral view. e Vulva, dorsal view. f Schematic course of internal duct system.

Measurements of palp and legs. Leg formula: ? Palp: 6.5 [2.2, 0.9, 1.3, 2.1]; Legs: I 42.5 [11.6, 2.2, 11.8, 11.1, 5.8], III 22.0 [6.7, 1.4, 5.4, 5.6, 2.9], IV 33.7 [9.8, 1.7, 8.7, 8.6, 4.9].

Palpal claw with 14 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 656, III 555, IV 545; patella I–IV 000; tibia I 3038, III–IV 3136; metatarsus I&III 3035, IV 3036.

Copulatory organ (see also diagnosis and general description of *singaporensis*-group). MS more or less trapezoid (Fig. 17d). Slit sense organs and epigynal muscle sigilla outside epigynal field. CD with winding for 1/4 length at most until reaching receptaculum (Fig. 17e), ca. 1.5x longer than diameter of receptaculum.

Colouration of male and female (see also description for *singaporensis*-group and *Psechrus*). Median bands on carapace serrated (Fig. 82f). Width of lateral bands ca. 1.4x diameter of PME and serrated.

Distribution. Thailand (Fig. 99).

Specimens from *singaporensis*-group with doubtful identification

Figs 18a–c

Material examined (2 ♂♂, 1 s.a. ♀)**: MALAYSIA: Terengganu Province:** Pulau Perhentian Besar, trail across island, from Teluk Pauh to Teluk Dalam, N 05°53'53", E 102°44'53", 110 m, evergreen rain forest; P. Schwendinger leg. at night 05.VI.2008; TPME-08/02; 1 ♂ (SB 134), MHNG. **MALAYSIA: Pahang Province:** Taman-Negara National Park, ca. N 04°40', E 102°28', 200 m, rainforest; P. Nabavi leg. 03.IV.1999; [ex. CJW], |E473/5|; 1 ♂ (SB 1145), 1 s.a. ♀ (SB 1146), SMF.

Description. Male:

Body and eye measurements. Carapace length 7.1, carapace width 5.2, anterior width of carapace 2.7, opisthosoma length 9.4, opisthosoma width 3.5. Eyes: AME 0.42, ALE 0.43, PME 0.43, PLE 0.43, AME–AME 0.21, AME–ALE 0.07, PME–PME 0.26, PME–PLE 0.38, AME–PME 0.43, ALE–PLE 0.41, clypeus height at AME 0.89, clypeus height at ALE 0.67.

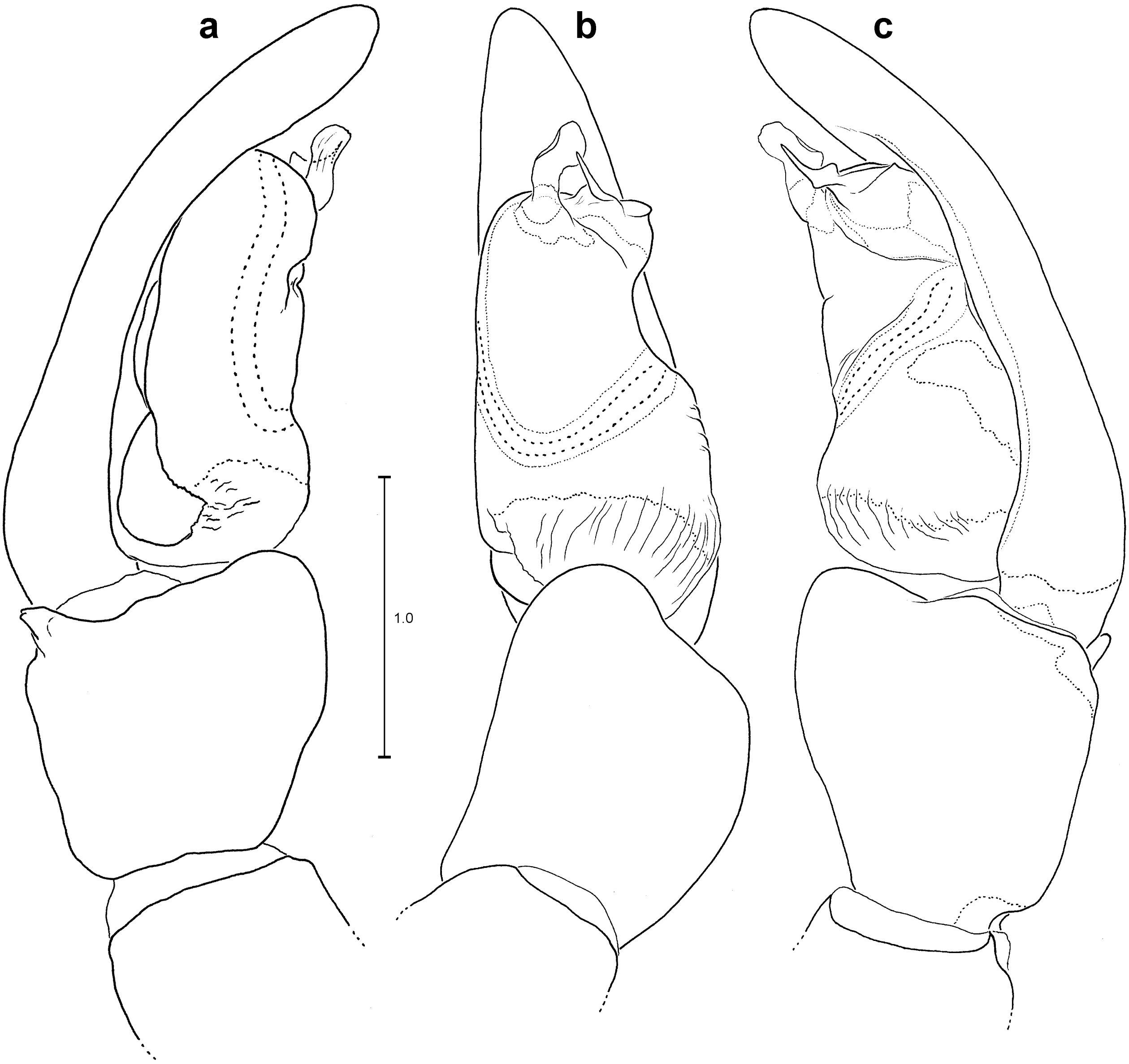
Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 8.1 [2.9, 1.6, 1.1, 2.5]; Legs: I 87.5 [22.6, 3.5, 23.7, 26.8, 10.9], II 64.1 [16.8, 3.1, 16.5, 19.5, 8.2], III 41.3 [11.6, 2.3, 10.3, 12.0, 5.1], IV 67.0 [18.2, 2.6, 16.7, 20.8, 8.7].

Spination. Palp: 141, 110 (prolateral one very small), 1101 (prolateral and ventral one very small); legs: femur I–II 656, III–IV 555; patella I–IV 000; tibia I 3049, II 3036, III 3134, IV 3136; metatarsus I–III 3035, IV 3036.

Palpal femur modified with rounded ventral bulge like in *P. elachys* **sp. nov.** MC-I and MT-I: present, but just as apical row.

Remark: According to the male palp structures (Figs 18a–c) these specimens are very similar to *P. elachys* **sp. nov.** All features match, except for the following: Embolus with dorsal lobe (Fig. 18c). SB 134 from Perhentian solely differs in having a slightly longer tegulum (T) and conductor (C), which arises slightly further retrolateral. This could either mean that the differences to the character features of the palp of the male paratype of *P. elachys* (Fig. 17c) are part of a rather wide range of intraspecific variation in *P. elachys* **sp. nov.** On the other hand, it could be that these specimens belong to a new, slightly different species. Further, it cannot be excluded that they are conspecific with *P. norops* **sp. nov.**, from which only the adult female is known. More *Psechrus* material from Northern and North-Eastern Malaysia, especially females, is required to help solving this ambiguity.



FIGURES 18a–c. *Psechrus* ♂ SB 134 [*singaporensis*-group] with doubtful identification from Malaysia, Terengganu Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view).

Psechrus norops sp. nov.

Figs 19a–c, 87j, 90j

Type material: Holotype ♀ (SB 860), **MALAYSIA: Pahang Province:** Fraser's Hill, ca. N 03°42'30", E 101°44'30", ca. 1200 m; Coll. Rae Sherriffs; Tilg. 27-9-1962; ZMUC 5730.

Etymology. The specific name refers to the bright receptacula seminis in the holotype female (Ancient Greek "norops" means "bright, flashing, gleaming"); term (adjective) in apposition.

Diagnosis (see also diagnosis for *singaporensis*-group above)**.** Females similar to *P. singaporensis* in having a rather simple median septum (MS) and medium sized copulatory ducts (CD). Distinguished by the spermathecal heads (SH) arising upon spermatheca and the narrower copulatory ducts (CD) (Fig. 19b).

Description. Male: unknown.

Female:

Body and eye measurements. Carapace length 5.5, carapace width 3.8, anterior width of carapace 2.4, opisthosoma length 7.8, opisthosoma width 3.1. Eyes: AME 0.34, ALE 0.37, PME 0.39, PLE 0.37, AME–AME

0.19, AME–ALE 0.08, PME–PME 0.27, PME–PLE 0.35, AME–PME 0.52, ALE–PLE 0.43, clypeus height at AME 0.69, clypeus height at ALE 0.58.

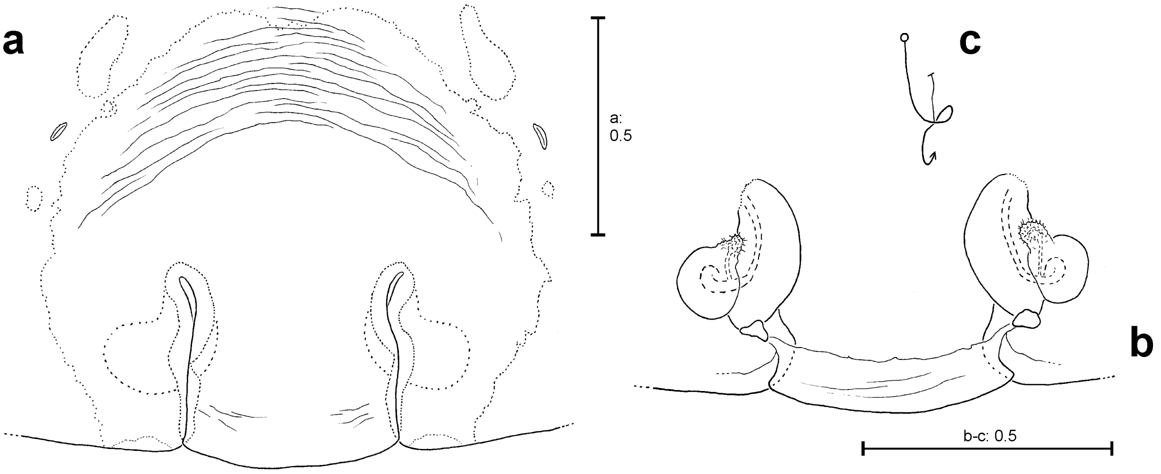
Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 6.6 [2.2, 0.9, 1.2, 2.3]; Legs: I 37.3 [10.0, 2.3, 10.4, 9.3, 5.3], II 28.0 [8.0, 2.0, 7.4, 6.8, 3.8], III 20.3 [5.9, 1.4, 5.0, 4.8, 2.7], IV 30.3 [8.6, 1.8, 7.8, 7.6, 4.5].

Palpal claw with 14 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 656, II 655, III–IV 555; patella I–IV 000; tibia I–II 3038, III–IV 3136; metatarsus I–IV 3035.

Copulatory organ (see also diagnosis and general description of *singaporensis*-group). MS more or less rectangular. Copulatory openings small and narrow (Fig. 19a). Slit sense organs and epigynal muscle sigilla outside epigynal field, but close by. CD with ca. 1/3 winding until reaching receptaculum (Fig. 19b).



FIGURES 19a–c. *Psechrus norops* **sp. nov.**, ♀ holotype SB 860 from Malaysia, Pahang Prov. a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system.

Colouration (see also description for *singaporensis*-group and *Psechrus*). Median bands on carapace at most slightly serrated. Width of lateral bands ca. 1.2x diameter of PME and at most slightly serrated.

Distribution. Malaysia (Fig. 99).

Psechrus arcuatus **sp. nov.**

Figs 20a–c, 87k, 90k

Psechrus singaporensis — Simon 1899: 79, misidentified.

Type material: Holotype ♀ (SB 333), **INDONESIA: Sumatra, Sumatera Barat Province:** Baso; E. Jacobson leg.; Coll. E. Reimoser; E. Reimoser det. *P. singaporensis*; NHMW 12·386.

Etymology. The specific name refers to the anteriorly arcuated copulatory ducts in the holotype female (Latin “arcuatus” means “arcuated, curved”); adjective.

Diagnosis (see also diagnosis for *singaporensis*-group above)**.** Females with rather complex median septum (MS) with anteriorly diverging margins (Fig. 20a). Vulva similar to that of *P. norops* **sp. nov.** in having spermathecal heads (SH) located upon receptacula. Distinguished by the very large copulatory ducts (CD) (ca. 4–5x longer than diameter of receptaculum, Fig. 20b).

Description. Male: unknown.

Female (Tarsi of both legs I, III and IV lost)**:**

Body and eye measurements. Carapace length 5.6, carapace width 4.0, anterior width of carapace 2.3, opisthosoma length 9.2, opisthosoma width 5.3. Eyes: AME 0.32, ALE 0.42, PME 0.43, PLE 0.39, AME–AME 0.19, AME–ALE 0.09, PME–PME 0.30, PME–PLE 0.33, AME–PME 0.53, ALE–PLE 0.45, clypeus height at AME 0.88, clypeus height at ALE 0.62.

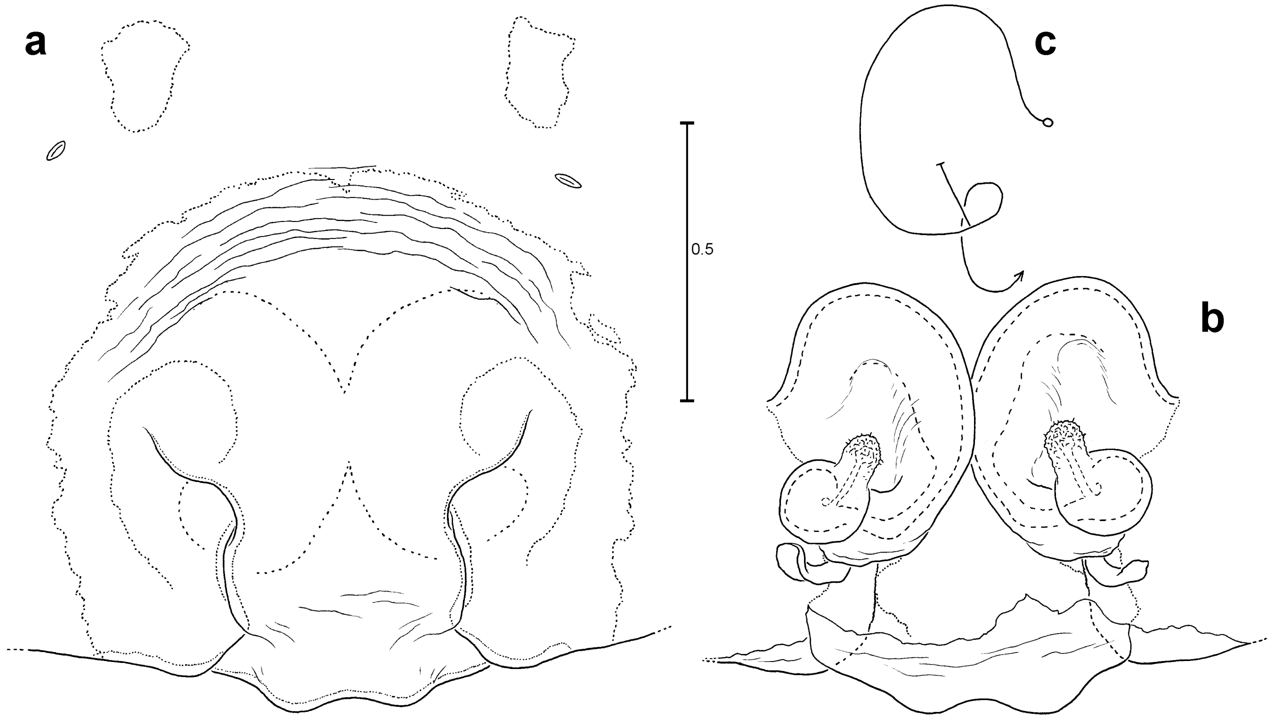
Cheliceral furrow with three promarginal and five (left)/ four (right) retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.1 [2.4, 1.0, 1.3, 2.4]; Legs: I 35.0 (without tarsus) [11.0, 2.2, 11.3, 10.5, –], II 30.9 [8.7, 2.0, 8.0, 7.8, 4.4], III 18.7 (without tarsus) [6.4, 1.7, 5.1, 5.5, –], IV 28.0 (without tarsus) [9.3, 1.9, 8.3, 8.5, –].

Palpal claw with 14 teeth.

Spination. Palp: 161{141}, 110, 1101, 2007{1014}; legs: femur I 654, II 556, III 545, IV 555; patella I–IV 000; tibia I–II 3038, III 3136, IV 3134; metatarsus I–III 3035, IV 3034.

Copulatory organ (see also diagnosis and general description of *singaporensis*-group). MS with two flat bulges posteriorly (Fig. 20a). Copulatory openings large, located underneath the diverging, anterior sections of MS-margins. Slit sense organs and epigynal muscle sigilla outside epigynal field (Fig. 20a). CD with characteristic arcuated anterior margin and ca. 3/4 winding until reaching receptaculum (Fig. 20b).



FIGURES 20a–c. *Psechrus arcuatus* **sp. nov.**, ♀ holotype SB 333 from Indonesia, Sumatra, Sumatera Barat Prov. a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system.

Colouration (see also description for *singaporensis*-group and *Psechrus*). Median bands on carapace slightly serrated. Width of lateral bands ca. 1.4x diameter of PME and slightly serrated.

Remarks. Simon (1899) examined juveniles and subadult females of *Psechrus* from Fort-de-Kock (today: INDONESIA: Sumatra: Sumatera Barat Prov.: Bukittinggi), which is only 8 km west of Baso, the type locality of *P. arcuatus* **sp. nov.** He identified them as *P. singaporensis* and stated that his determination was dubious. Unfortunately, it was not clear in Simon (1899) where the respective material had been deposited, hence it was not examined in the present study. Nevertheless, regarding the geographic situation, Simon (1899) most likely dealt with *P. arcuatus* **sp. nov.**, instead of *P. singaporensis*.

Distribution. Indonesia [Sumatra] (Fig. 99).

ancoralis-group

Diagnosis. Males with elongated, filiform embolus (E) arising retrolaterally on tegulum (T) and with fleshy or membranous conductor (Figs. 21b–c, 25b–c). Females are distinguished from those of all other species groups except the *himalayanus*-group by the following combination of characters: Epigyne without tegimentum (TM, Figs

69a, 89m) and strongly sclerotised epigynal field (EF, Figs 87c–d), with small, slit-like copulatory openings (CO, Fig. 37d) and mostly converging anterior sections of epigynal slits (Figs 27e, 36a) and median septum (MS) mostly broader than long; receptacula not distinctly round, copulatory ducts without distinctly rough surface (Fig. 80b) and bulbous (Fig. 63b) or twisted (Fig. 59b) sections and at most 1.5 times broader than diameter of one receptaculum. Females are distinguished from those of the *himalayanus*-group by the spermathecal heads (SH) located upon the copulatory ducts (CD) (Figs 21e, 29b); the latter longer than diameter of receptaculum.

Description. Sternum yellowish brown at lateral margins and with brown, tapered patch centrally (Fig. 82h). Dorsal spines on tibia III and IV may be present or absent (see each species description). Legs medium-sized in relation to other species-groups: FEM-I+MTT-I/CL : Males: ca. 5; Females: 3–3.7.

Sperm duct in males in ventral view mostly more or less broad U-shaped. Tegulum mostly oval. Cymbium dorsally with moderate dense scopula (Fig. 83a), covering ca. 1/3 of cymbium, in *P. laos* **sp. nov.** only 1/4. Palpal femur without modification. Macrosetae ventrally on coxae of leg I and II (MC-I–II) and trochanter of leg I (MT-I) absent (Fig. 82o), except in *P. ancoralis* Bayer & Jäger, 2010: MC-I and MT-I present, but only as apical row (Fig. 82m).

Females with median septum (MS) broader than long (Figs 21d, 29a). Epigynal field in some species completely degenerated (Figs 27e, 88b,d). Course of internal duct system varying strongly among the different species (Figs 21f, 24c, 25d, 27g, 29c, 30g).

Psechrus ancoralis Bayer & Jäger, 2010

Figs 21a–g, 22a–d, 81a, 82m, 83a, 85a, 88a, 91a

Psechrus ancoralis Bayer and Jäger 2010: 65, figs 26–40, 44–53, 56, 61–62 (Description of ♂ and ♀, illustration of ♂♂ and ♀♀). [Holotype ♀ (SB 4) from LAOS: Luang Nam Tha Province: Nam Ha Protected Area |3|, N 21°08'17.6", E 101°21'07.3", 746 m, under bridge; P. Jäger leg. 06.III.2008; SMF; Paratypes: 2 ♀♀ (SB 3, 5), same data as for holotype; SMF; 2 ♀♀ (SB 23, 27) from Nam Ha Protected Area |2|, N 21°06'43.0", E 101°20'36.1", 693 m, under bridge; P. Jäger leg. 06.III.2008; MHNG; 1 ♂ (SB 26), same data as for SB 23; SMF; 1 ♂ (SB 24), same data as for SB 23; MHNG; 1 ♀ (SB 55) from Nam Ha Protected Area |6|, N 21°03'32.1", E 101°24'03.0", 589 m, under bridge; P. Jäger leg. 07.III.2008; RMNH, all type material examined].

Additional material examined (5 ♂♂, 28 ♀♀, 3 s.a. ♀♀, 3 juvs)**. LAOS: Luang Nam Tha Province:** Nam Ha Protected Area |2|, N 21°06'43", E 101°20'36.1", 693 m, tubes under street; P. Jäger leg. 06.III.2008; 1 p.s.a. ♂ (SB 25), SMF. Nam Ha Protected Area |3|, N 21°08'17.6", E 101°21'07.3", 746 m, tubes under street; P. Jäger leg. 06.III.2008; 2 s.a. ♂♂ (SB 18–19), SMF. Nam Ha Protected Area |4|, N 21°08'48.9", E 101°21'19.0", 770 m, tubes under street; P. Jäger and S. Bayer leg. 19.XI.2009; 4 ♀♀ (SB 314–317), 1 s.a. ♂ (SB 313), SMF. Nam Ha Protected Area |5|, N 21°09'07.2", E 101°19'47.9", 848 m, tubes under street; P. Jäger and S. Bayer leg. 19.XI.2009; 1 ♂ (SB 296), 3 ♀♀ (SB 299, 335, 394), 1 s.a. ♂ (SB 319), 1 juv. (SB 297), SMF. Vieng Phou Kha, Ban Nam Eng, Kao Rao cave, N 20°43'30.5", E 101°09'14.9", 729 m, entrance of cave and aphotic zone; P. Jäger leg. 03.III.2008; 3 ♀♀ (SB SB 33–35), 1 juv. (SB 32), SMF. Vieng Phou Kha, Tham Pasat Thia, NW entrance, N 20°46'37.2", 101°01'00.2", 705 m, inside cave; P. Jäger leg. 04.III.2008; 2 ♀♀ (SB 46–47), SMF. Tham Pasat Thia |2|, N 20°46'45.2", E 101°00'49.7", in cave; H. Steiner leg. 09.II.2006; 1 ♀ (SB 70), RMNH; same data, 1 s.a. ♀ (SB 71), 1 juv. (SB 72), SMF. **Oudomxai Province:** Namor District, Tham Na Thong, N 20°52'20.6", E 101°46'57.8"; |F47-120-003|, ‘Northern Lao – European Cave Project 2009/2010’; |085/10|; H. Steiner leg. 31.I.2010; 1 ♀ (SB 457), SMF. **Luang Prabang Province:** Phou Khoun, Tham Seua, N 19°26'55.7", E 102°26'09.4", in cave; H. Steiner leg. 04.II.2005; |119/05|, 1 ♀ (SB 75), 1 juv. (SB 89), SMF. Phou Khoun, way to Tham Seua, N 19°26'35.8", E 102°26'19.1", 1226 m, slopes at wayside (with escarpments); P. Jäger and S. Bayer leg. by night 13.XI.2009; 3 ♂♂ (SB 320–322), 6 ♀♀ (SB 324–326, 383–385), 2 s.a. ♀♀ (SB 386–387), SMF, 1 ♂ (SB 323), 1 ♀ (SB 327), DUY. Luang Prabang, Nong Khiao, Tham Pathok, N 20°33'05", E 102°37'55", 370 m, outside cave; P. Jäger leg. by night 29.II.2008; 1 ♀ (SB 88), same data but P. Jäger and S. Bayer leg. 16.XI.2009, 1 ♀ (SB 344), both SMF. **Houaphan Province:** Vieng Thong, Tham Mue, N 20°16'54.7", E 103°22'18.4"; H. Steiner leg. 15.I.2009; |F48-135-010|, ‘Northern Lao – European Cave Project 2009’, |50/09|; 1 ♀ (SB 13), SMF. **THAILAND: Nan Province:** Tha Wang Pha District, Nantaburi National Park, Doi Wao, 1500–1600 m, moist evergreen hill forest; P. Dankittipakul and P. Schwendinger leg. 07.XII.2005; 2 ♀♀ (SB 211–212), MHNG; same data, 1 ♀ (SB 217), SMF.

Revised diagnosis (see also diagnosis for *ancoralis*-group above)**.** Males similar to *P. antraeus* Bayer & Jäger, 2010 in having embolus (E) about as long as width of tegulum (T). Distinguished by the broad conductor (C) (more than 1/3 width of T, Fig. 21b). Females with typical short median septum (MS) (at least twice as broad as long) (Fig. 21d). Vulva with spermatheca located anteriolaterally, copulatory ducts (CD) posteriomedially (Fig. 21e) and spermathecal heads (SH) upon anterior, distal part of CD.

Description. Male:

Body and eye measurements. Carapace length 4.5–7.3, carapace width 3.2–5.4, anterior width of carapace 1.8–2.8, opisthosoma length 5.7–8.6 , opisthosoma width 2.9–3.6. Eyes: AME 0.27–0.37, ALE 0.31–0.41, PME 0.32–0.43, PLE 0.31–0.41, AME–AME 0.14–0.18, AME–ALE 0.05–0.08, PME–PME 0.19–0.25, PME–PLE 0.29–0.34, AME–PME 0.42–0.53, ALE–PLE 0.29–0.38, clypeus height at AME 0.50–0.96, clypeus height at ALE 0.48–0.86.

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 6.0–9.2 [2.1–3.3, 1.0–1.7, 0.9–1.4, 2.0–2.8]; Legs: I 40.1–57.5 [9.7–15.4, 2.0–3.4, 11.0–16.1, 11.8–16.3, 5.6–6.3], II 30.7–46.1 [8.1–12.8, 1.9–3.0, 8.0–12.5, 8.6–12.7, 4.1–5.1], III 20.8–31.2 [5.8–9.0, 1.4–2.4, 5.0–7.7, 5.7–8.3, 2.9–3.8], IV 31.6–47.6 [8.3–13.4, 1.7–2.6, 8.0–12.3, 9.0–13.4, 4.6–5.9].

Spination (most common pattern, in parentheses the second most common one).

Palp: 131, 110 (prolateral one very small), 0000; legs: femur I 555 (656), II 555 (556) III 555 (556), IV 554; patella I–IV 000; tibia I–II 3038, III–IV 3034 (3036); metatarsus I–III 3035, IV 3036 (3035).

Palpal femur without modification, distally slightly broader than proximally (see fig. 30 in Bayer and Jäger 2010). MC-I and MT-I present as apical row (Fig. 82m).

Copulatory organ (see also diagnosis and general description for *ancoralis*-group). Flange of C folded retrolaterad to ventrad (Fig. 21c). Basal section of T broader than distal section (Fig. 21b). Palpal tibia in lateral view medium-sized (Fig. 21a,c).

Female: (Measurements of holotype first, those of other specimens as range in parentheses).

Body and eye measurements. Carapace length 7.7 (5.0–8.4), carapace width 5.6 (3.3–5.8), anterior width of carapace 3.2 (2.1–3.5), opisthosoma length 10.2 (6.6–10.4), opisthosoma width 5.2 (3.6–5.8). Eyes: AME 0.41 (0.31–0.40), ALE 0.45 (0.38–0.47), PME 0.53 (0.42–0.53), PLE 0.49 (0.39–0.49), AME–AME 0.19 (0.15–0.21), AME–ALE 0.03 (0.03–0.06), PME–PME 0.26 (0.18–0.33), PME–PLE 0.38 (0.28–0.45), AME–PME 0.56 (0.47–0.67), ALE–PLE 0.46 (0.32–0.58), clypeus height at AME 1.21 (0.72–1.41), clypeus height at ALE 1.04 (0.69–1.24).

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.0 (6.1–9.8) [3.1 (2.0–3.3), 1.4 (0.9–1.5, 1.6 (1.1–1.8), 2.9 (2.1–3.2)]; Legs: I 40.0 (29.9–45.7) [11.0 (8.0–12.3), 3.1 (2.1–3.5), 11.2 (8.2–12.8), 10.0 (7.8–11.7), 4.7 (3.8–5.4)], II 32.5 (24.0–36.4) [9.5 (6.8–10.1), 2.7 (1.8–3.1), 8.5 (6.3–9.8), 7.9 (5.9–9.0), 3.9 (3.2–4.4)], III 23.7 (16.9–24.4) [7.0 (5.0–7.2), 2.2 (1.4–2.2), 5.8 (4.1–6.2), 5.8 (4.1–5.7), 2.9 (2.3–3.1)], IV 32.8 (24.2–38.1) [9.5 (6.9–10.4), 2.4 (1.7–2.7), 8.6 (6.0–10.2), 8.1 (6.1–9.9), 4.2 (3.5–4.9)].

Palpal claw with 16 (13–15) teeth.

Spination. Palp: 131 (131), 110 (110), 1101 (1101), 1014 (1014,1013); legs (—except for patella— variable, only most common states noted): femur I 556 (556,566), II 556 (556) III 556 (555,566), IV 555 (555,554,553); patella I–IV 000; tibia I 3038 (3038), II 3038 (3038), III 3034 (3034,3036), IV 3036 (3034,3036); metatarsus I–III 3035 (3035), IV 3034 (3034,3036).

Copulatory organ (see also diagnosis and general description of *ancoralis*-group). Epigyne with flat depressions in front of copulatory openings (CO) (Figs 21d, 88a). Slit sense organs and epigynal muscle sigilla outside epigynal field.

Primordial copulatory organ. Pre-epigyne: Pre-MS with transversal foldings medially in anterior half (Fig. 22a).

Pre-vulva: Pre-copulatory ducts, in contrast to CD of adult ♀, anterior to (pre-) receptacula (Fig. 22b).

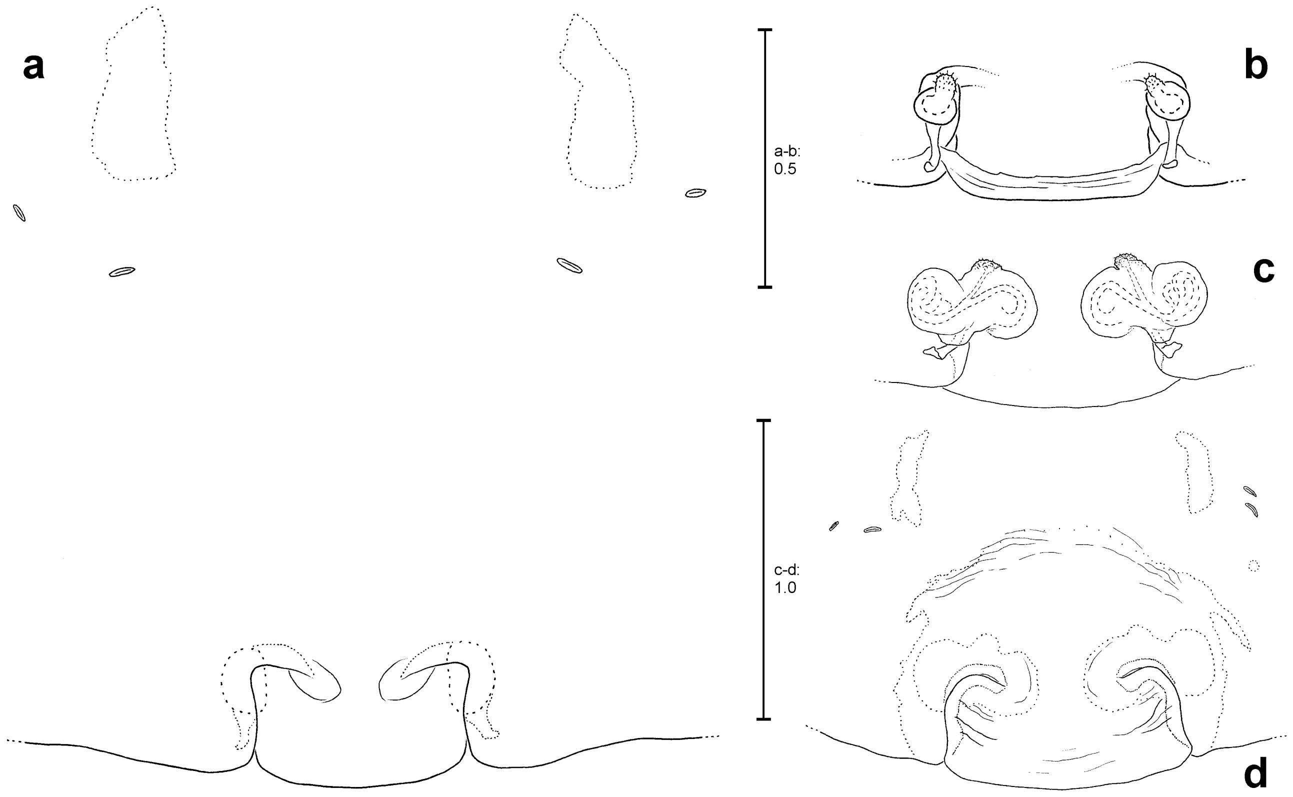
Colouration of male and female (see also description for *ancoralis*-group and *Psechrus*). Median bands on carapace slightly serrated or serrated (Fig. 81a). Lateral bands narrow (ca. 1/2 diameter of PME) and slightly serrated. Light longitudinal line ventrally on opisthosoma continuous, its width medium-sized. If measured centrally on opisthosoma, its width is ca. 2/3 the width of one half of the cribellum.

FIGURES 21a–g. *Psechrus ancoralis*, from Laos, Luang Nam Tha Prov. a–c ♂ paratype SB 26. d–f ♀ holotype SB 4. g ♀ paratype SB 27. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d Epigyne, ventral view. e Vulva, dorsal view. f Schematic course of internal duct system. g right palpal claw, retrolateral view.

Variation of copulatory organs. Males with only slight variation (not illustrated). In females the variation is high (see description and illustrations in Bayer and Jäger 2010). Length of MS and the distances between copulatory openings vary. In the vulva, the distance between spermatheca varies, copulatory ducts extend differently posteriorly.

Remarks: The specimens SB 211–212 and 217 (Figs 22c,d) from Nan Province, Thailand differ from specimens recorded in Laos. Their vulvae seem shifted, hence CD are located almost as far anterior as the spermatheca (Fig. 22c). Additionally, the SH are on average shorter than in the specimens from Laos (which means that there are also Laotian specimens with rather flat SH). The epigynes of the specimens SB 211–212 and 217 fit in with the variation range of *P. ancoralis*. Unfortunately no male was recorded from Nan Province. Because of those rather slight differences (in interspecific regard) and the lack of material, especially males, I do not consider those specimens as belonging to a different species.

Distribution. Laos, Thailand (Fig. 98).



FIGURES 22a–d. *Psechrus ancoralis*, ♀ primordial and adult copulatory organ. a–b s.a. ♀ SB 386 from Laos, Luang Prabang Prov. c–d ♀ SB 217 from Thailand, Nan Prov. a Pre-epigyne, ventral view. b Pre-vulva, dorsal view. d Epigyne, ventral view. c Vulva, dorsal view.

Psechrus rani Wang & Yin, 2001

Figs 23a–d, 24a–e, 85b, 88b, 91b

Psechrus rani Wang and Yin 2001: 335, figs 13–18 (Description and illustration of ♂ and ♀). [Holotype ♂ from CHINA: Guizhou Province: Libo, Maolan National Nature Reserve, Sanchahe; X.P. Wang leg. 06.X.1997; IZB; Paratype: ♀ from CHINA: Guizhou Province: Libo, Xiaoqikong; J.C. Ran leg. 02.III.1995; IZB; both types not available on request as they could not be found in the arachnid collection of IZB (S. Li, IZB, pers. comm.), thus not examined]. Bayer and Jäger 2010: 65, figs 41–43 (illustration of ♂).

Psechrus sinensis — Silva 2003: 45, fig. 16a (SEM-photo of ♂ palp, misidentified).

Material examined (1 ♂, 3 ♀♀, 1 s.a. ♀, 1 juv.). **CHINA: Hongkong:** New Territories, Tai Po Kau National Park, N 22°25'57", E 114°10'58", 400 m; S. Huber leg. 13.XII.2003; 1 ♀ (SB 818), SMF. New Territories, Kadoorie Farm, N 22°25'48", E 114°07'19", 411 m; S. Huber leg. 11.XII.2003; 1 ♀ (SB 819), SMF. **VIETNAM: Lang Son**

Province: N Hong Phong, Cave Mudi; P. Beron & D. Karucharov leg. 13.III.1986; 1 ♂ (SB122), 1 juv. (SB 945), Deeleman Coll. in RMNH. **Lang Son Province:** Klu Choeng; leg. 01.V.1998; Coll. X.P. Wang; 1 ♀ (SB 1157), 1 s.a. ♀ (SB 1158), AMNH.

Revised diagnosis (see also diagnosis for *ancoralis*-group above)**.** Males similar to *P. ancoralis* in having tegulum (T) broadest basally. Distinguished from *P. ancoralis* by the longer embolus (E) and the narrower conductor (C) exhibiting a large base (CB) (Figs 23a–c). Males also similar to *P. laos* **sp. nov.**, namely in having a large CB. Distinguished from *P. laos* **sp. nov.** by the smaller and less voluminous CB and the shorter E. Females similar to *P. laos* **sp. nov.** in shape of median septum (MS) and general shape of vulva. The latter with short and initially complicatedly curved copulatory duct (CD) and helical spermathecal section (Figs 24b, 25d). Distinguished by the lower helical spermathecal section of vulva with less than three windings (Fig. 24b) and by the distance between the two fields of epigynal muscle sigilla (EM), which, —in contrast to *P. laos* **sp. nov.**— is clearly longer than the width of MS.

Description. Male (both legs I lost)**:**

Body and eye measurements. Carapace length 6.3, carapace width 4.5, anterior width of carapace 2.4, opisthosoma length 7.4, opisthosoma width 2.9. Eyes: AME 0.36, ALE 0.42, PME 0.43, PLE 0.42, AME–AME 0.13, AME–ALE 0.07, PME–PME 0.20, PME–PLE 0.32, AME–PME 0.45, ALE–PLE 0.37, clypeus height at AME 0.68, clypeus height at ALE 0.67.

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 8.2 [2.8, 1.3, 1.3, 2.8]; Legs: II 44.8 [12.7, 2.6, 11.1, 12.3, 6.1], III 30.8 [8.1, 2.1, 7.3, 8.1, 4.2], IV 46.6 [12.8, 2.4, 11.6, 13.1, 6.7].

Spination. Palp: 131, 110, 1101 (prolateral and ventral one very small); legs: femur II 556, III 555, IV 556; patella II–IV 000; tibia II 3038, III 3134, IV 3035; metatarsus II–IV 3035.

Palpal femur without modification (Fig. 23d), similar to the one of *P. ancoralis.*

Copulatory organ (see also diagnosis and general description for *ancoralis*-group). Flange of C bent retrolaterad to ventrad. Basal section of T retrolaterally with small bulge (Figs 23b,c). Palpal tibia with very flat ventral bulge (Figs 23a,c).

Female: (Measurements of SB 818 from Tai Po Kau first, those of SB 819 in parentheses).

Body and eye measurements. Carapace length 5.8 (7.7), carapace width 3.8 (4.8), anterior width of carapace 2.3 (3.0), opisthosoma length 8.2 (10.0), opisthosoma width 4.1 (5.2). Eyes: AME 0.37 (0.39), ALE 0.43 (0.43), PME 0.43 (0.43), PLE 0.42 (0.43), AME–AME 0.18 (0.18), AME–ALE 0.06 (0.06), PME–PME 0.21 (0.21), PME–PLE 0.30 (0.30), AME–PME 0.50 (0.50), ALE–PLE 0.34 (0.34), clypeus height at AME 0.98 (1.17), clypeus height at ALE 0.88 (1.03).

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.2 (8.6) [2.4 (2.9), 1.1 (1.3), 1.3 (1.6), 2.4 (2.8)]; Legs: I 38.1 (45.9) [10.1 (12.5), 2.5 (3.0), 10.6 (13.0), 9.8 (11.7), 5.1 (5.7)], II 29.9 (35.9) [8.3 (10.0), 2.2 (2.9), 8.0 (9.5), 7.5 (9.0), 3.9 (4.5)], III 21.8 (25.3) [6.4 (7.5), 1.7 (2.1), 5.4 (6.2), 5.4 (6.3), 2.9 (3.2)], IV 31.4 (36.8) [9.0 (10.5), 2.1 (2.5), 8.0 (9.5), 7.9 (9.3), 4.4 (5.0)].

Palpal claw with 14 (14) teeth.

Spination. Palp: 131{141} (131), 110 (110), 1101 (1101), 1014 (1014); legs: femur I 566 (557), II 556 (556) III–IV 555 (555); patella I–IV 000 (000); tibia I–II 3038 (3038), III 3134 (3134), IV 3136 (3134); metatarsus I–III 3035 (3035), IV 3034 (3034).

Copulatory organ (see also diagnosis and general description of *ancoralis*-group). Epigyne without epigynal field (Fig. 24a, 88b). Lateral margins of MS anteriorly strongly curved. MS showing two, curved longitudial ridges posterior to the copulatory openings (CO) (Fig. 24a).

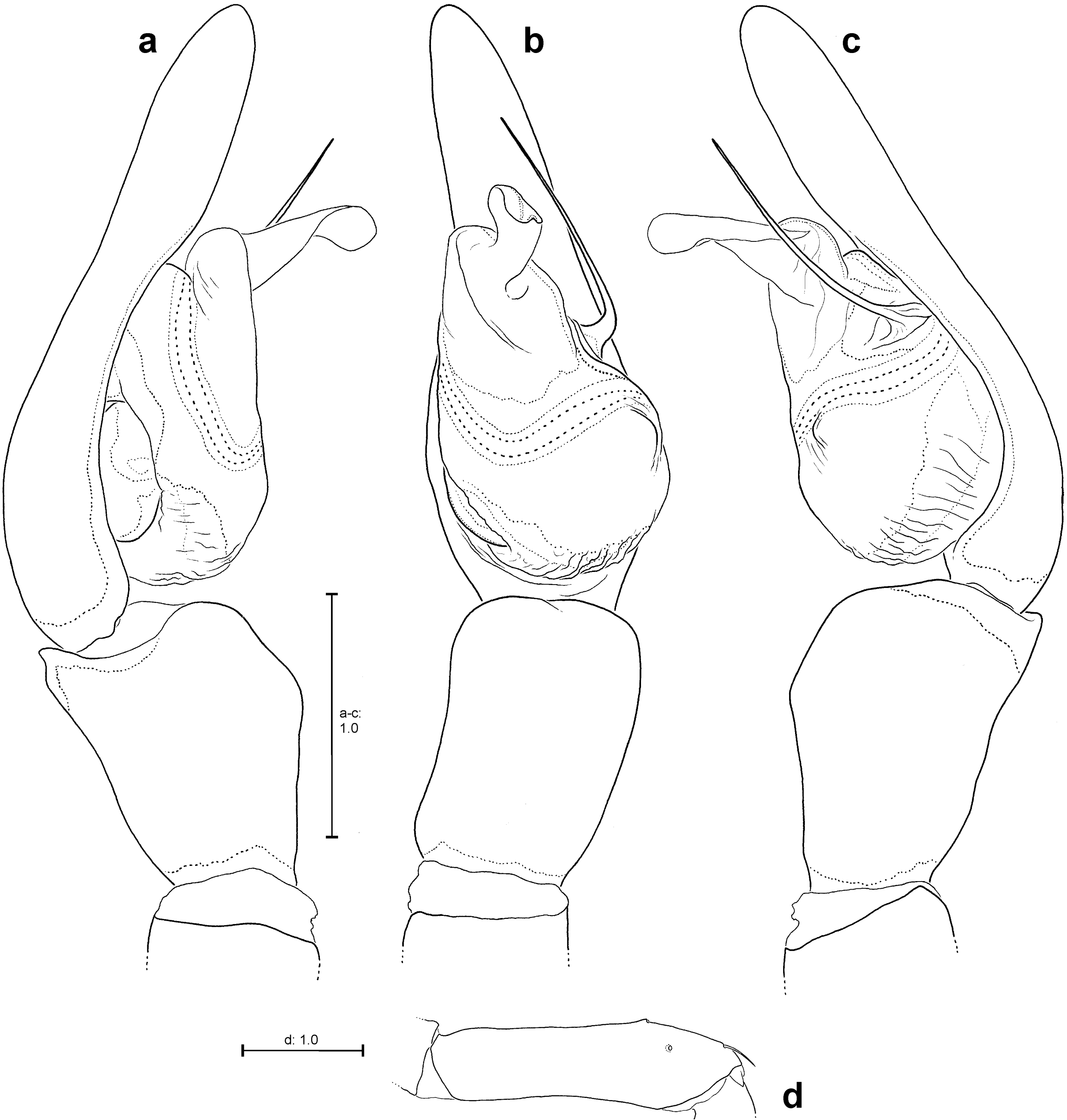
Colouration of male and female (see also description for *ancoralis*-group and *Psechrus*). Median bands on carapace serrated. Lateral bands rather narrow (almost diameter of PME) and slightly serrated. Light longitudinal line ventrally on opisthosoma continuous and narrow. If measured centrally on opisthosoma, its width is ca. 1/3 the width of one half of the cribellum.

Variation of copulatory organs. The two, curved longitudial ridges posterior to the CO in SB 818 less distinct (Fig. 88b).

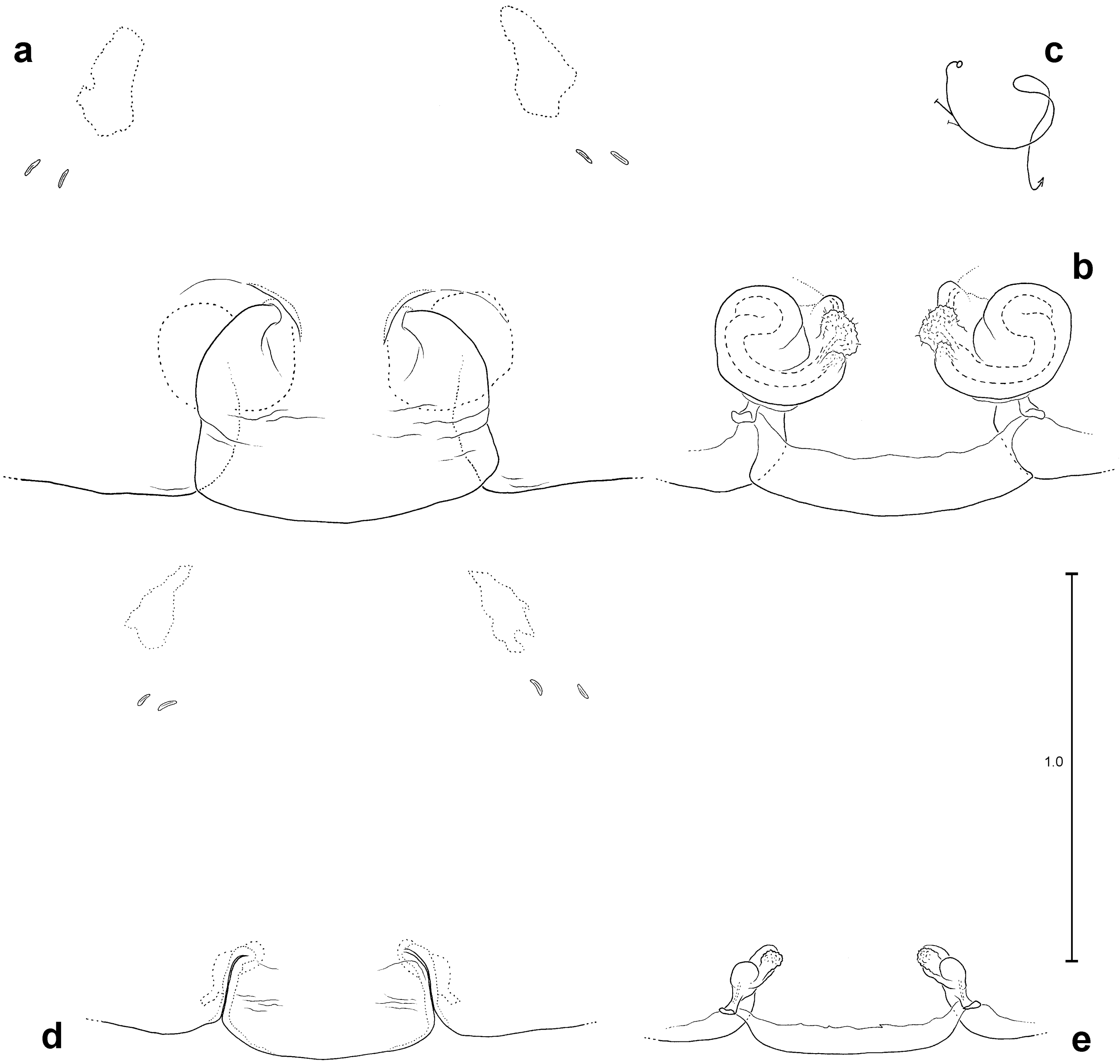
Remarks: There is a possibily that the males and females examined herein and in Wang and Yin (2001) may not be conspecific, as the recorded localities of the two type specimens were not exactly the same (see synonymic list above); however it is much more likely that they are conspecific because the female of *P. laos* **sp. nov.** (a very closely related species) shows the same basic structure in vulva and the shorter E in the males of *P. rani*, in comparison to those of *P. laos* **sp. nov.**, would fit in the shorter helical spermathecal section in the vulvae of female *P. rani*.

Although the types of *P. rani* were not available for examination, the males and females examined in the present study were identified as such, as they match the illustrations of *P. rani* in Wang and Yin (2001). This does not apply to their illustration of male palp in retrolateral view (see Wang and Yin 2001, fig. 14). It is likely that this illustration does not reflect the real situation (for that concern see also discussion in Bayer and Jäger 2010, p. 73).

Distribution. China, Vietnam (Fig. 96).



FIGURES 23a–d. *Psechrus rani*, ♂ SB 122 from Vietnam, Lang Son Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ right palpal femur, retrolateral view.



FIGURES 24a–e. *Psechrus rani*, ♀ primordial and adult copulatory organ. a–c ♀ SB 819 from China, Hongkong. d–e s.a. ♀ SB 1158 from Vietnam, Lang Son Prov. a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system. d Pre-epigyne, ventral view. e Pre-vulva, dorsal view.

Psechrus laos sp. nov.

Figs 25a–f, 26a–d, 85c, 88c, 91c

Type material: Holotype ♂ (SB 367), **LAOS: Bolikhamsay Province:** Lak Sao |1|, N 18°11'09.0", E 104°53'55.0", 500 m, between rocks; P. Jäger & S. Bayer leg. 08.XI.2009; SMF. **Paratypes:** ♂ (SB 355), ♀ (SB 368), same data as for holotype; SMF; **3** ♀♀ (SB 372–374), Lak Sao |4|, N 18°13'38.2", E 104°44'47.3", 534 m, cave entrance, between rocks; P. Jäger & S. Bayer leg. 09.XI.2009; SMF; **2** ♀♀ (SB 377–378), Lak Sao, Tham Mang Kone, N 18°13'16.1", E 104°48'45.9", 500 m, cave entrance; P. Jäger & S. Bayer leg. 09.XI.2009; SMF.

Additional material examined (5 s.a. ♂♂, 1 s.a. ♀, 2 juvs)**. LAOS: Bolikhamsay Province:** Lak Sao |1|, N 18°11'09.0", E 104°53'55.0", 500 m, between rocks; P. Jäger & S. Bayer leg. 08.XI.2009; 3 s.a. ♂♂ (SB 341, 345, 370), 1 s.a. ♀ (SB 406), 1 juv. (SB 369), SMF. Lak Sao |4|, N 18°13'38.2", E 104°44'47.3", 534 m, cave entrance, between rocks; P. Jäger & S. Bayer leg. 09.XI.2009; 1 s.a. ♂ (SB 343), 1 juv. (SB 376), SMF. Lak Sao, Tham Mang

Kone, N 18°13'16.1", E 104°48'45.9", 500 m, cave entrance; P. Jäger & S. Bayer leg. 09.XI.2009; 1 s.a. ♂ (SB 354), SMF

Etymology. The specific name refers to the habitat of this species (Ancient Greek “las” means “stone, rock, crag”; genitive case: “laos”); noun in genitive case.

Diagnosis (see also diagnosis for *ancoralis*-group above)**.** Males similar to *P. rani* in having a large conductor base (CB). Distinguished by the very long embolus (E) (clearly longer than tegulum [T]) and the larger, voluminous CB (Figs 25a–c). Females similar to *P. rani* in shape of median septum (MS) and general shape of vulva (see diagnosis *P. rani*). Distinguished by the higher (longer) helical spermathecal section of vulva with more than three windings (Fig. 25d) and by the distance between the two epigynal muscle sigilla (EM), which is not or just slightly longer than the width of MS (Figs 25f, 26c).

Description. Male (measurements of holotype first, those of paratype SB 355 in parentheses)**:**

Body and eye measurements. Carapace length 6.0 (4.8), carapace width 4.1 (3.4), anterior width of carapace 2.4 (1.9), opisthosoma length 7.3 (6.2), opisthosoma width 3.4 (2.7). Eyes: AME 0.37 (0.33), ALE 0.43 (0.39), PME 0.45 (0.41), PLE 0.44 (0.41), AME–AME 0.16 (0.15), AME–ALE 0.02 (0.03), PME–PME 0.18 (0.16), PME–PLE 0.31 (0.28), AME–PME 0.55 (0.49), ALE–PLE 0.32 (0.29), clypeus height at AME 0.82 (0.74), clypeus height at ALE 0.71 (0.64).

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp 8.1 (6.8) [2.8 (2.4), 1.2 (0.9), 1.2 (1.0), 2.9 (2.5)] , I 54.9 (46.5) [14.2 (11.5), 2.6 (2.2), 15.3 (12.8), 16.0 (14.0), 6.8 (6.0)], II 42.5 (35.2) [12.0 (9.3), 2.4 (2.1), 10.9 (9.1), 12.0 (10.4), 5.2 (4.3)], III 30.0 (23.4) [8.7 (6.7), 2.0 (1.7), 7.2 (5.6), 8.2 (6.4), 3.9 (3.0)], IV 44.3 (36.8) [12.3 (10.0), 2.2 (1.8), 11.2 (9.3), 12.4 (10.3), 6.2 (5.4)].

Spination. Palp: 131 (141), 010 (010), 0100 (0100); legs: femur I 656 (556), II 555 (556) III 555 (555), IV 545{554} (545); patella I–IV 000; tibia I 3039 (3038), II 3038 (3039), III 3036 (3036), IV 3035 (3036); metatarsus I 3037 (3035), II 3035 (3035), III 3035 (2023), IV 3035{3036} (3036).

Palpal femur without modification, shaped like in *P. antraeus* (see below).

Copulatory organ (see also diagnosis and general description for *ancoralis*-group). Proximal section of T short. CB medio-distally with semicircular notch (Fig. 25b). Palpal tibia short (Fig. 25a,c).

Female:

Body and eye measurements. Carapace length 5.1–7.6, carapace width 3.4–5.2, anterior width of carapace 2.3–3.3, opisthosoma length 6.9–11.9, opisthosoma width 3.9–5.9. Eyes: AME 0.34–0.38, ALE 0.44–0.47, PME 0.41–0.46, PLE 0.42–0.46, AME–AME 0.18–0.21, AME–ALE 0.06–0.08, PME–PME 0.22–0.24, PME–PLE 0.32–0.36, AME–PME 0.49–0.60, ALE–PLE 0.38–0.47, clypeus height at AME 0.86–1.01, clypeus height at ALE 0.79–0.97.

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 6.4–9.2 [2.2–3.1, 1.0–1.3, 1.1–1.7, 2.1–3.1]; Legs: I 34.4–47.5 [9.5–13.3, 2.1–3.3, 9.8–12.3, 8.6–12.7, 4.4–5.9], II 27.3–38.2 [7.8–10.9, 2.0–3.0, 7.2–10.0, 6.8–9.7, 3.5–4.6], III 19.0–27.9 [6.0–8.3, 1.4–2.3, 4.6–6.8, 4.5–7.1, 2.5–3.4], IV 28.4–39.2 [8.0–11.2, 1.9–2.6, 7.4–10.1, 7.3–10.1, 3.8–5.2].

Palpal claw with 14–15 teeth.

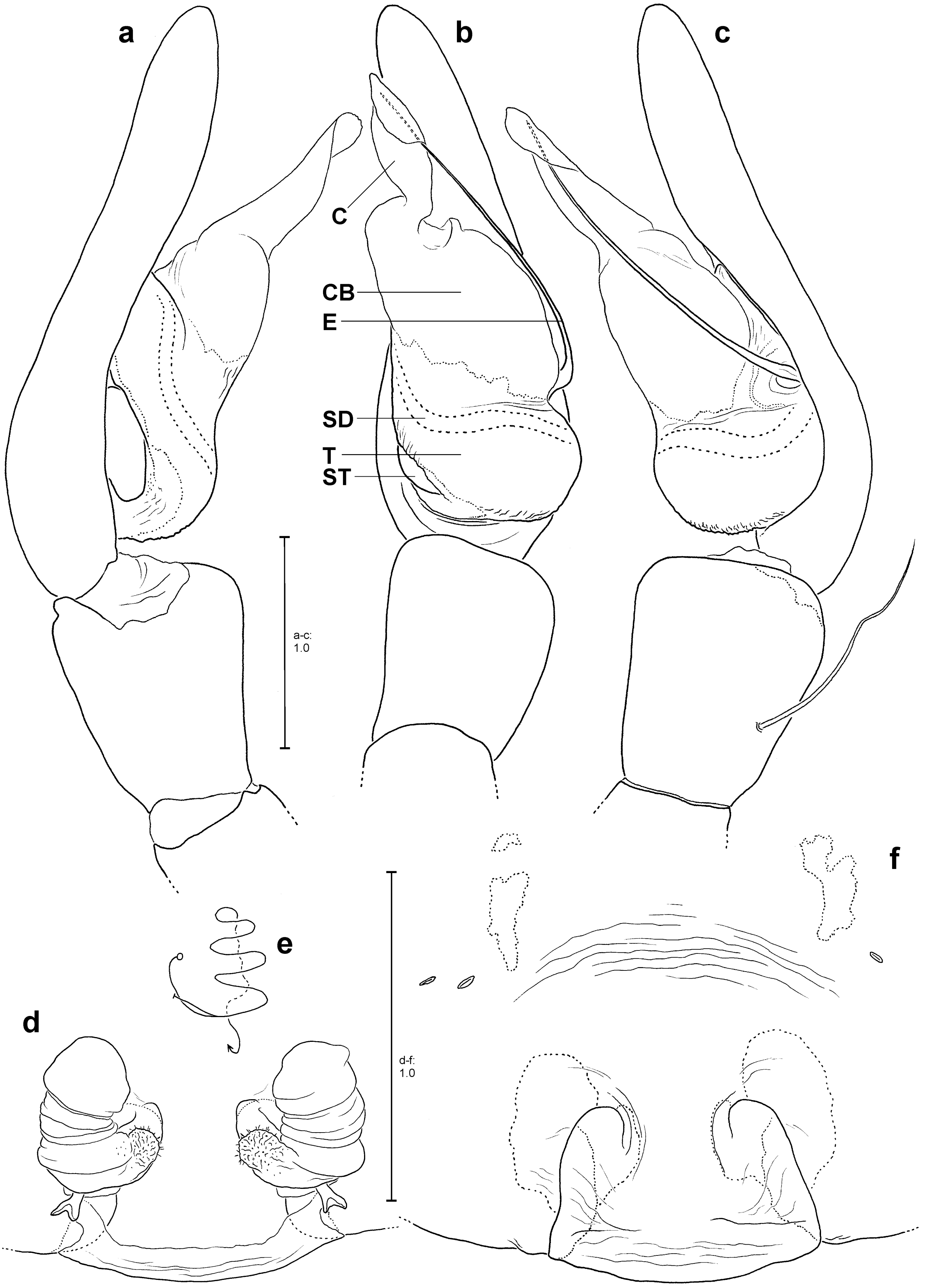
Spination. Palp: 131, 110, 1101, 1014 (1015); legs (—except for patella— variable, only most common states noted): femur I 556 (557,566), II 556, III 556 (555), IV 544 (554); patella I–IV 000; tibia I–II 3038, III 3036 (3035,3026), IV 3035 (3036,3037); metatarsus I–III 3035, IV 3034 (3036).

Copulatory organ (see also diagnosis and general description of *ancoralis*-group). Lateral margins of MS anteriorly strongly curved. MS showing two, slightly curved longitudial ridges posterior to copulatory openings (Figs 25f, 26c), which are generally more distinct than in *P. rani*. Epigynal field mostly absent, if present, then indistinct.

Primordial copulatory organ. Pre-epigyne: Pre-septum relatively long, with two fine transversal edges in posterior half (Fig. 26a).

Pre-vulva: Pre-copulatory duct just slightly curved (Fig. 26b), pre-spermatheca and pre-spermathecal head quite compact.

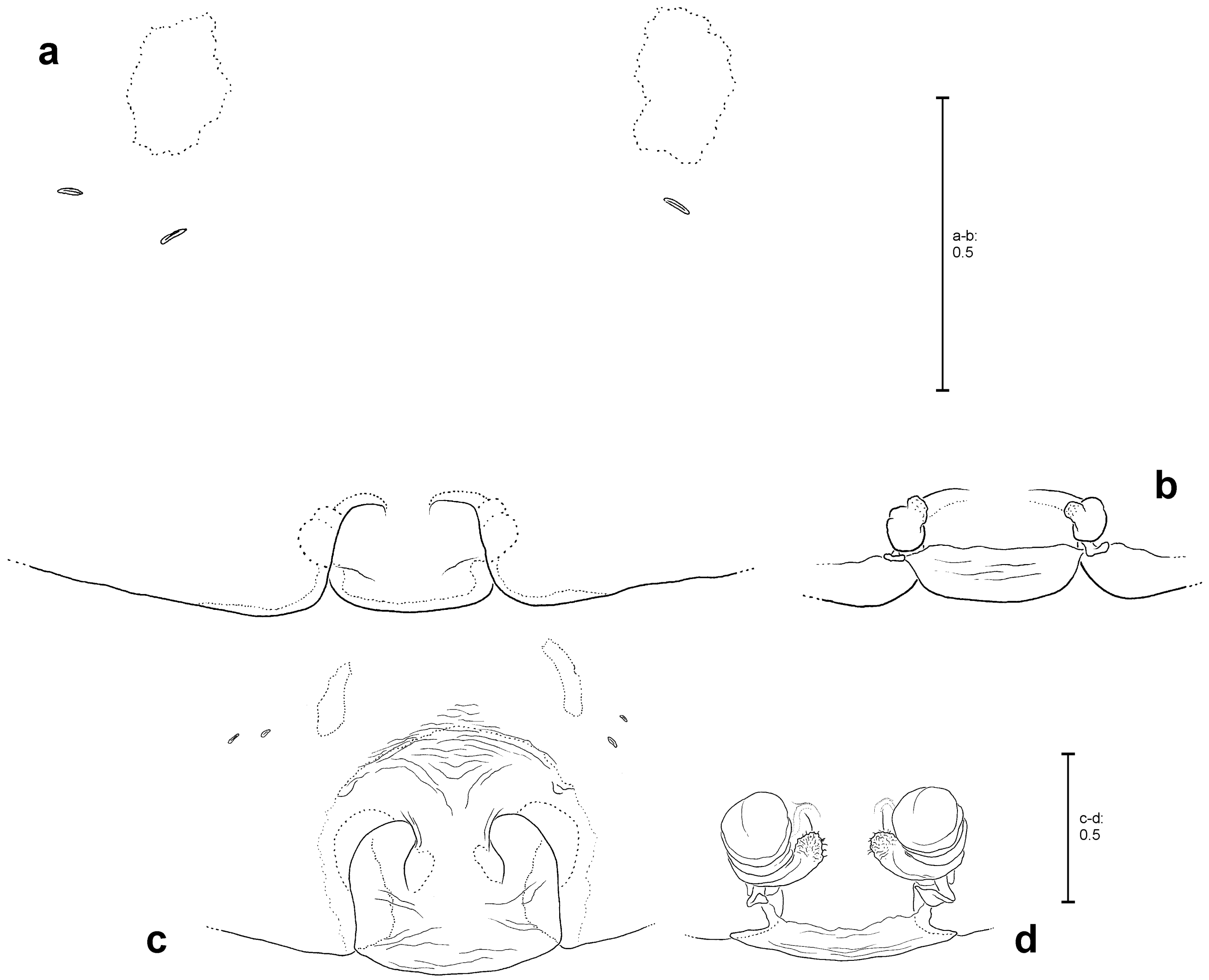
Colouration of male and female (see also description for *ancoralis*-group and *Psechrus*). Median bands on carapace serrated. Lateral bands narrow (ca. 1/2 diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma continuous and rather narrow. If measured centrally on opisthosoma, its width is ca. 1/2 the width of one half of the cribellum.



FIGURES 25a–f. *Psechrus laos* **sp. nov.**, from Laos, Bolikhamsay Prov. a–c ♂ holotype SB 367. d–f ♀ paratype SB 377. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). f Epigyne, ventral view. d Vulva, dorsal view. e Schematic course of internal duct system. C: Conductor; CB: Conductor base; E: Embolus; SD: Sperm duct; ST: Subtegulum; T: Tegulum.

Variation of copulatory organs. Males: Variation only insignificant. Females: Epigyne may be with indistinct (Fig. 26c) or without epigynal field (Fig. 25f). The two, slightly curved longitudial ridges posterior to the area of copulatory openings differ in length and structure (Figs 25f, 26c). Lateral margins of MS may be parallel (Fig. 26c) or converging somewhat (Fig. 25f, 88c). In vulva the length of helical spermathecal section differs (Fig. 25d, 26d) at high level.

Distribution. Laos (Fig. 98).



FIGURES 26a–d. *Psechrus laos* **sp. nov.**, from Laos, Bolikhamsay Prov., primordial and adult copulatory organ. a–b s.a. ♀ paratype SB 406. c–d ♀ paratype SB 368. a Pre-epigyne, ventral view. b Pre-vulva, dorsal view. c Epigyne, ventral view. d Vulva, dorsal view.

Psechrus antraeus **Bayer & Jäger, 2010**

Figs 27a–g, 82h,o, 85d, 88d, 91d

Psechrus antraeus Bayer and Jäger 2010: 61, figs 10–23, 55, 58–60 (Description of ♂ and ♀, illustration of ♂ and ♀♀). [Holotype ♀ (SB 8) from LAOS: Vientiane Province: Vang Vieng, W of VV, Tham Khan, N 18°55'32.0", E 102°24'57.7", 302 m, in cave; P. Jäger leg. 15.III.2008; SMF; Paratypes: 1 ♂ (SB7), same data as for holotype; SMF; 2 ♀♀ (SB43–44) from Vang Vieng, W of VV, Tham Pou Kham, N 18°55'32.9", E 102°24'44", 260 m, inside limestone cave; P. Jäger leg. 15.III.2008; MHNG; 2 ♀♀ (SB73–74) from same locality as SB 43–44; P. Jäger & F. Steinmetz leg. 13.III.2007; RMNH; all type material examined].

Additional material examined (2 ♀♀, 1 s.a. ♂, 1 juv.)**. LAOS: Vientiane Province:** Vang Vieng, W of VV, Tham Pou Kham, N 18°55'32.9", E 102°24'44", 260 m, inside limestone cave; P. Jäger leg. 15.III.2008; 1 juv. (SB 45), SMF; Same locality; P. Jäger & S. Bayer leg. 12.XI.2009; 2 ♀♀ (SB 294–295), SMF. Vang Vieng, W of VV, Tham Pou Na, N 18°55'32.5", E 102°22'55.5", 280 m, overgrown rockwall; P. Jäger & S. Bayer leg. 12.XI.2009; 1 s.a. ♂ (SB 298), SMF.

Revised diagnosis (see also diagnosis for *ancoralis*-group above)**.** Males similar to *P. ancoralis* in having embolus (E) about as long as width of tegulum (T). Distinguished by the narrower conductor (C) (ca. 1/4 width of T, Fig. 27b) and the E, which is curved prolaterad in distal section (Fig. 27b). Females with median septum (MS) just slightly shorter than broad (Figs 27e, 88d). Distance between copulatory openings (CO) at most half as long as entire septum length. In vulva the initial parts of copulatory ducts (CD) located clearly anterior to spermathecal heads (SH) and spermathecae (Figs 27f, 91d).

Description. Male:

Body and eye measurements. Carapace length 5.5, carapace width 3.9, anterior width of carapace 2.2, opisthosoma length 5.8, opisthosoma width 2.4. Eyes: AME 0.31, ALE 0.44, PME 0.42, PLE 0.42, AME–AME 0.11, AME–ALE 0.03, PME–PME 0.18, PME–PLE 0.26, AME–PME 0.47, ALE–PLE 0.38, clypeus height at AME 0.68, clypeus height at ALE 0.59.

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.2 [2.5, 1.2, 1.1, 2.4]; Legs: I 53.8 [14.4, 2.6, 14.7, 15.4, 6.7], II 41.2 [11.2, 2.5, 10.9, 11.6, 5.0], III 26.4 [7.7, 2.0, 6.2, 7.1, 3.4], IV 42.4 [11.4, 2.1, 10.6, 12.4, 5.9]. Spination. Palp: 131, 010, 1101(prolateral and ventral one smaller); legs: femur I–II 566, III–IV 555; patella I–IV 000; tibia I 3038{30310}, II 3038, III 3034, IV 3036; metatarsus I 3038, II–III 3035, IV 3037.

Palpal femur without modification, rather slim (Fig. 27d).

Copulatory organ (see also diagnosis and general description for *ancoralis*-group). Conductor (C) almost straight and almost as long as T (Figs 27a–c). Palpal tibia (Figs 27a–c) longer and narrower than in *P. ancoralis*.

Female: (Measurements of holotype first, those of other specimens as range in parentheses).

Body and eye measurements. Carapace length 5.7 (5.9–8.1), carapace width 4.0 (4.0–5.6), anterior width of carapace 2.5 (2.5–3.3), opisthosoma length 7.6 (8.8–12.6), opisthosoma width 3.6 (4.4–7.4). Eyes: AME 0.37 (0.36–0.45), ALE 0.40 (0.43–0.51), PME 0.45 (0.47–0.52), PLE 0.44 (0.43–0.51), AME–AME 0.12 (0.13–0.19), AME–ALE 0.06 (0.03–0.06), PME–PME 0.22 (0.18–0.27), PME–PLE 0.35 (0.24–0.41), AME–PME 0.44 (0.46–0.58), ALE–PLE 0.36 (0.26–0.42), clypeus height at AME 0.75 (0.98–1.24), clypeus height at ALE 0.70 (0.89–0.96).

Cheliceral furrow with three promarginal and six retromarginal teeth in holotype and one other female (three promarginal and five retromarginal in remaining females).

Measurements of palp and legs. Leg formula: 1423. Palp: 7.2 (7.5–9.7) [2.6 (2.5–3.1), 1.0 (1.1–1.4, 1.3 (1.4–2.0), 2.3 (2.5–3.2)]; Legs: I 37.9 (39.9–50.1) [10.3 (10.7–13.4), 2.4 (2.5–3.4), 10.9 (11.2–14.5), 9.9 (10.4–13.0), 4.4 (5.1–5.8)], II 29.9 (31.8–40.3) [8.8 (9.1–11.6), 2.0 (2.3–3.1), 8.0 (8.5–10.7), 7.6 (8.0–10.2), 3.5 (3.9–4.7)], III 20.8 (21.8–28.8) [6.3 (6.6–8.7), 1.7 (1.7–2.4), 5.1 (5.3–7.1), 5.2 (5.5–7.3), 2.5 (2.7–3.3)], IV 30.9 (33.0–40.6) [9.1 (9.5–11.8), 1.9 (2.0–2.8), 7.9 (8.6–11.2), 8.0 (8.4–10.6), 4.0 (4.2–4.5)].

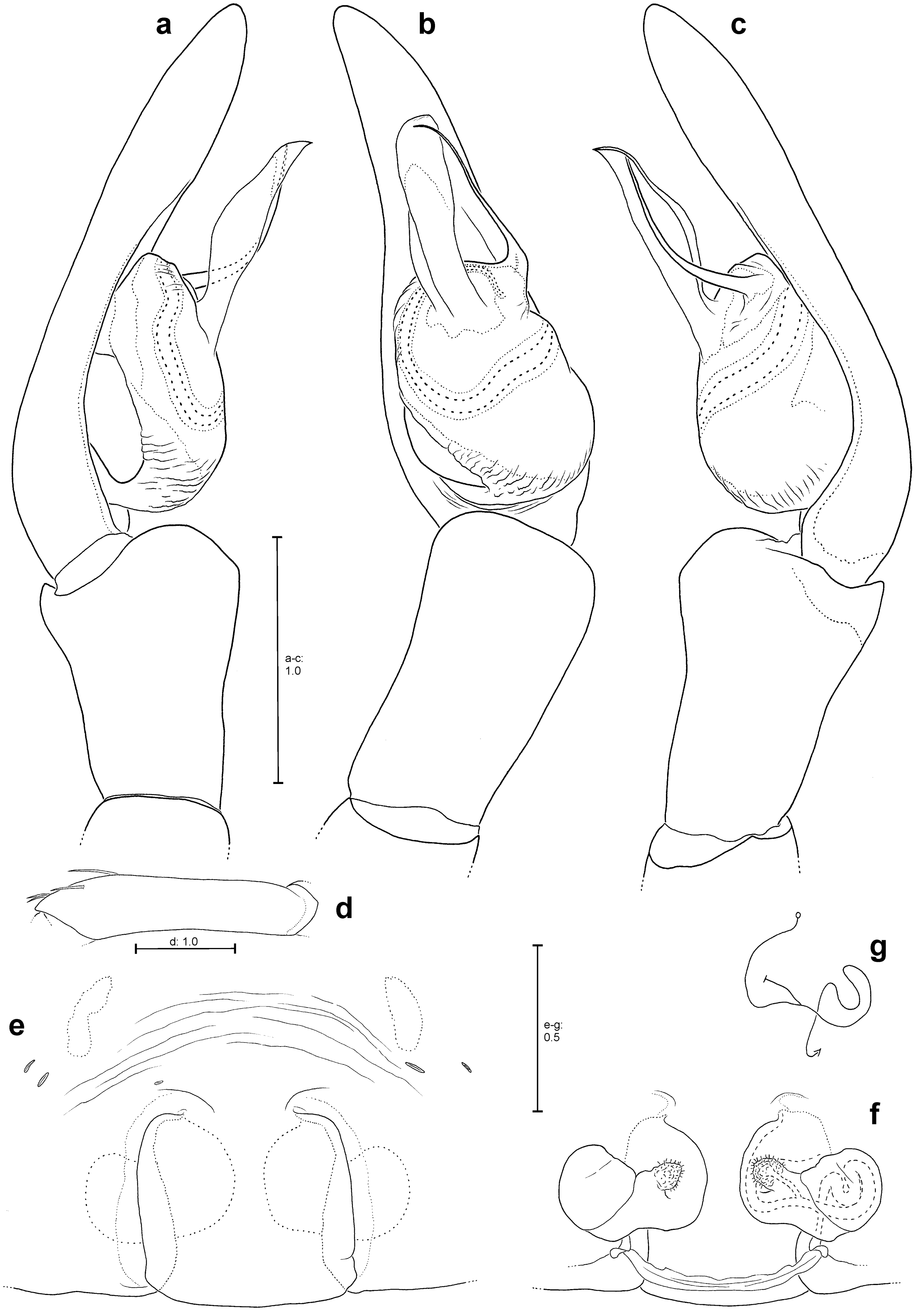
Palpal claw with 13 (13–16) teeth.

Spination. Palp: 131 (131), 110 (110), 1101 (1101), 1013 (1014,2013); legs: femur I–II 556 (556), III 555 (555), IV 555 (555,545,554); patella I–IV 000; tibia I–II 3038 (3038), III 3234 (3134,3136), IV 3133 (3033,3136); metatarsus I–III 3035 (3035), IV 3035 (3035,3034).

Copulatory organ (see also diagnosis and general description of *ancoralis*-group). Epigyne without epigynal field (Figs 27e, 88d). Median septum mostly (almost) square (Fig. 27e). Spermatheca extending laterally (Fig. 27f). Colouration of male and female (see also description for *ancoralis*-group and *Psechrus*). Median bands on carapace slightly serrated. Lateral bands narrow (almost diameter of PME) and slightly serrated. Light longitudinal line ventrally on opisthosoma continuous and rather narrow. If measured centrally on opisthosoma, its width is ca. 1/2 the width of one half of the cribellum.

Variation of copulatory organs. For variation in female copulatory organs see description and illustrations in Bayer and Jäger (2010).

Distribution. Laos (Fig. 98).



FIGURES 27a–g. *Psechrus antraeus*, from Laos, Vientiane Prov. a–d ♂ paratype SB 7. e–g ♀ holotype SB 8. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e Epigyne, ventral view. f Vulva, dorsal view. g Schematic course of internal duct system.

Psechrus khammouan Jäger, 2007

Figs 28a–d, 29a–e, 82b, 85e, 88e, 91e

Psechrus khammouan Jäger 2007: 47, figs 54–67 (Description of ♂ and ♀, illustration of ♂ and ♀). [Holotype ♂ (SB 1038) from LAOS: Khammouan Province: Thakek, 9.5 km NE Thakek, N 17°26'56.2", E 104°52'30", 160 m, cave entrance, rock wall; P. Jäger & V. Vedel leg. 30.X.2004; SMF 56386; Paratypes: 1 ♀ (SB 1039) from Khammouan Province: Ban Thathot, N 17°37'54", E 105°07'30", 200 m, cave entrance of Tham Kamouk Limestone Cave; P. Jäger leg. 19.II.2003; SMF 56387; 1 ♀ (SB 1040) from same locality as SB 1039, but: primary forest between street and cave; P. Jäger leg. 19.II.2003; SMF 56388; all type material examined]. Bayer and Jäger 2010: 59.

Additional material examined (1 ♂, 4 ♀♀)**. LAOS: Khammouan Province:** Thakek, 9.5 km NE Thakek, N 17°26'56.2", E 104°52'30", 160 m, cave entrance area, rock wall; P. Jäger & S. Bayer leg. 06.XI.2009; 1 ♂ (SB381), 1 ♀ (SB 382), SMF. Ban Kouanphavang, N 17°27'09", E 104°56'19", ca. 180 m, in/ near cave; P. Jäger & S. Bayer leg. 06.XI.2009; 1 ♀ (SB 379) (in cave), 1 ♀ (SB 380) (outside cave, between rocks), SMF. Ban Thathot, N 17°37'54", E 105°07'30", 200 m, cave entrance of Tham Kamouk Limestone Cave; P. Jäger & F. Steinmetz leg. 10.III.2007; 1 ♀ (SB 63), SMF.

Revised diagnosis (see also diagnosis for *ancoralis*-group above)**.** Males similar to *P. antraeus* in having distally curved embolus (E) and long and narrow conductor (C). Distinguished by the shorter E and C (Figs 28a–c) and the bulky T (Fig. 28c). Females similar to *P. steineri* Bayer & Jäger, 2010 in having median septum (MS) with diverging lateral margins (Figs 29a,e, 30e), initial sections of copulatory ducts (CD) running transversally and spermathecal heads, which are clearly separated from spermathecae (at least 2x the diameter of one SH) (Figs 29b,d, 30f). Distinguished by the less diverging MS-margins (Figs 29a,e) and the distinctly longer CD (Figs 29b,d).

Description. Male (only holotype, measurements of other male not, or just insignificantly deviating)**:**

Body and eye measurements. Carapace length 5.1, carapace width 3.7, anterior width of carapace 2.0, opisthosoma length 7.5, opisthosoma width 2.8. Eyes: AME 0.30, ALE 0.35, PME 0.36, PLE 0.35, AME–AME 0.14, AME–ALE 0.03, PME–PME 0.22, PME–PLE 0.28, AME–PME 0.44, ALE–PLE 0.32, clypeus height at AME 0.64, clypeus height at ALE 0.58.

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 6.6 [2.3, 1.1, 1.2, 2.0]; Legs: I 51.0 [13.5, 2.5, 14.5, 14.8, 5.7], II 38.0 [10.2, 2.2, 10.3, 10.9, 4.4], III 24.5 [7.0, 1.7, 6.0, 6.8, 3.0], IV 38.7 [10.4, 1.9, 9.9, 11.5, 5.0].

Spination. Palp: 131, 110 (prolateral one very small), 1101 (prolateral and ventral one very small); legs: femur I 667, II 566, III–IV 555; patella I–IV 000; tibia I–II 3038, III 3136, IV 3135; metatarsus I–IV 3035.

Palpal femur long and slim, without modification (Fig. 28d).

Copulatory organ (see also diagnosis and general description for *ancoralis*-group). Conductor (C) distally folded ventrad (Figs 28b,c). Palpal tibia (Figs 28a–c) quite long.

Female:

Body and eye measurements. Carapace length 5.5–7.8, carapace width 3.7–5.4, anterior width of carapace 2.4–3.4, opisthosoma length 7.8–9.1, opisthosoma width 3.4–4.5. Eyes: AME 0.33–0.46, ALE 0.38–0.48, PME 0.39–0.49, PLE 0.38–0.49, AME–AME 0.18–0.22, AME–ALE 0.05–0.07, PME–PME 0.23–0.27, PME–PLE 0.36–0.40, AME–PME 0.59–0.63, ALE–PLE 0.36–0.45, clypeus height at AME 0.71–1.12, clypeus height at ALE 0.65–1.08.

Cheliceral furrow with three promarginal and five (proximal of which smaller) retromarginal teeth.

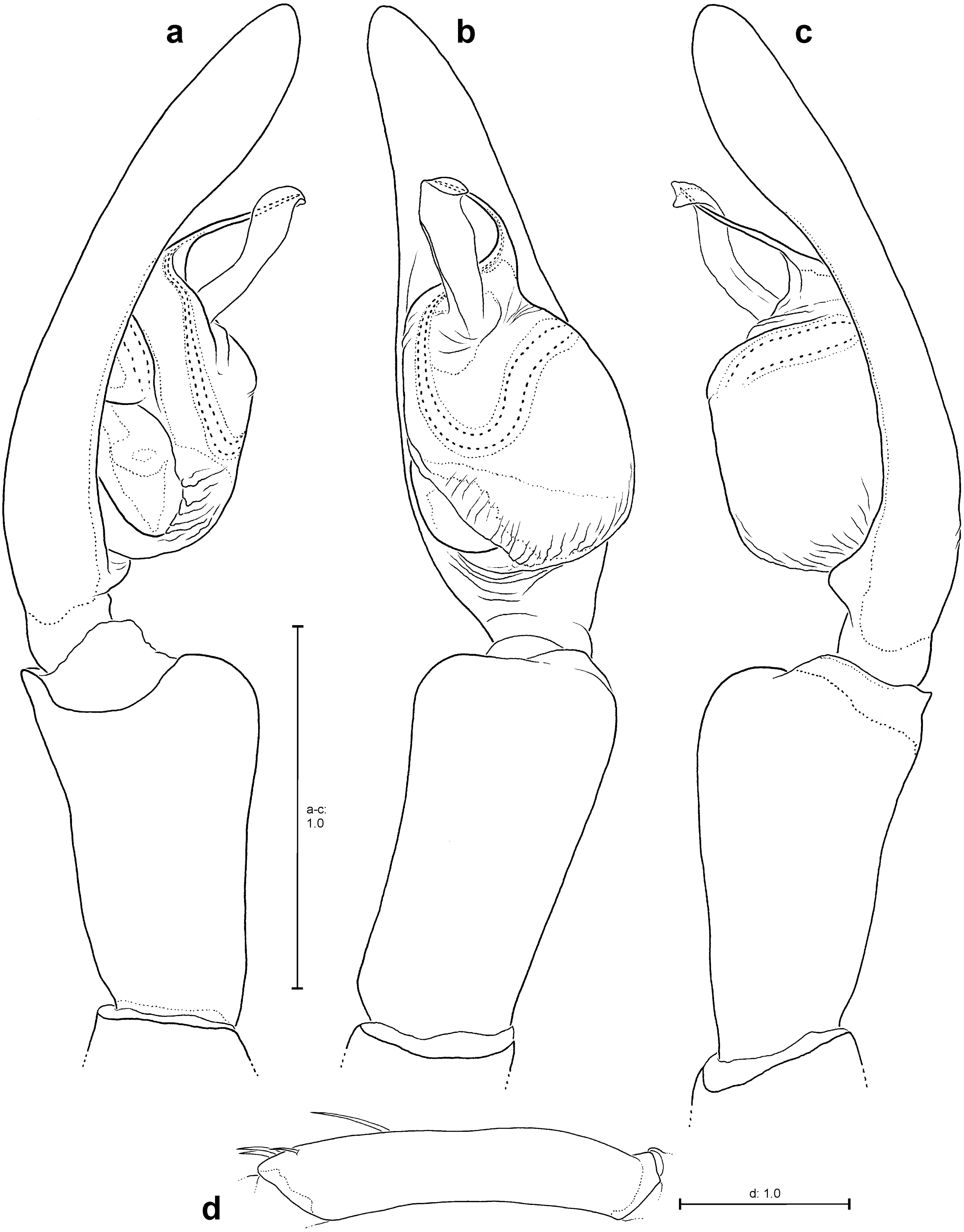
Measurements of palp and legs. Leg formula: 1423. Palp: 7.5–9.4 [2.6–3.2, 1.0–1.3, 1.4–1.9, 2.5–3.0]; Legs: I 40.2–46.4 [11.2–12.4, 2.4–3.2, 11.7–13.5, 10.3–12.0, 4.6–5.3], II 31.3–36.9 [8.8–10.3, 2.1–3.0, 8.7–10.2, 8.0–9.3, 3.7–4.1], III 21.3–26.3 [6.3–8.0, 1.7–2.2, 5.3–6.7, 5.5–6.5, 2.5–2.9], IV 32.2–38.5 [9.4–11.1, 1.9–2.6, 8.6–10.1, 8.3–10.1, 4.0–4.6].

Palpal claw with 13–14 teeth.

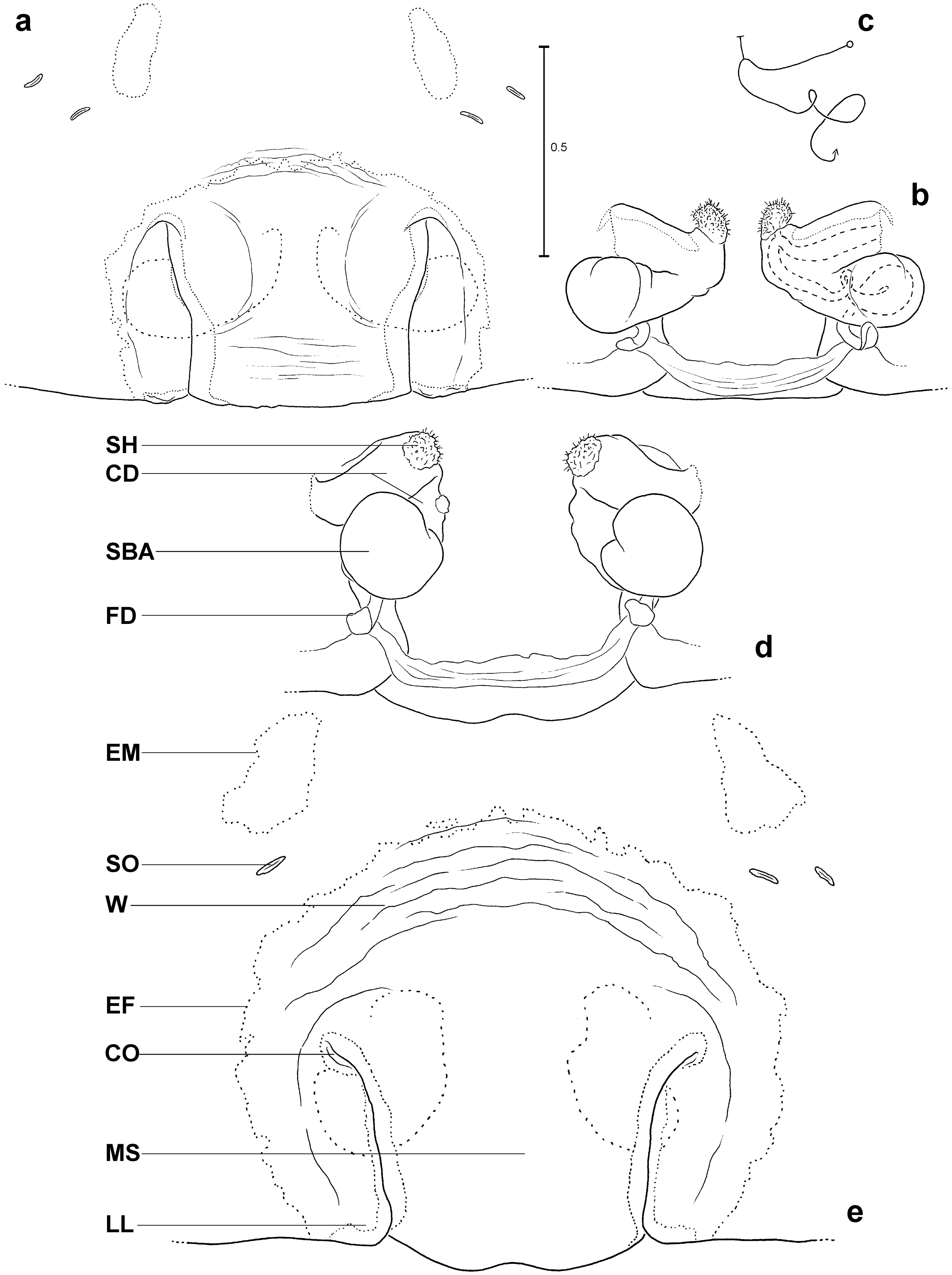
Spination. Palp: 131, 110, 1101, 1014; legs (—except for patella— variable, only most common states noted): femur I 555 (556,566), II 555 (566), III 555 (556), IV 555 (554); patella I–IV 000; tibia I–II 3038, III 3134 (3035), IV 3136 (3033,3133); metatarsus I–III 3035, IV 3034 (3035).

Copulatory organ (see also diagnosis and general description of *ancoralis*-group). Epigynal muscle sigilla and slit sense organs outside epigynal field (Figs 29a,e). Spermathecal heads located anterio-medially (Figs 29b,d), at distinct bend of CD.

Colouration of male and female (see also description for *ancoralis*-group and *Psechrus*). Median bands on carapace not serrated (Fig. 82b). Lateral bands extremely narrow or not even recognisable (at most 1/4 diameter of PME), not serrated (Fig. 82b). Light longitudinal line ventrally on opisthosoma continuous and narrow. If measured centrally on opisthosoma, its width ca. 1/3 the width of one half of the cribellum.



FIGURES 28a–d. *Psechrus khammouan*, from Laos, Khammouan Prov. a–c ♂ holotype SB 1038. d ♂ SB 381. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.



FIGURES 29a–e. *Psechrus khammouan*, from Laos, Khammouan Prov., ♀ copulatory organ. a–c ♀ paratype SB 1040. d–e ♀ SB 379. a, e Epigyne, ventral view. b, d Vulva, dorsal view. c Schematic course of internal duct system. CD: Copulatory duct; EF: Epigynal field. EM: Epigynal muscle sigilla; FD: Fertilisation duct; LL: Lateral lobe; MS: Median septum; SBA: Spermathecal base; SH: Spermathecal head; SO: Slit sense organ; W: Wrinkles anteriorly in EF.

Variation of copulatory organs. The two males examined show no significant variation. In females there are differences in shape of MS (Figs 29a,e, 88e), which are not linked to geographical location. Further, there are differences in the shape of vulva. Spermathecae are slightly larger in some specimens (Fig. 29d). Spermathecal head position seems shifted posteriorly on copulatory duct (CD) in two of the three specimens from Thakek region (Fig. 29d). In the specimens from Ban Thathot the initial part of CD does not exactly run transversally, but slightly from anterio-lateral to posterio-medial (Fig. 29b). In the females from Thakek region it runs either transversally or slightly from posterio-lateral to anterio-medial (Figs 29d, 91e). In specimens from Thakek region the entire vulva half is shifted somewhat ventrally, which gives the impression that the CD was shorter (Figs 29d, 91e).

With few specimens available it presently cannot be clarified if the differences between the specimens from Ban Thathot region and Thakek region are species-specific or if they fall in the variation spectrum of *P. khammouan*. As long as there are no further specimens from Ban Thathot region available, especially no males, I consider the respective females (including the paratypes) belonging to *P. khammouan*.

Distribution. Laos (Fig. 98).

Psechrus steineri Bayer & Jäger, 2010

Figs 30a–g, 85f, 88f, 91f

Psechrus steineri Bayer and Jäger 2010: 59, figs 1–9, 54, 57 (Description of ♂ and ♀, illustration of ♂ and ♀). [Holotype ♀ (SB 65) from LAOS: Khammouan Province: Ban Nong Ping, Xe Bangfai cave system, Tham Pha Leusi, N 17°22'23.4", E 105°50'28.4", ca. 300 m, inside cave; H. Steiner leg. 15.II.2007; SMF; Paratype: 1 ♂ (SB 64), same data as for holotype; SMF; all type material examined].

Additional material examined. LAOS: Khammouan Province: Ban Nong Ping, Xe Bangfai cave system, Tham Pha Leusi, N 17°22'23.4", E 105°50'28.4", ca. 300 m, inside cave; H. Steiner leg. 15.II.2007; 1 juv. (SB 66), SMF.

Revised diagnosis (see also diagnosis for *ancoralis*-group above)**.** Males similar to *P. khammouan* in having bulky tegulum (T) and narrow conductor (C). Distinguished by the shorter embolus (E) and C, the even more bulky and larger T (Figs 30a–c), the differently shaped embolus base (EB) and the median ridge distally on conductor (Fig. 30b). Females similar to *P. khammouan* in having median septum (MS) with lateral margins diverging (Figs 29e, 30e), initial sections of copulatory ducts (CD) running transversally and spermathecal heads clearly separated from spermathecae (Figs 29b, 30f). Distinguished by the strongly diverging margins of MS causing anterior sections running almost parallel with epigastric furrow (Fig. 30e). Moreover, CD distinctly shorter (Fig. 30f).

Description. Male:

Body and eye measurements. Carapace length 8.4, carapace width 5.8, anterior width of carapace 3.1, opisthosoma length 9.6, opisthosoma width 3.8. Eyes: AME 0.42, ALE 0.48, PME 0.52, PLE 0.49, AME–AME 0.22, AME–ALE 0.06, PME–PME 0.35, PME–PLE 0.39, AME–PME 0.62, ALE–PLE 0.43, clypeus height at AME 1.04, clypeus height at ALE 0.95.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.8 [3.6, 1.8, 1.6, 2.8]; Legs: I 65.9 [16.9, 3.9, 18.5, 19.5, 7.1], II 49.0 [13.0, 3.6, 13.5, 13.2, 5.7], III 33.9 [9.8, 2.8, 8.3, 9.1, 3.9], IV 50.6 [13.5, 3.0, 13.0, 14.7, 6.4].

Spination. Palp: 131, 010, 0100; legs: femur I 666, II 566, III 656{555}, IV 565; patella I–IV 000; tibia I 3037{3038}, II 3038, III–IV 3035; metatarsus I–III 3035, IV 3034.

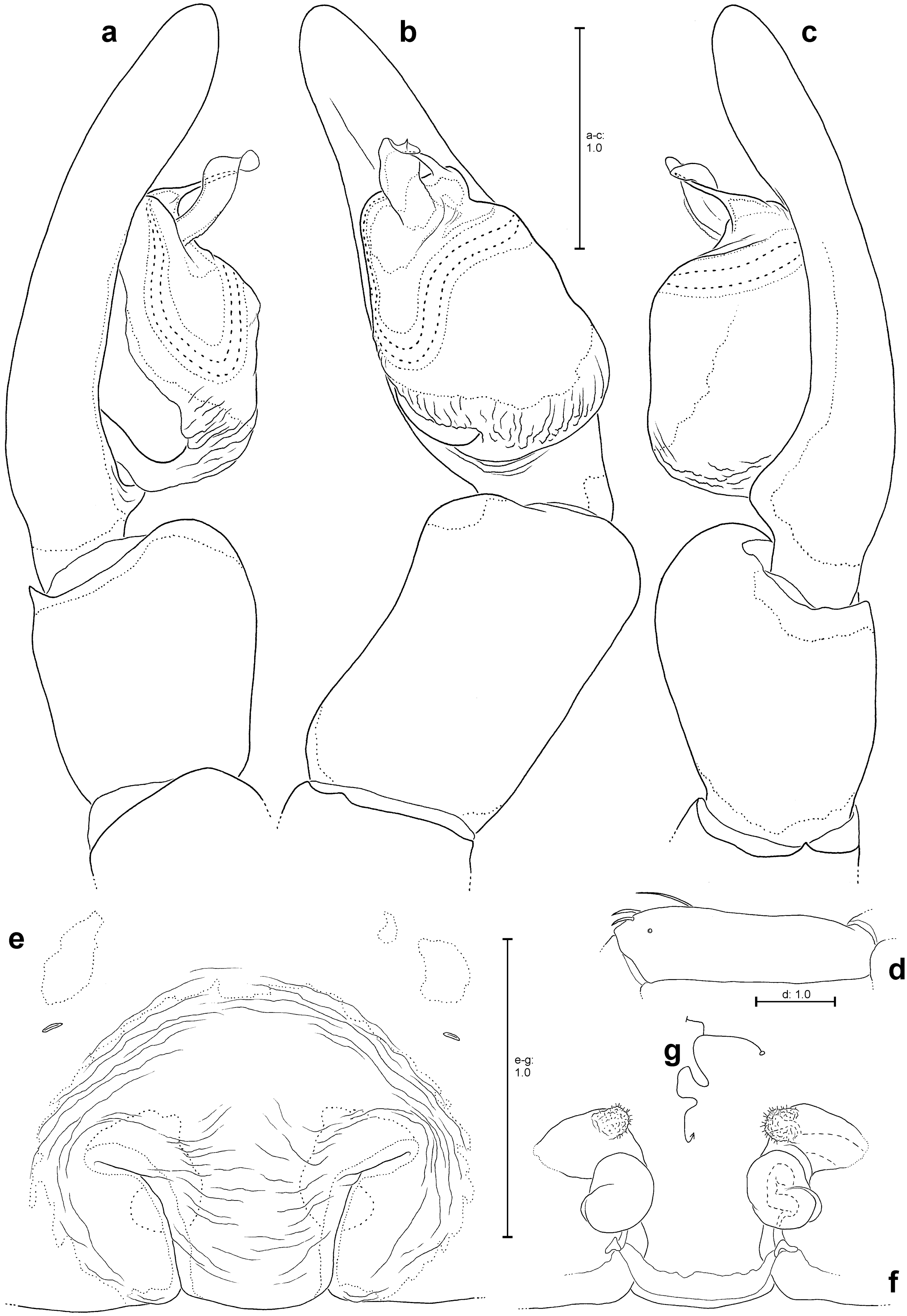
Palpal femur not very slim, without modification (Fig. 30d).

Copulatory organ (see also diagnosis and general description for *ancoralis*-group). Conductor (C) distally folded ventrad (Figs 30b–c). Tegulum with rounded “corner” (Fig. 30b) close to the arising point of E. Palpal tibia (Figs 30a–c) relatively short and bulky (Figs 30a–c).

Female:

Body and eye measurements. Carapace length 8.2, carapace width 5.5, anterior width of carapace 3.4, opisthosoma length 10.2, opisthosoma width 4.6. Eyes: AME 0.47, ALE 0.50, PME 0.50, PLE 0.49, AME–AME 0.18, AME–ALE 0.02, PME–PME 0.29, PME–PLE 0.48, AME–PME 0.65, ALE–PLE 0.50, clypeus height at AME 1.19, clypeus height at ALE 1.04.

Cheliceral furrow with three promarginal and four (five, right) retromarginal teeth.



FIGURES 30a–g. *Psechrus steineri*, from Laos, Khammouan Prov., Xe Bangfai cave system. a–d ♂ paratype SB 64. e–g ♀ holotype SB 65. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e Epigyne, ventral view. f Vulva, dorsal view. g Schematic course of internal duct system.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.5 [3.3, 1.5, 1.9, 2.8]; Legs: I 50.1 [13.9, 3.4, 14.2, 13.0, 5.6], II 40.0 [11.4, 3.2, 10.8, 10.2, 4.4], III 27.6 [8.3, 2.3, 6.8, 7.1, 5.1], IV 41.1 [11.8, 2.8, 10.6, 10.8, 5.1].

Palpal claw with 13 teeth.

Spination. Palp: 131{141}, 110, 1101, 1014; legs: femur I–II 556, III 555, IV 554; patella I–IV 000; tibia I–II 3038, III 3134(dorsal one small), IV 3135(dorsal one small); metatarsus I–IV 3035.

Copulatory organ (see also diagnosis and general description of *ancoralis*-group). Epigynal muscle sigilla and slit sense organs outside epigynal field (Fig. 30e). Spermathecal heads located anterio-medially. Spermatheca irregularly shaped (Fig. 30f, 91f).

Colouration of male and female (see also description for *ancoralis*-group and *Psechrus*). Median bands on carapace not serrated. Lateral bands extremely narrow or not even recognisable (at most 1/4 diameter of PME), not serrated. Light longitudinal line ventrally on opisthosoma continuous and narrow. If measured centrally on opisthosoma, its width is ca. 1/2 the width of one half of the cribellum.

Distribution. Laos (Fig. 98).

himalayanus-group

Diagnosis. Males with embolus (E) arising medially at distal half of tegulum (T) (Figs. 31b, 37b, 48b). In males, either coxae of legs I (Figs 82l,r) or the most proximal part of palpal femur (Fig. 35d) ventrally with field of distinct macrosetae. Females are distinguished from those of all other species groups except the *ancoralis*-group by the following combination of characters: Epigyne without tegimentum (TM, Figs 69a, 89m) and strongly sclerotised epigynal field (EF, Figs 87c–d), with small, slit-like copulatory openings (CO, Fig. 37d) and mostly converging anterior sections of epigynal slits (Figs 27e, 36a) and median septum (MS) mostly broader than long (Figs 32a, 36a, 41e); receptacula not distinctly round, copulatory ducts without distinctly rough surface (Fig. 80b) and bulbous (Fig. 63b) or twisted (Fig. 59b) sections and at most 1.5 times broader than diameter of one receptaculum. Females are distinguished from those of the *ancoralis*-group by the spermathecal heads (SH) located on the receptacula (spermathecae) and by the copulatory ducts (CD) mostly narrow and shorter than the diameter of one receptaculum (Figs 37e, 41f, 47b, 49b).

Description. Sternum yellowish brown at lateral margins and with brown, tapered patch centrally. Median bands on carapace may be slightly, but mostly clearly serrated (Fig. 82e). Lateral bands narrow to medium-sized and (slightly) serrated (see each species description). Dorsal spines on tibia III and IV may be present, but mostly absent (see each species description). Legs medium-sized in relation to other species-groups: FEM-I+MTT-I/CL: Males: ca. 5; Females: 3–3.3 (in 4 species females with “short” legs, FEM-I+MTT-I/CL even less than 3, see respective species descriptions).

Sperm duct in males in ventral view mostly U-shaped, in some species W-shaped or broad W-shaped. Cymbium dorsally may be with very dense-, moderate dense- or without scopula (see each species description). Palpal femur without modification. Macrosetae ventrally on coxae of leg I (MC-I) present and distinctly developed (see diagnosis above), those of leg II (MC-II) and trochanter of leg I (MT-I) may be indistinct or missing.

In contrast to *ancoralis*-group, females never without epigynal field. Course of internal duct system varies among the different species (Figs 32c, 34c, 36c, 37f, 41g, 44c, 47c, 49c, 51c).

Psechrus himalayanus Simon, 1906

Figs 31a–d, 32a–k, 82l, 85g, 88h, 91h

Psechrus himalayanus Simon 1906: 287 (Description of ♂). [Lectotype ♂ (SB 14), here designated, from INDIA: Uttarakhand Province: Dehradun; Smythier leg. before 1905; Simon Coll.-No. 17595; MNHN AR5206; Paralectotype p.s.a. ♀ (SB 724), with same data as for lectotype; MNHN AR5206, all type material examined]. Kulczyński 1908: 568. Berland and Berland 1914: 132. Fage 1929: 360. Lehtinen 1967: 261. Hubert 1973: 678, figs 7–12 (Description of ♂ and ♀, illustration of ♂ and ♀). Levi 1982: 119, figs 7–12 (Description of ♂ and s.a. ♀, illustration of ♂ and s.a. ♀). Griswold 1993: 7, ad part (Record of ♂ from Kooloo valey, India; other record from Nepal misidentified, see *P. marsyandi*). Jäger 2007: 45. Sebastian and Peter 2009: 528.

Additional material examined (5 ♂♂, 19 ♀♀, 2 s.a. ♂♂, 10 s.a. ♀♀, 2 juvs)**. Without any note on recording locality:** GVOT Museum Madras; Coll. H. Wiehle; Wiehle det. *Psechrus alticeps* Pocock; 1 ♀ (SB 1), SMF. **INDIA: Himachal Pradesh Province:** Kooloo valley; M.M. Carleton leg. [1870's?]; 1 ♂ (SB 172), MCZ 82515. **Uttarakhand Province:** Pulna, 2200 m, forest, between rocks; S. Quasin leg. 27.X.2009; 1 ♀ (SB 908), WII. Govind Ghat, 1800–2400 m; forest, between rocks; S. Quasin leg. 25.X.2009; 1 ♀ (SB 907), SMF; 1 s.a. ♂ (SB 909), WII. Dehradun, Wildlife Institute of India, Campus, N 30°16'59.8", E 77°58'31.4", 587 m, forest, wall; P. Jäger leg. at night 14.III.2011; 1 ♀ (SB 988), SMF; P. Jäger leg. at night 13.III.2011; 6 s.a. ♀♀ (SB 989–994), 1 juv. (SB 995), SMF; P. Jäger leg. at night 19.III.2011; 1 s.a. ♀ (SB 987), SMF. Rudraprayag, riverside Alaknanda river, N 30°17'12.0", E 78°58'44.9", 667 m, between rocks; P. Jäger & S. Quasin leg. at night 18.III.2011; 1 juv. (SB 996), SMF. Kathgodam, 10 minutes N of this town, 1240 m; E. Ross & D.Q. Cavagnaro leg. 01.XII.1961; 1 s.a. ♀ (SB 975), CAS 9032234. **NEPAL: Rapti Province:** Near Daban ('apres Dhoban'); M. Hubert leg. 07.V.1970; 1 ♂ (SB 17), MNHN. Liwang ('Libang'), 1500–1600 m; M. Hubert leg. 17.V.1970; 1 ♂ (SB 731), MNHN AR5159; M. Hubert leg. 19.V.1970; 1 ♀ (SB 732), MNHN AR5162; M. Hubert leg. V.1970; 3 ♀♀ (SB 744–746), MNHN AR5163. Liwang ('Libang'), Tobeiem; M. Hubert leg. 02.V.1970; 2 ♂♂ (SB 725–726), 1 ♀ (SB 727), MNHN AR5157. Liwang ('Libang'), Ninguana, jungle; M. Hubert leg. 22.IV.1970; 3 ♀♀ (SB 738–740), MNHN AR5158; M. Hubert leg. 02.V.1970; 3 ♀♀ (SB 733–735), MNHN AR5161. Liwang ('Libang'), Taktem; M. Hubert leg. 04.V.1970; 3 ♀♀ (SB 741–743), MNHN AR5160. **Bagmati Province:** Kathmandu Valley; 1956–1958; 1 s.a. ♀ (SB 770), MCZ 82518. Patan (Kathmandu); X.1956, III.–IV.1957; 1 s.a. ♀ (SB 771), MCZ 82510. **Narayani Province:** Chitawan District, 15 km S of Meghauli, Sauraha, Chitawan National Park, forest near Rapti R., 200 m; J. Coddington leg. 31.V.1985; 1 s.a. ♂ (SB 755), USNM. **BHUTAN: Timphu Province:** Timphu river; leg. 28.IV.1972, 'Bhutan Expedition 1972'; [7/5]; 1 ♀ (SB 607), NHMB 2738a.

Revised diagnosis (see also diagnosis for *himalayanus*-group above)**.** Males similar to *P. marsyandi* Levi, 1982 and *P. inflatus* **sp. nov.** in having the straight embolus (E) completely associated with conductor (C) (Figs 31b, 33b, 35b). Distinguished from *marsyandi* by the U-shaped sperm duct and the longer E and C (Fig. 31b). Distinguished from *inflatus* by the U-shaped sperm duct and the narrower C (Fig. 31b). Females similar to *P. marsyandi* in general shape of median septum (MS) and vulva. The former with anteriorly curved margins facing each other medially (Fig. 32a, 34a), running parallel with the margins of the lateral lobes (LL) (Fig. 32a, 88h) at those transversal sections. Distally both margins end by diverging (Fig. 32a, 34a), thereby building the copulatory openings (CO). Vulva with copulatory ducts (CD) flowing into spermatheca transversally from medial (Fig. 32b, 34d). Distinguished from *marsyandi* by the longer copulatory ducts and the flatter spermathecal heads (SH) (Fig. 32b).

Description. Male (measurements of lectotype first, those of other specimens given as ranges in parentheses)**:** Body and eye measurements. Carapace length 6.9 (6.7–8.9), carapace width 5.0 (4.8–6.4), anterior width of carapace 2.5 (2.5–3.3), opisthosoma length 9.5 (7.8–10.9), opisthosoma width 3.7 (3.4–4.0). Eyes: AME 0.33 (0.32–0.38), ALE 0.37 (0.36–0.46), PME 0.40 (0.38–0.45), PLE 0.39 (0.37–0.44), AME–AME 0.13 (0.12–0.23), AME–ALE 0.05 (0.05–0.06), PME–PME 0.24 (0.22–0.29), PME–PLE 0.30 (0.29–0.38), AME–PME 0.52 (0.49–0.63), ALE–PLE 0.38 (0.37–0.48), clypeus height at AME 0.75 (0.68–0.90), clypeus height at ALE 0.73 (0.64–0.89).

Cheliceral furrow with three promarginal and four retromarginal teeth (one specimen with five retr.m. t.).

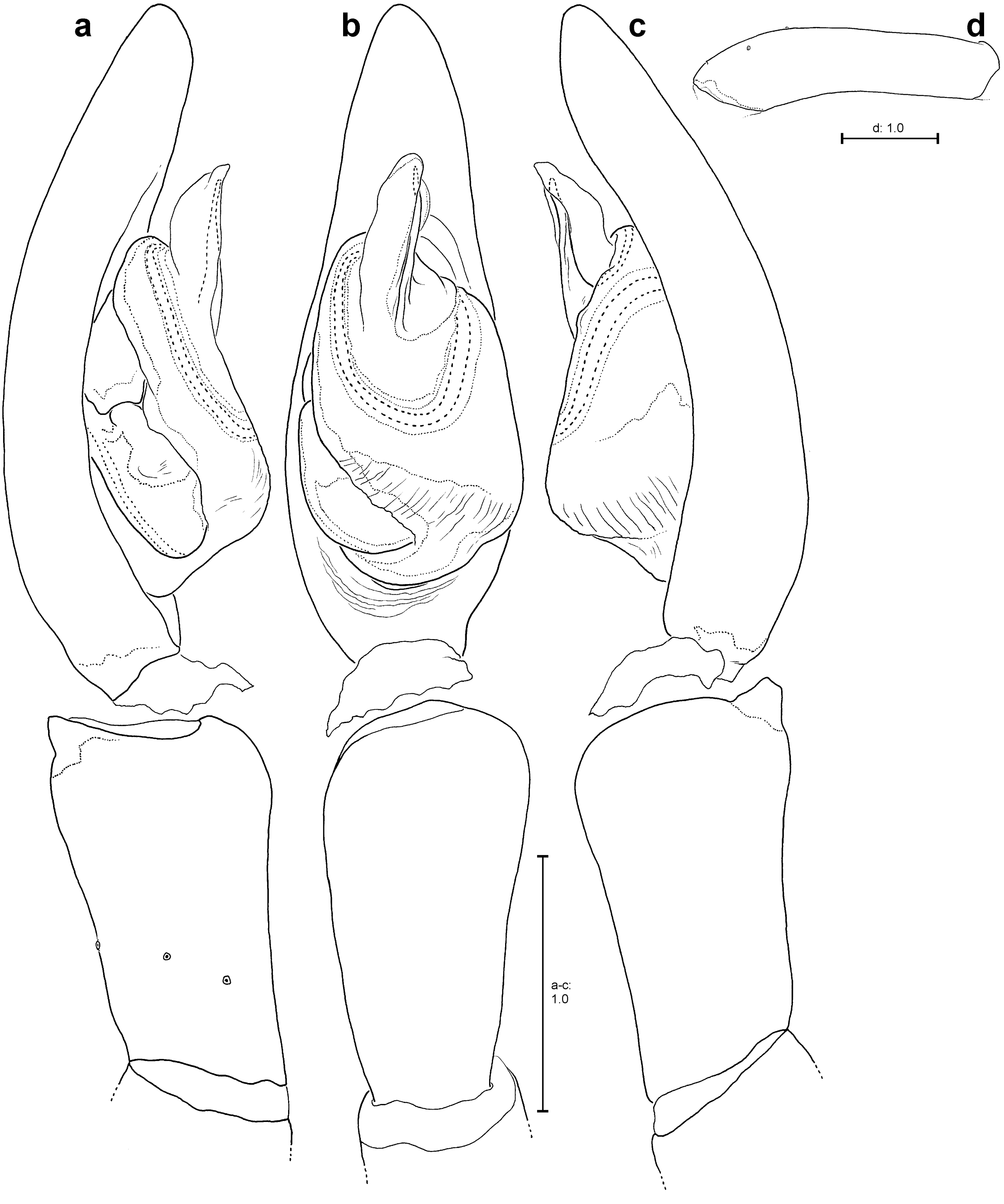
Measurements of palp and legs. Leg formula: 1423. Palp 8.7 (8.3–9.3) [3.2 (3.0–4.0), 1.4 (1.4–1.6), 1.4 (1.3–1.7), 2.7 (2.6–3.4)], I 64.1 (59.6–78.5) [16.9 (15.5–20.4), 3.3 (3.2–4.5), 17.8 (16.2–21.7), 18.0 (16.9–22.6), 8.1 (7.8–9.3)], II 49.2 (45.9–61.2) [13.7 (12.6–16.8), 3.0 (2.5–3.8), 12.9 (12.0–16.4), 13.4 (13.1–17.1), 6.2 (5.7–7.1)], III 32.6 (30.7–40.9) [9.5 (9.1–12.2), 2.3 (2.2–3.0), 8.0 (7.3–9.9), 8.7 (8.1–11.0), 4.1 (4.0–4.8)], IV 49.4 (46.4–61.6) [13.7 (12.7–17.1), 2.7 (2.3–3.4), 12.4 (11.7–15.8), 14.0 (13.6–17.4), 6.6 (6.1–7.9)].

Spination. Palp: 131 (131), 110 (110), 1101 (1101); legs: femur I 655 (566,556,646), II 655 (566) III 555 (555), IV 655 (545,555); patella I–IV 000; tibia I–II 3038 (3038), III 3034 (3034), IV 3036 (3035,3045); metatarsus I–IV 3035 (3035).

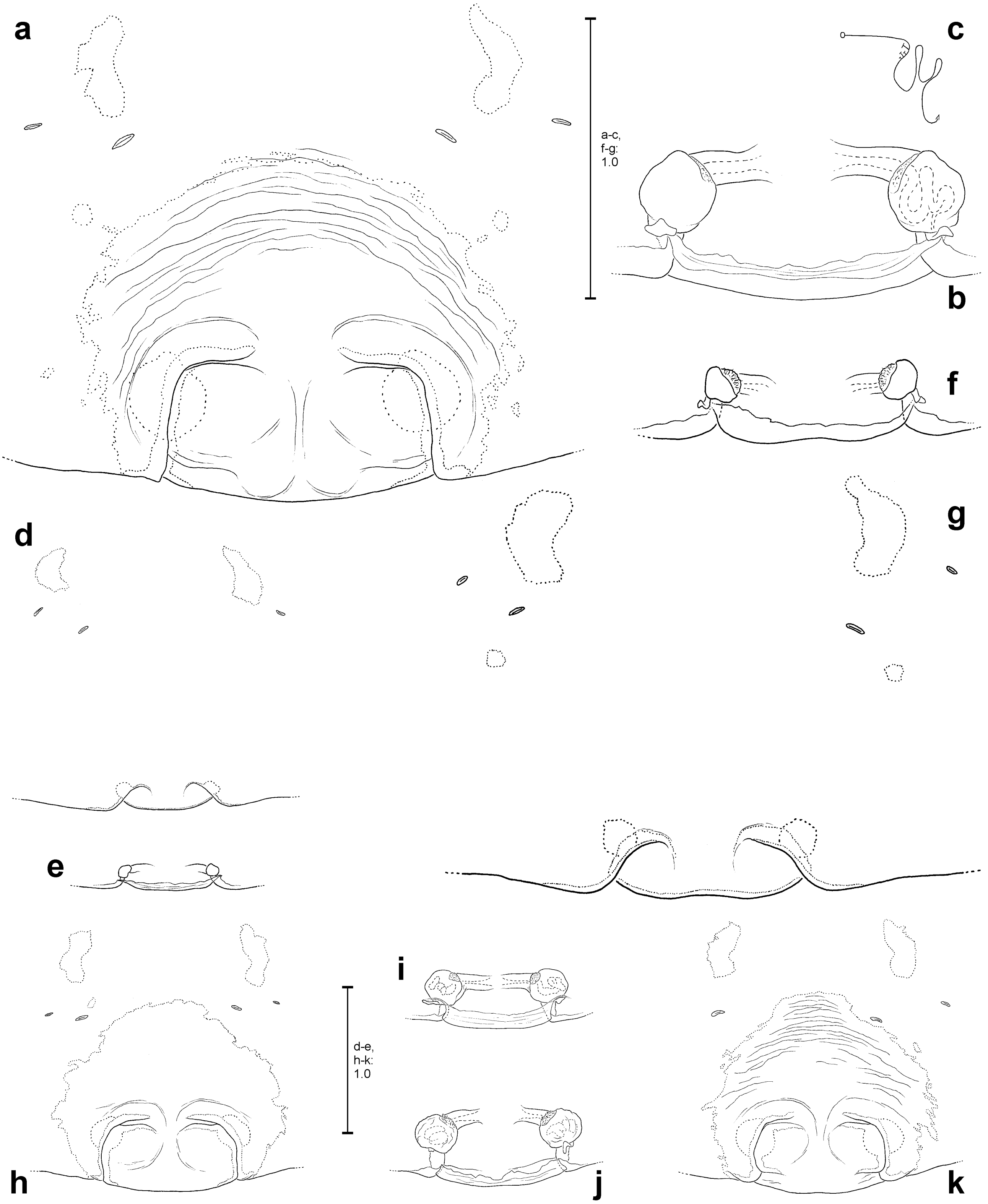
Palpal femur without modification, distally slightly broader than proximally (Fig. 31d).

Copulatory organ (see also diagnosis and general description for *himalayanus*-group). In male bulb subtegulum (ST) protruding distinctly underneath tegulum (T) (Fig. 31a,b). In comparison to *P. marsyandi* and *P. inflatus* **sp. nov.** T rather elongated. Palpal tibia in lateral view relatively slim (Fig. 31c). Cymbium dorsally with very dense scopula, covering ½ of the former.

Female: Body and eye measurements. Carapace length 6.3–9.1, carapace width 4.4–6.5, anterior width of carapace 2.7–3.6, opisthosoma length 11.0–13.9, opisthosoma width 6.4–7.2. Eyes: AME 0.32–0.38, ALE 0.39–0.46, PME 0.41–0.49, PLE 0.40–0.48, AME–AME 0.19–0.25, AME–ALE 0.06–0.07, PME–PME 0.23–0.31, PME–PLE 0.32–0.42, AME–PME 0.59–0.73, ALE–PLE 0.45–0.61, clypeus height at AME 0.73–0.96, clypeus height at ALE 0.70–1.02.



FIGURES 31a–d. *Psechrus himalayanus*, ♂ lectotype SB 14 from India, Uttarakhand Prov., Dehradun. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.



FIGURES 32a–k. *Psechrus himalayanus*, ♀ primordial and adult copulatory organ. a–c ♀ SB 988, d–e p.s.a. ♀ paralectotype SB 724, both from India, Uttarakhand Prov., Dehradun. f–g s.a. ♀ SB 770 from Nepal, Bagmati Prov. h ♀ SB 733 from Nepal, Rapti Prov. i ♀ SB 607 from Bhutan, Timphu Prov. j–k ♀ SB 727 from Nepal, Rapti Prov. a, h, k Epigyne, ventral view. b, i–j Vulva, dorsal view. c Schematic course of internal duct system. g Pre-epigyne, ventral view. f Pre-vulva, dorsal view. d Pre-pre-epigyne, ventral view. e Pre-pre-vulva, dorsal view.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.9–10.8 [2.7–3.6, 1.1–1.6, 1.5–2.1, 2.6–3.5]; Legs: I 43.6–54.4 [12.0–15.0, 3.0–4.1, 12.1–15.2, 11.0–13.6, 5.5–6.5], II 34.4–42.8 [9.9–12.4, 2.6–3.5, 9.2–11.5, 8.5–10.5, 4.2–4.9], III 23.6–30.8 [7.2–9.2, 2.0–2.8, 5.5–7.7, 5.9–7.5, 3.0–3.6], IV 34.6–44.5 [9.9–13.1, 2.4–3.2, 8.9–11.3, 8.8–11.3, 4.6–5.6].

Palpal claw with 14–15 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 566 (556), II 556, III–IV 555; patella I–IV 000; tibia I–II 3038, III 3034 (3024,3036), IV 3036 (3034,3035); metatarsus I–III 3035, IV 3034 (3035).

Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Epigyne with flat bulges posterior to the CO (Fig. 32a,h,k). Slit sense organs and epigynal muscle sigilla outside epigynal field. Anterior to epigyne lots of slightly curved wrinkles.

Primordial copulatory organ. Pre-epigyne: Pre-septum (Fig. 32g) not as cross-rectangular in appearance as in adult MS. Distinguished from the similar *P. marsyandi* by the shorter distance between distal endings of anterior margins of pre-LL (Fig. 32g).

Pre-vulva: Pre-vulva (Fig. 32f) already similar to adult one. Distinguished from the similar *P. marsyandi* by the longer pre-copulatory ducts.

The pre-pre-epigyne (Fig. 32d) is similar to the pre-epigyne, but distinctly smaller. The pre-pre-vulva (Fig. 32e) also, but the pre-pre-receptacula are just recognisable as very small balls.

Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace serrated and often broader than in other *Psechrus* species. Lateral bands narrow (almost diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma continuous and medium-sized to broad. If measured centrally on opisthosoma, its width is ca. 0.7–1.1 times the width of one half of the cribellum.

Variation of copulatory organs. Males: In one male (SB 725 from Tobeiem, Nepal, not illustrated) T with darker colour than generally. Females: In some specimens flat bulges below CO more distinct (Fig. 32k). Curves of lateral margins of MS may be less sharp (Fig. 32h). SH in some specimens (Fig. 32b) flatter than in others (Figs 32i–j).

Remarks: Hubert (1973) first described the female of *P. himalayanus.* He recorded males, which were unambiguously conspecific with the male type specimen. Some of them had been recorded at exactly the same localities as females he had determined as *P. himalayanus*. This material was also examined herein. Moreover, a female from the type locality Dehradun was available for the present study (Figs 32a–c). This specimen matches the females examined in Hubert (1973). Consequently, the females described in Hubert (1973) and in the present study unambiguously belong to *P. himalayanus*.

Distribution. India, Nepal, Bhutan (Fig. 95).

Psechrus marsyandi **Levi, 1982**

Figs 33a–d, 34a–i, 81h, 82r, 85h, 88i, 91i

Psechrus marsyandi Levi 1982: 120, figs 13–15 (Description of ♂ and ♀, illustration of ♂ and ♀). [Holotype ♂ (SB 79) from NEPAL: Gandaki Province: Lamjung District, Marsyandi stream, Senghe, 1050 m, rock wall near river bank; J. Martens & A. Ausobsky leg. 10.IV.1980; SMF 30900; Paratypes: s.a. ♂ (SB 865), with same data as for holotype; SMF 30900; 2 ♀♀ (SB 231–232) from NEPAL: Dhawalagiri Province: near Sibang, N 28°27'30", E 83°22'30"; K.H. Hyatt leg. 18.VI.1954, 'British Museum Nepal Expedition'; NHM 1981·4·10·5,6; 2 ♀♀ (SB 226–227) from NEPAL: Dhawalagiri Province: near Darban, N 28°24'30", E 83°23'30"; K.H. Hyatt leg. 16.VI.1954; NHM 1981·4·10·7,8; 2 ♀♀ (SB 229–230) from NEPAL: Dhawalagiri Province: near Seti river, Pokhara, N 28°14', E 83°59'; K.H. Hyatt leg. 04.VIII.1954; NHM 1981·4·10·9,10; all type material examined]. Jäger 2007: 45.

Psechrus himalayanus — Griswold 1993: 7, ad part (Record of ♀ [in fact s.a. ♀] from Gandaki zone, Nepal, misidentified).

Additional material examined (1 ♀, 7 s.a. ♂♂, 12 s.a. ♀♀, 3 p.s.a. ♀♀, 3 juvs)**. NEPAL: Dhawalagiri Province:** Dana, South of D.; M. Hubert leg. 28.I.1967; 3 s.a. ♀♀ (SB 747, 750–751), MNHN. Darban, near D., N 28°24'30", E 83°23'30"; K.H. Hyatt leg. 16.VI.1954; 1 ♀ (SB 228), NHM. Kabre; M. Hubert leg. 17.I.1967; 2 s.a. ♀♀ (SB 729–730), 1 juv. (SB 728), MNHN. Rakhu; M. Hubert leg. 14.I.1967; 2 s.a. ♀♀ (SB 748–749), MNHN. Garamdi (near Kali Gandaki); M. Hubert leg. 15.I.1967; 2 s.a. ♀♀ (SB 752–753), 1 s.a. ♂ (SB 754), MNHN. **Gandaki Province:** Kaski District, Kahre – Pokhara, ca. 1400 m; J. Coddington leg. 29.X.1985; 2 p.s.a. ♀♀ (SB

757–758), 2 s.a. ♂♂ (SB 759–760), 1 juv. (SB 756), USNM. Kaski District, W of Landrung, ca. 1600 m, forest; J. Coddington leg. 21.X.1985; 1 s.a. ♀ (SB 761), 1 juv. (SB 762), USNM. Kaski District, Bhichuk, ca. 1800 m; J. Coddington leg. 20.X.1985; 2 s.a. ♀♀ (SB 766–767), 3 s.a. ♂♂ (SB 763–765), USNM. Kaski District, Landrung - Chomrung, 1500–1900 m; J. Coddington leg. 21.X.1985; 1 p.s.a. ♀ (SB 768), 1 s.a. ♂ (SB 769), USNM.

Revised diagnosis (see also diagnosis for *himalayanus*-group above)**.** Male similar to *P. himalayanus* and *P. inflatus* **sp. nov.** in having the straight embolus (E) completely associated with conductor (C). Distinguished from *himalayanus* by the W-shaped sperm duct and the shorter E and C (Fig. 33b). Distinguished from *inflatus* by the two equal long loops of sperm duct and the narrower C (Fig. 33b). Distinguished from both by the distally structured E exhibiting a very small barbed hook (Fig. 33b). Females similar to *P. himalayanus* in general shape of median septum (MS) and vulva (see diagnosis *P. himalayanus*). Distinguished from *himalayanus* by the shorter copulatory ducts and the more prominent spermathecal heads (SH) (Figs 34b,d–e).

Description. Male:

Body and eye measurements. Carapace length 8.9, carapace width 6.8, anterior width of carapace 3.4, opisthosoma length 12.7, opisthosoma width 6.3. Eyes: AME 0.38, ALE 0.43, PME 0.44, PLE 0.43, AME–AME 0.28, AME–ALE 0.10, PME–PME 0.33, PME–PLE 0.38, AME–PME 0.67, ALE–PLE 0.46, clypeus height at AME 0.96, clypeus height at ALE 0.97.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 11.9 [4.5, 2.2, 2.1, 3.1]; Legs: I 76.4 [20.1, 4.5, 21.4, 24.0, 9.8], II 61.6 [16.9, 4.1, 17.2, 16.2, 7.2], III 40.4 [11.3, 3.2, 9.7, 11.1, 5.1], IV 61.2 [17.3, 3.7, 15.2, 17.2, 7.8]. Spination. Palp: 141, 010, 0000; legs: femur I 566, II 556, III–IV 555; patella I–IV 000; tibia I–II 3038, III 2034, IV 3036; metatarsus I–IV 3035.

Palpal femur without modification, broadest medially (Fig. 33d).

Copulatory organ (see also diagnosis and general description for *himalayanus*-group). Sperm duct prolaterally at central position of tegulum with very small curve (Fig. 33a,b). Palpal tibia (in lateral view) medium sized (Figs 33a–c). Cymbium dorsally with very dense scopula, covering almost ½ of the former.

Female: Body and eye measurements. Carapace length 7.7–11.7, carapace width 5.2–8.5, anterior width of carapace 3.5–5.1, opisthosoma length 10.0–17.0, opisthosoma width 4.1–11.2. Eyes: AME 0.35–0.48, ALE 0.42–0.51, PME 0.45–0.53, PLE 0.45–0.53, AME–AME 0.22–0.33, AME–ALE 0.07–0.11, PME–PME 0.28–0.46, PME–PLE 0.45–0.53, AME–PME 0.67–0.89, ALE–PLE 0.50–0.64, clypeus height at AME 0.74–1.82, clypeus height at ALE 0.89–1.79.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 9.7–14.2 [3.3–5.0, 1.5–2.2, 1.9–2.6, 3.0–4.5]; Legs: I 45.9–65.6 [12.6–18.2, 3.4–5.1, 12.8–18.2, 12.2–17.4, 4.9–7.6], II 36.9–53.0 [10.5–15.0, 3.1–4.6, 10.1–14.6, 8.9–13.3, 4.3–6.0], III 26.0–37.9 [8.0–11.7, 2.3–3.5, 6.3–9.3, 6.2–9.1, 3.2–4.3], IV 36.9–51.9 [10.7–14.8, 2.7–4.1, 9.3–13.2, 9.6–13.6, 4.6–6.2].

Palpal claw with 12–15 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 566, II 566 (556), III 555 (556), IV 555 (554,556,564); patella I–IV 000; tibia I–II 3038, III 3036 (3034), IV 3036 (3034); metatarsus I–IV 3035.

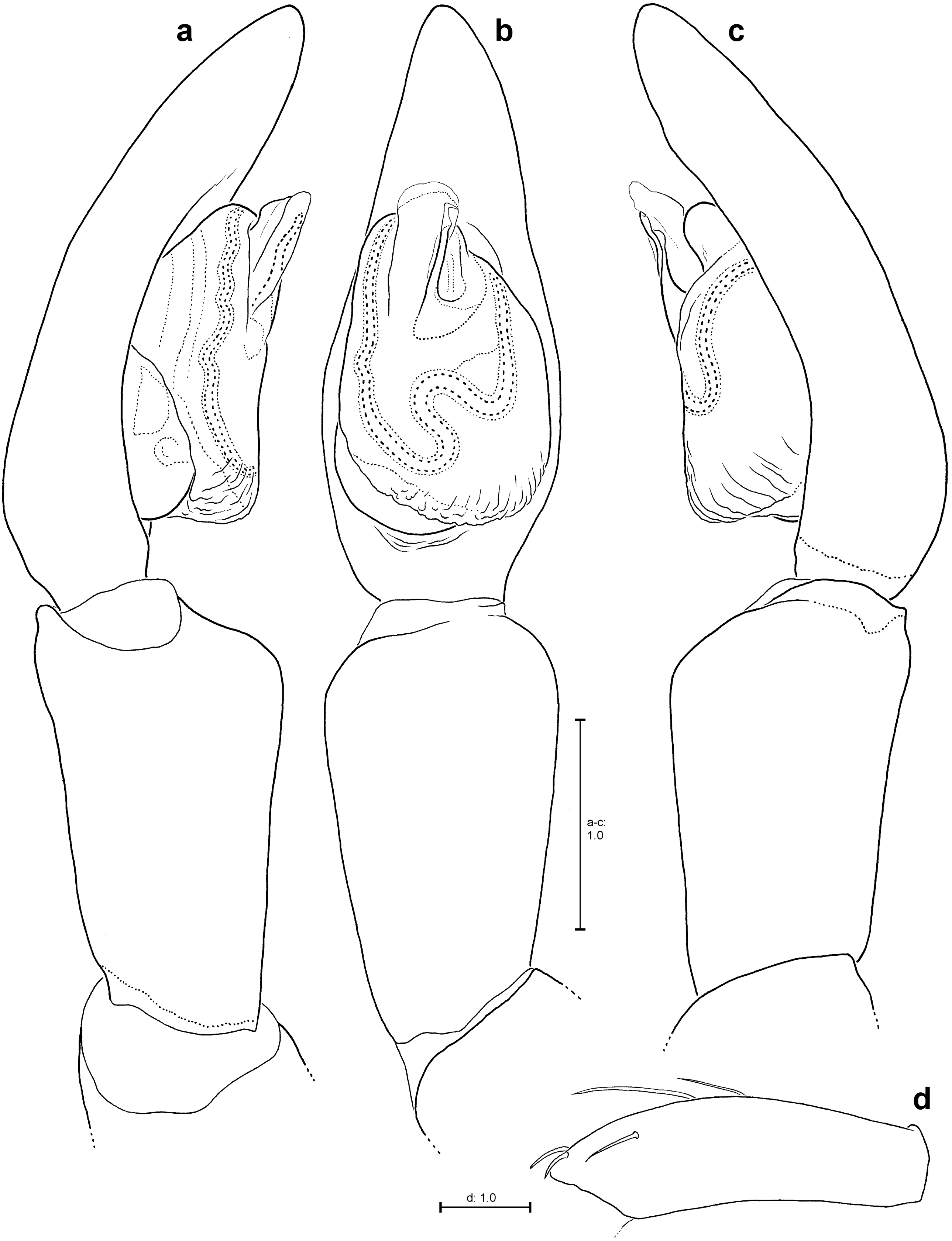
Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Epigyne with bulges in the regions of the CO (Figs 34a,f,i, 88i). Slit sense organs and epigynal muscle sigilla outside epigynal field (EF). Anterior to epigyne numerous slightly curved wrinkles.

Primordial copulatory organ. Pre-epigyne: Similar to the one of *P. himalayanus*. Distinguished by the longer distance between distal endings of anterior margins of pre-LL (Fig. 34g). Pre-EF more distinctly developed.

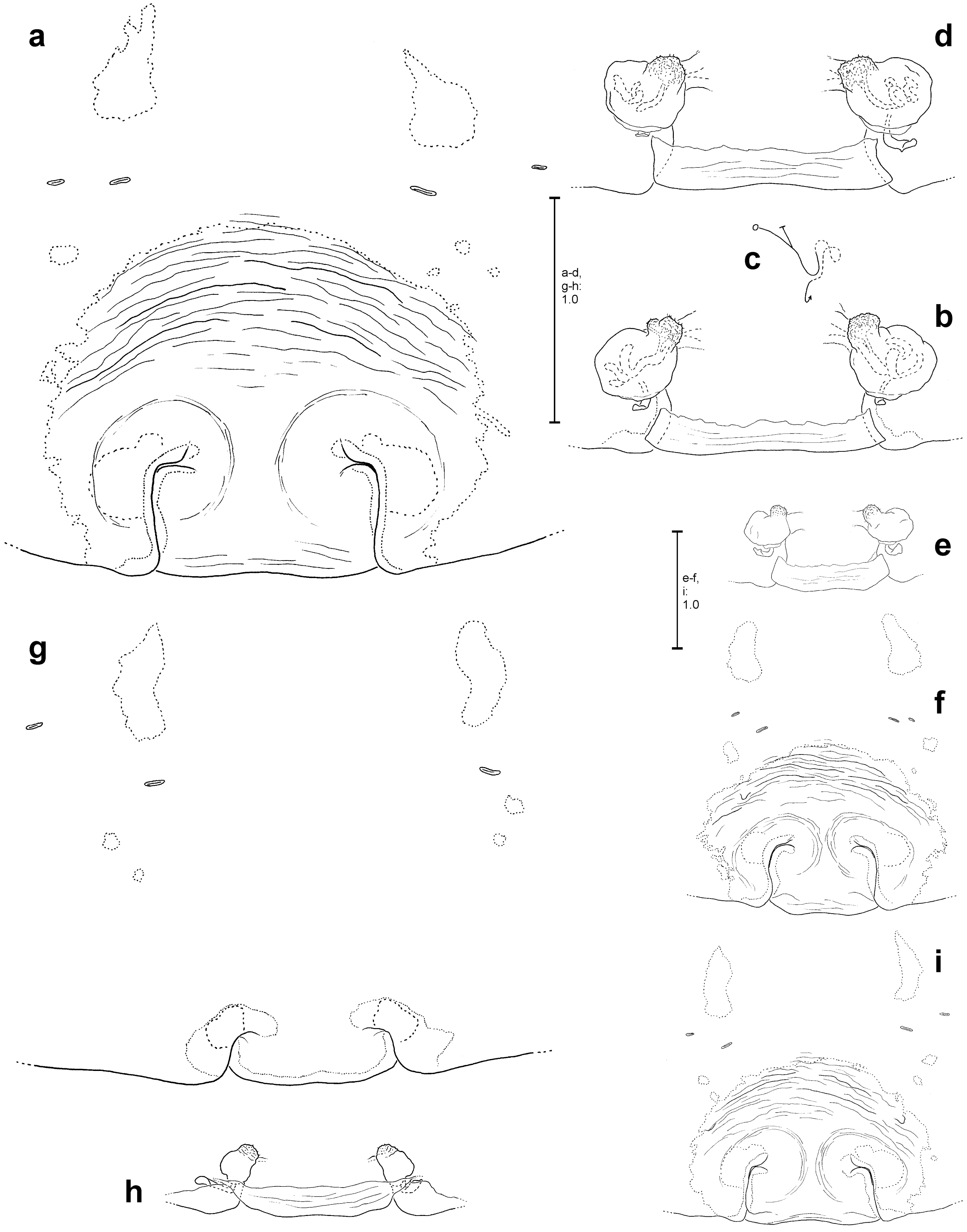
Pre-vulva: Similar to *P. himalayanus*. Distinguished by the shorter pre-copulatory ducts and the slightly protruding pre-SH (Fig. 34h) (in *P. himalayanus* these are very flat).

Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace, if present as such, slightly serrated. However, carapace mostly completely dark brown overflown. Lateral bands, if present as such, narrow (almost diameter of PME) and slightly serrated. Light longitudinal line ventrally on opisthosoma subdistally either broken or strongly constricted (Fig. 81h) with most distal section (or patch) often broader than main section. This ventral median line quiet broad. If measured centrally on opisthosoma, its width is ca. 0.9–1.2 times the width of one half of the cribellum.

Variation of copulatory organs. Females: Posterior part of MS may be slightly broader (Fig. 34i) or protruding slightly more (Fig. 34f) than generally (Fig. 34a). Vulvae with insignificant differences (Figs 34b,d,e).



FIGURES 33a–d. *Psechrus marsyandi*, ♂ holotype SB 79 from Nepal, Gandaki Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.



FIGURES 34a–i. *Psechrus marsyandi*, ♀ primordial and adult copulatory organ. a–c ♀ paratype SB 230 from Nepal, Gandaki Prov. d ♀ paratype SB 228, e–f ♀ paratype SB 226, g–h s.a. ♀ SB 748, i ♀ paratype SB 227, all from Nepal, Dhawalagiri Prov. a, f, i Epigyne, ventral view. b, d, e Vulva, dorsal view. c Schematic course of internal duct system. g Pre-epigyne, ventral view. h Pre-vulva, dorsal view.

Remarks: Levi (1982) matched the females from Southern Dhawalagiri Province and Eastern Gandaki Prov. with the male holotype of *P. marsyandi.* The latter locality is just 35 km away from type locality. I also strongly assume that these females are conspecific with the male holotype. Not only because of geographical reasons, but also due to the shorter copulatory duct, which corresponds to the shorter —in comparison to the males of the closely related *P. himalayanus*— embolus in the male holotype.

Distribution. Nepal (Fig. 95).

***Psechrus inflatus* sp. nov.**

Figs 35a–d, 36a–f, 85i, 88g, 91g

Type material: Holotype ♂ (SB 952), **CHINA: Yunnan Province:** Gongshan Co., Dulongjiang Township, trail to Makucun (Maku Yakou), 0.5 air km WSW of Makucun village, N 27°40'59", E 98°18'01.4", 1845 m; J.A. Miller & D.H. Kavanaugh leg. by night 30.VIII.2006; field-no. JM 06083004; CAS 9039432; **Paratypes** (4 ♀♀)**: 1** ♀ (SB 951), with same data as for holotype; CAS 9039432; **2** ♀♀ (SB 950, CAS 9022346 and SB 960, CAS 9022404), **CHINA: Yunnan Province:** Lushui Co., Pianma Township, Xuetang, 0–4 km E Ganfang, Sancha Lukou, N 26°07'19.85" – 26°07'15.78", E 98°34'32" – 98°34'40", 1640–1785 m, along roadcut with embankments and rocky cliffs; C. Griswold & D. Kavanaugh leg. 16.V.2005; field-no. CGY108; CAS (Coll.-numbers, see above); **1** ♀ (SB 961), **CHINA: Yunnan Province:** Nujiang Prefecture, Gangfang, Sancha Lukou, N 26°07', E 98°35', 1500 m, weedy vegetation and road cuts; C. Griswold, D. Kavanaugh & C.L. Long leg. 14.X.1998; CAS 9023975.

Additional material examined (1 p.s.a. ♀, 7 juvs)**. CHINA: Yunnan Province:** Nujiang Prefecture, Gangfang, Sancha Lukou, N 26°07', E 98°35', 1500 m, weedy vegetation and road cuts; C. Griswold, D. Kavanaugh & C.L. Long leg. 14.X.1998; 1 p.s.a. ♀ (SB 968), 6 juvs (SB 962–967), CAS 9023975. Lushui Co., Pianma Township, Xuetang, 0–4 km E Ganfang, Sancha Lukou, N 26°07'19.85" – 26°07'15.78", E 98°34'32" – 98°34'40", 1640–1785 m, along roadcut with embankments and rocky cliffs; C. Griswold & D. Kavanaugh leg. 16.V.2005; field-no. CGY108; 1 juv. (SB 959), CAS 9022404.

Etymology. The specific name refers to the strongly swollen opisthosoma females may exhibit before egg deposition (Latin “inflatus” means “swollen, puffed up”); adjective.

Diagnosis (see also diagnosis for *himalayanus*-group above)**.** Male similar to *P. himalayanus* and *P. marsyandi* in having the straight embolus (E) completely associated with conductor (C). Distinguished from *himalayanus* by the more complex curved sperm duct (Fig. 35b). Distinguished from *marsyandi* by the inhomogeneous ventro-retrolateral loops of sperm duct (Fig. 35b). Distinguished from both by the more inhomogeneous tegulum (T) with tranversal edges (Fig. 35b,c), the broader C (Fig. 35b) and the macrosetae ventro-proximally on palpal femur (Fig. 35d). Females similar to *P. ghecuanus* Thorell, 1897 in having a simple median septum (MS) and a simple, compact vulva. Distinguished by the small notches at lateral margins of MS (Figs 36a,d) and the broader and flatter spermathecal heads (SH) (Fig. 36b). Moreover, initial section of copulatory duct (CD) with tranversal (Fig. 36f) instead of ventro-dorsal direction like in *P. ghecuanus* (Fig. 37g).

Description. Male:

Body and eye measurements. Carapace length 8.1, carapace width 5.9, anterior width of carapace 3.1, opisthosoma length 10.3, opisthosoma width 3.8. Eyes: AME 0.46, ALE 0.45, PME 0.46, PLE 0.46, AME–AME 0.18, AME–ALE 0.03, PME–PME 0.25, PME–PLE 0.37, AME–PME 0.54, ALE–PLE 0.42, clypeus height at AME 0.78, clypeus height at ALE 0.78.

Cheliceral furrow with three promarginal and four retromarginal teeth.

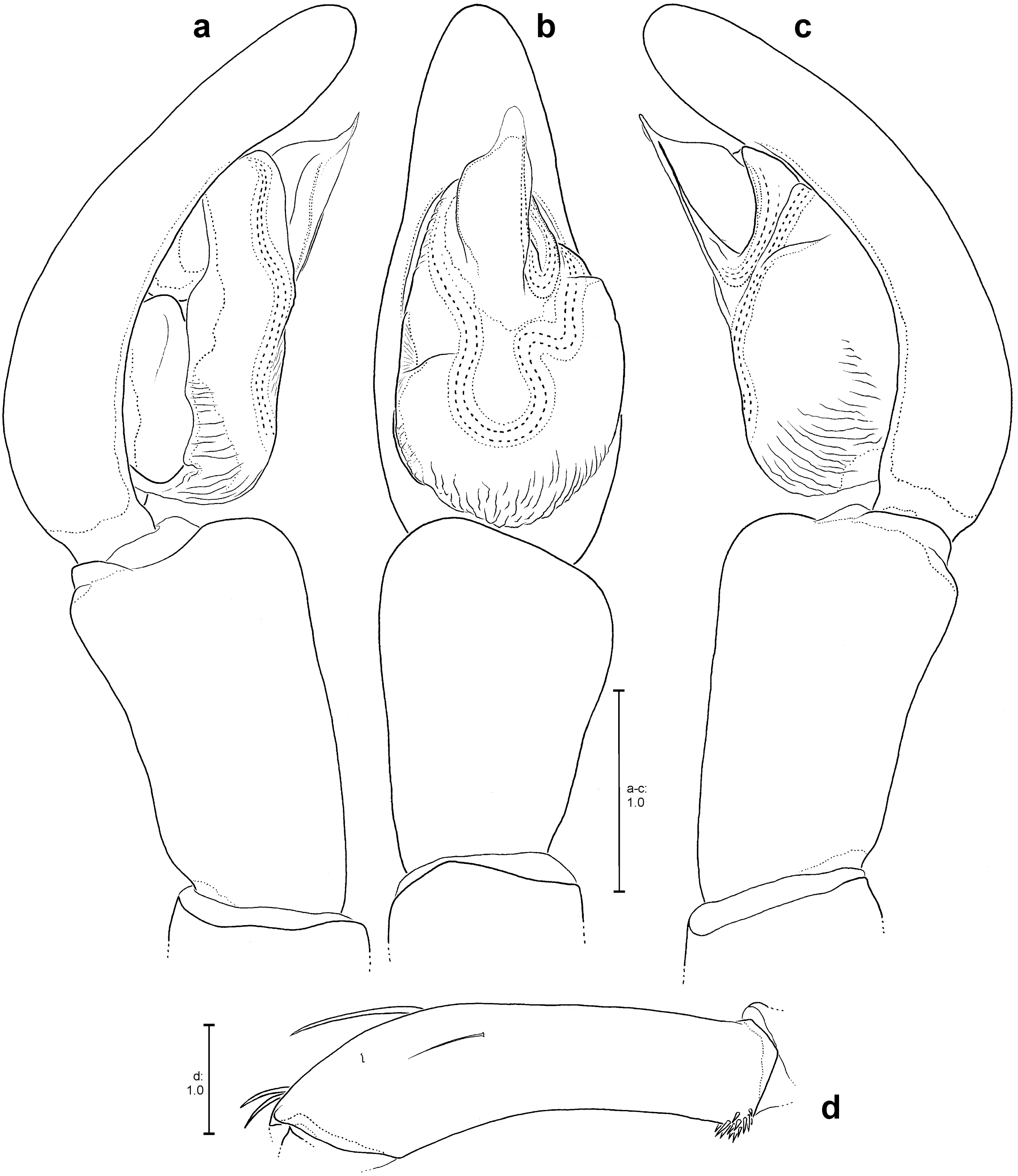
Measurements of palp and legs. Leg formula: 1423. Palp: 11.8 [4.7, 2.1, 2.0, 3.0]; Legs: I 75.8 [19.2, 4.1, 20.0, 22.7, 9.8], II 59.8 [15.9, 3.7, 15.7, 17.0, 7.5], III 39.6 [11.0, 3.0, 9.8, 10.7, 5.1], IV 60.1 [15.9, 3.4, 15.1, 17.4, 8.3]. Spination. Palp: 131, 110 (prolateral one very small), 0000; legs: femur I 536, II 546, III 545{555}, IV 555; patella I–IV 000; tibia I–II 3038, III–IV 3036; metatarsus I–IV 3035.

Palpal femur without modification, but ventro-proximally with macrosetae (as mentioned above) (Fig. 35d).

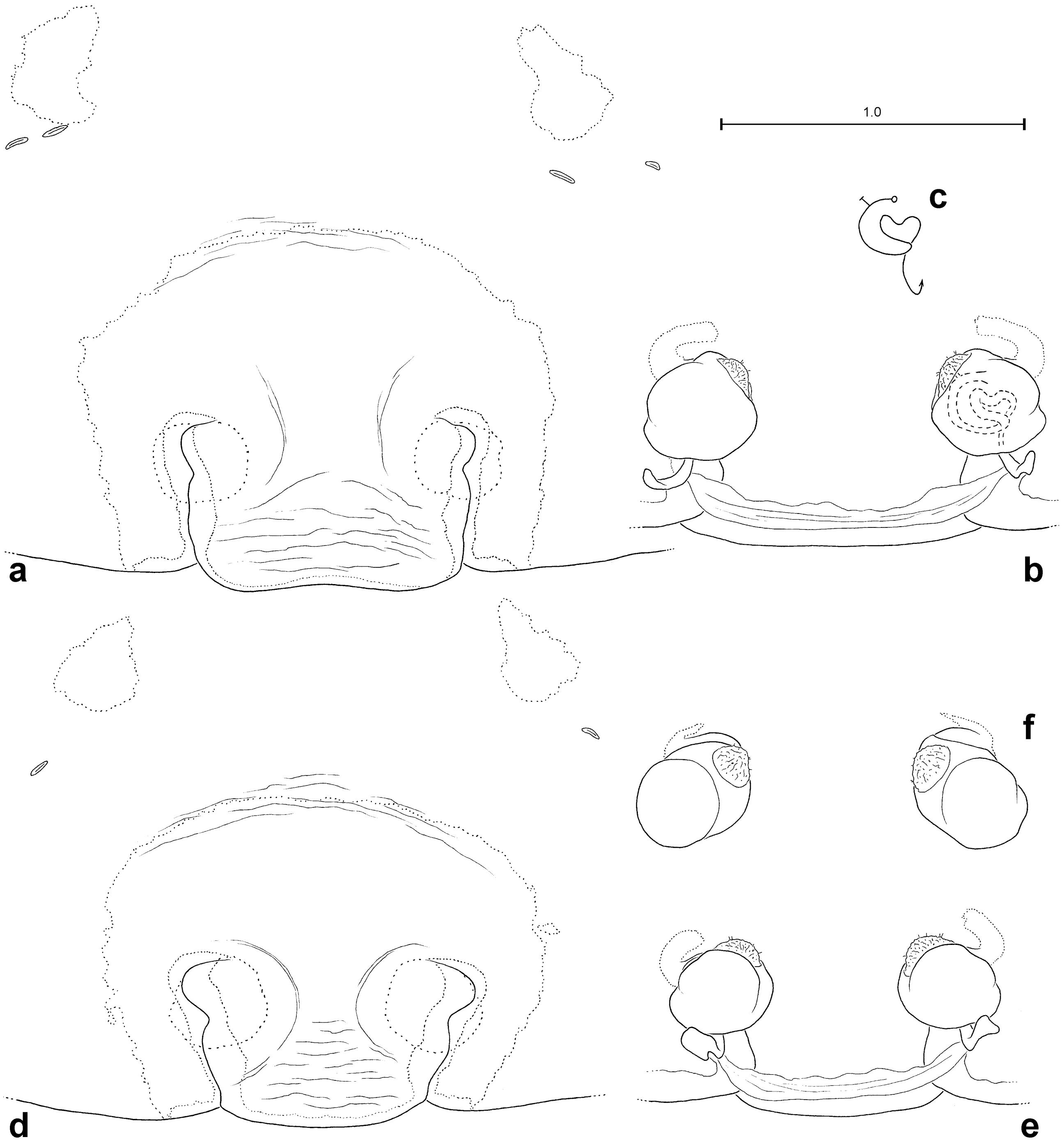
Copulatory organ (see also diagnosis and general description for *himalayanus*-group). Conductor at apical section narrow and hyaline (Fig. 35b). In ventral view subtegulum barely recognisable underneath tegulum. Palpal tibia in lateral view medium sized (Figs 35a,c). Cymbium dorsally with very dense scopula, covering ½ of the former.

Female: Body and eye measurements. Carapace length 9.8–12.1, carapace width 6.4–8.3, anterior width of carapace 4.2–4.9, opisthosoma length 15.4–19.0, opisthosoma width 8.2–14.4. Eyes: AME 0.51–0.55, ALE 0.50–0.55, PME 0.52–0.54, PLE 0.51–0.55, AME–AME 0.27–0.33, AME–ALE 0.04–0.08, PME–PME 0.33–0.47, PME–PLE 0.50–0.55, AME–PME 0.66–0.79, ALE–PLE 0.57–0.62, clypeus height at AME 1.39–1.73, clypeus height at ALE 1.46–1.68.

Cheliceral furrow with three promarginal and four retromarginal teeth.



FIGURES 35a–d. *Psechrus inflatus* **sp. nov.**, ♂ holotype SB 952 from China, Yunnan Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.



FIGURES 36a–f. *Psechrus inflatus* **sp. nov.**, from China, Yunnan Prov., ♀ paratypes, copulatory organ. a ♀ SB 950, b–c ♀ SB 960, d–e ♀ SB 951, f ♀ SB 961. a, d Epigyne, ventral view. b, e Vulva, dorsal view. c Schematic course of internal duct system. f Vulva, frontal view.

Measurements of palp and legs. Leg formula: 1243/1423. Palp: 12.1–13.6 [4.2–4.8, 1.8–2.2, 2.2–2.4, 3.9–4.2]; Legs: I 53.7–60.4 [14.6–16.7, 4.2–5.1, 14.8–16.5, 13.9–15.4, 6.2–6.7], II 43.1–49.2 [12.6–14.3, 3.7–4.6, 11.6–12.9, 10.5–12.1, 4.7–5.3], III 30.2–35.1 [9.1–10.6, 2.9–3.6, 7.3–8.5, 7.4–8.4, 3.5–4.0], IV 43.5–48.6 [12.8–14.5, 3.5–4.1, 10.9–12.2, 11.0–12.1, 5.3–5.7]. Thus, legs in females, in relation to other *Psechrus* species, short: FEM-I+MTT-I/ CL : 2.6–2.9.

Palpal claw with 14–15 teeth.

Spination. Palp: 131 (142,141), 110, 1101, 1014; legs: femur I 546 (536), II 546 (536), III 545 (555), IV 545 (555,544); patella I–IV 000; tibia I–II 3038, III 3034 (3036), IV 3036; metatarsus I–II 3035 (2035), III–IV 3035.

Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Slit sense organs and epigynal muscle sigilla outside epigynal field. Anterior to epigyne just a few and rather fine wrinkles (Figs 36a,d).

Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace serrated, but not distinctly, and quite broad. Lateral bands medium sized to narrow (slightly more than diameter of PME) and may be serrated or not. Light longitudinal line ventrally on opisthosoma continuous or subdistally constricted (most distal section may be broader than main section) and quiet broad. If measured centrally on opisthosoma, its width is ca. 1.0–1.2 times the width of one half of the cribellum.

Variation of copulatory organs. Females: Posterior part of MS may be narrower (Fig. 36d). Structure of compact receptaculum may differing slightly (Figs 36b,e).

Distribution. China (Fig. 96).

Psechrus ghecuanus Thorell, 1897

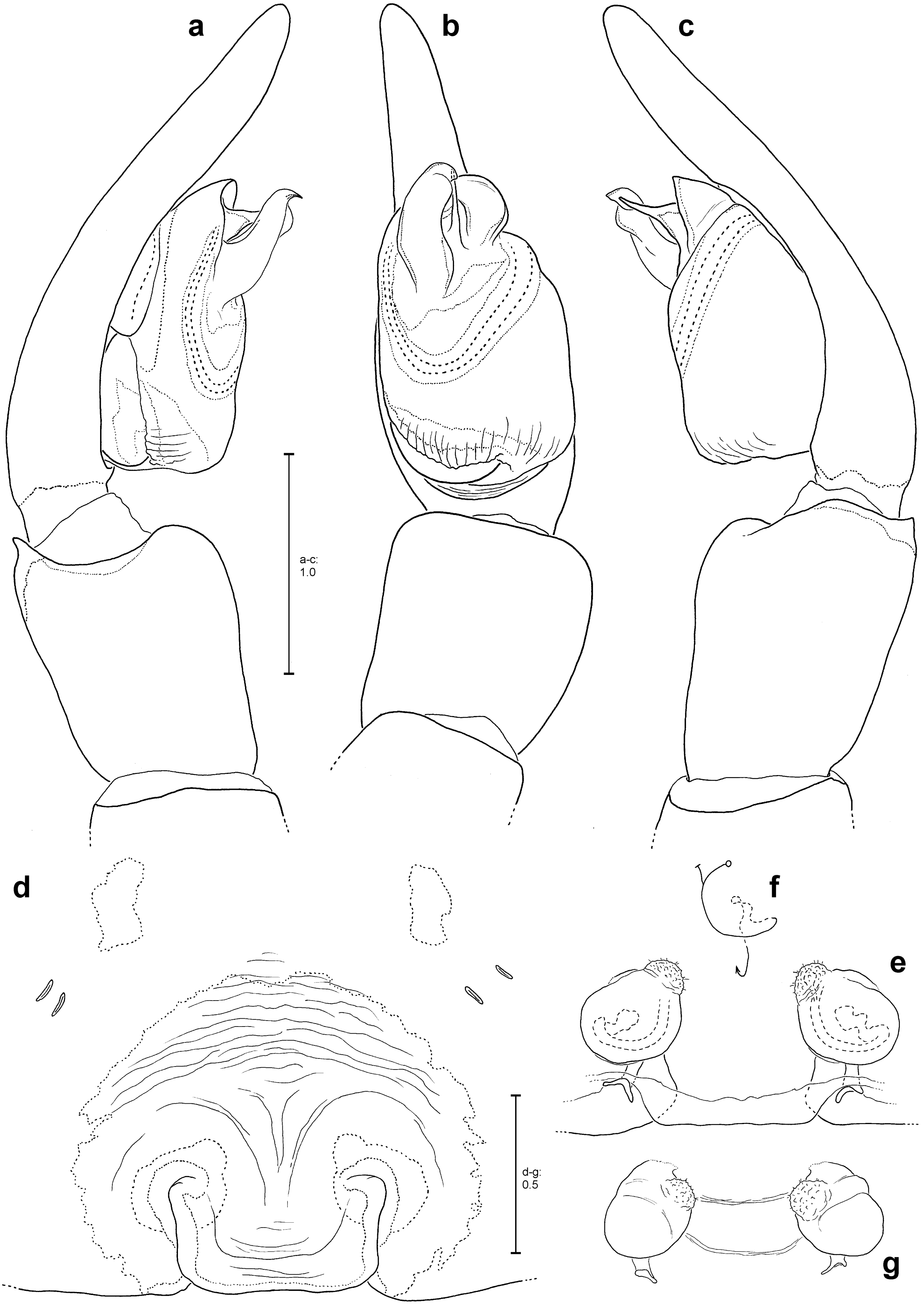
Figs 37a–g, 38a–f, 39a–h, 40a–d, 82e, 85j, 88k, 91k

Psechrus ghecuanus Thorell 1897: 101 (Description of s.a. ♀). [Syntypes: 2 s.a. ♀♀ (SB 221–222) from MYANMAR (BIRMA): Kayin Province: Ghecu, Mt. Carin (presently near Dedako), ca. N 19°17', E 96°42'30", 500–1000 m; Leonardo Fea leg. 1885–1889; Thorell det. 20.X.1896; Thorell Coll. No. 68; Mus. civ. Gen. ded.; NRS; 1 p.s.a. ♀ (SB 772) with same data as above; ZMUC 13112; 1 p.s.a. ♀ (SB 773) with same data as above; ZMH, all type material examined]. Pocock 1900: 211. Kulczyński 1908: 567. Berland and Berland 1914: 133. Fage 1929: 360. Lehtinen 1967: 260 (Syn. with *Psechrus torvus*, rejected by subsequent authors). Levi 1982: 123, figs 29–33, ad part, figs 32–33 misidentified (Description of ♀, figs 29–31: illustration of s.a. ♀ and ♀). Yin *et al.* 1985: 19, figs 1A–I (Description of ♂ and ♀, illustration of ♂ and ♀). Song *et al.* 1999: 397, figs 232A–B, M–N (Illustration of ♂ and ♀). Wang and Yin 2001: 333, figs 5–8 (Description of ♂ and ♀, illustration of ♂ and ♀). Jäger 2007: 45. Sebastian and Peter 2009: 528.

Additional material examined (6 ♂♂, 8 ♀♀, 7 s.a. ♂♂, 5 s.a. ♀♀, 4 juvs)**. MYANMAR: Kayin Province:** Tenasserim, Mulayit Taung (Mt. Mooleyit), 1600–1900 m; L. Fea leg. 1885–1889; T. Thorell det. 1898; 2 ♀♀ (SB 820–821, checked via photos of dorsal and ventral habitus and epigyne, kindly provided by Pakawin Dankittipakul), MCSN. **LAOS: Luang Nam Tha Province:** Muang Sing, Nam Det, N 21°10'11.6" – 21°09'59", E 101°14'26.7" – 101°14'44.5", 820–1100 m, secondary forest, along path; P. Jäger & V. Vedel leg. 06.XI.2004; 3 s.a. ♀♀ (SB 2, 837–838), 4 s.a. ♂♂ (SB 832–835), 3 juvs (SB 60, 836, 839), SMF. Vieng Phoukha, N of V.P., N 20°41'36.9", E 101°02'17.5", ca. 700 m, between villages, slope at wayside; P. Jäger leg. 05.III.2008; 2 ♂♂ (SB 28, 36), 5 ♀♀ (SB 29–31, 37, 39), 1 s.a. ♀ (SB 37, with fully developed adult epigyne underneath cuticle) SMF. **THAILAND: Mae Hong Son Province:** Sop Pong, Tham Lot Cave (8 km N of S.P.), ca. N 19°34', E 98°18'; V. & B. Roth leg. 05.–11.III.1990; 1 ♂ (SB 780), 2 s.a. ♂♂ (SB 779, 781), USNM. **Chiang Mai Province:** Chiang Mai District, Mae Rim (near Chiang Mai), secondary *Ficus* forest on a ridge of hill, in a small tree hole; H. Ono leg. 14.X.2009 as immature, reared, adult III.2010; 1 ♂ (SB 613), NSMT. Chiang Mai District, Doi Suthep-Pui National Park, N 18°48'46", E 98°56'34", 450 m, evergreen rainforest; P. Schwendinger leg. 30.XII.2009; 1 s.a. ♂ (SB 421), SMF. **Chiang Rai Province:** Phan District, Doi Luang National Park, Poo Kaeng Waterfalls, 500 m, 50 m W of WF, trail through evergreen forest; P. Dankittipakul leg. 20.II.2007; 1 ♂ (SB 207), 1 s.a. ♀ (SB 208), MHNG. **Lam Pang Province:** Ban Dong District, Tham Pha Thai, 300 m, secondary forest in front of cave entrance; P. Dankittipakul leg. 24.VI.2002; 1 ♀ (SB 201), 1 juv. (SB 786), SMF. **Lamphun Province:** Mae Tha District, Doi Khuntan National Park, 750 m; P. Schwendinger leg. 30.I.1997; 1 ♂ (SB 145), MHNG.

Doubtful material examined. MYANMAR: Sagaing Province: Alaungdaw Kathapa National Park, Log Cabin, N 22°19'08", E 94°28'32"; J. Coddington & R. Babtista leg. 20.–25.X.1998; 1 p.s.a. ♀ (SB 774), 4 juvs (SB 775–778), USNM. **CHINA: Yunnan Province:** Baoshan Prefecture, Bawan, N 24°57', E 98°50', 950 m, weedy vegetation and road cuts; C. Griswold & D. Kavanaugh leg. 08.XI.1998; 2 s.a. ♀♀ (SB 957–958), 1 p.s.a. ♂ (SB 956), CAS 9023974.

Revised diagnosis (see also diagnosis for *himalayanus*-group above)**.** Males similar to *P. pakawini* **sp. nov.** in having a quite strongly sclerotised, semicircular extension apically on tegulum (T) (see asterisk in Fig. 39g). Distinguished by the shorter embolus (E) and conductor (C) (the former with proximal section in ventral view compress) and the less proximally extending sperm duct (Fig. 37b). Moreover, E arising distal to arising point of C. Females similar to *P. pakawini* in shape of epigyne and vulva. Distinguished by the margins of lateral lobes (LL), which are at most 100° curved anteriorly and point medially (Fig. 37d) or at least almost medially, and by the shorter copulatory ducts (should be viewed from frontal, Fig. 37g) extending less medially.



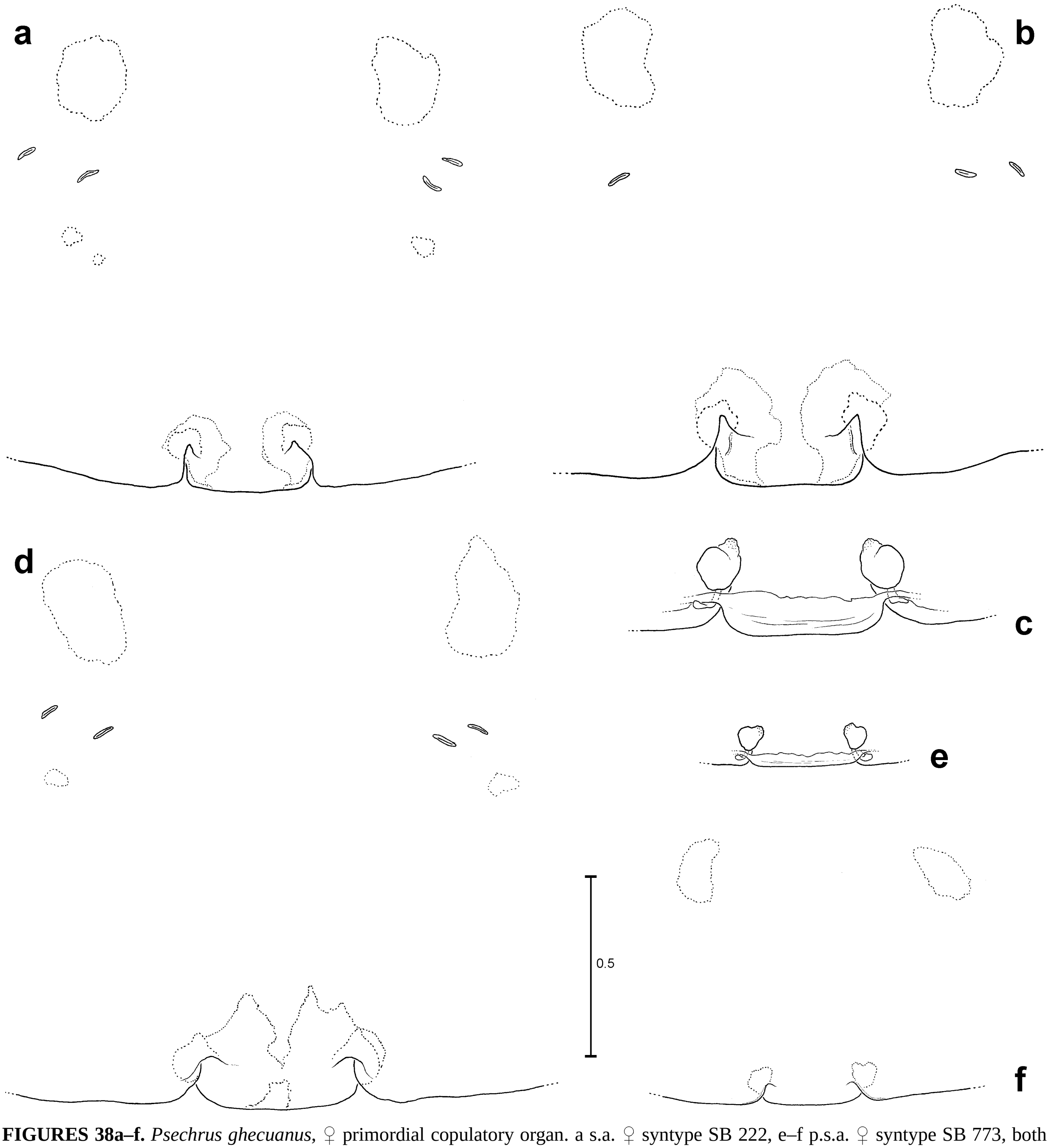
FIGURES 37a–g. *Psechrus ghecuanus*. a–c ♂ SB 613 from Thailand, Chiang Mai Prov. d–g ♀ SB 201 from Thailand, Lampang Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d Epigyne, ventral view. e Vulva, dorsal view. f Schematic course of internal duct system. g Vulva, frontal view.

Description. Male:

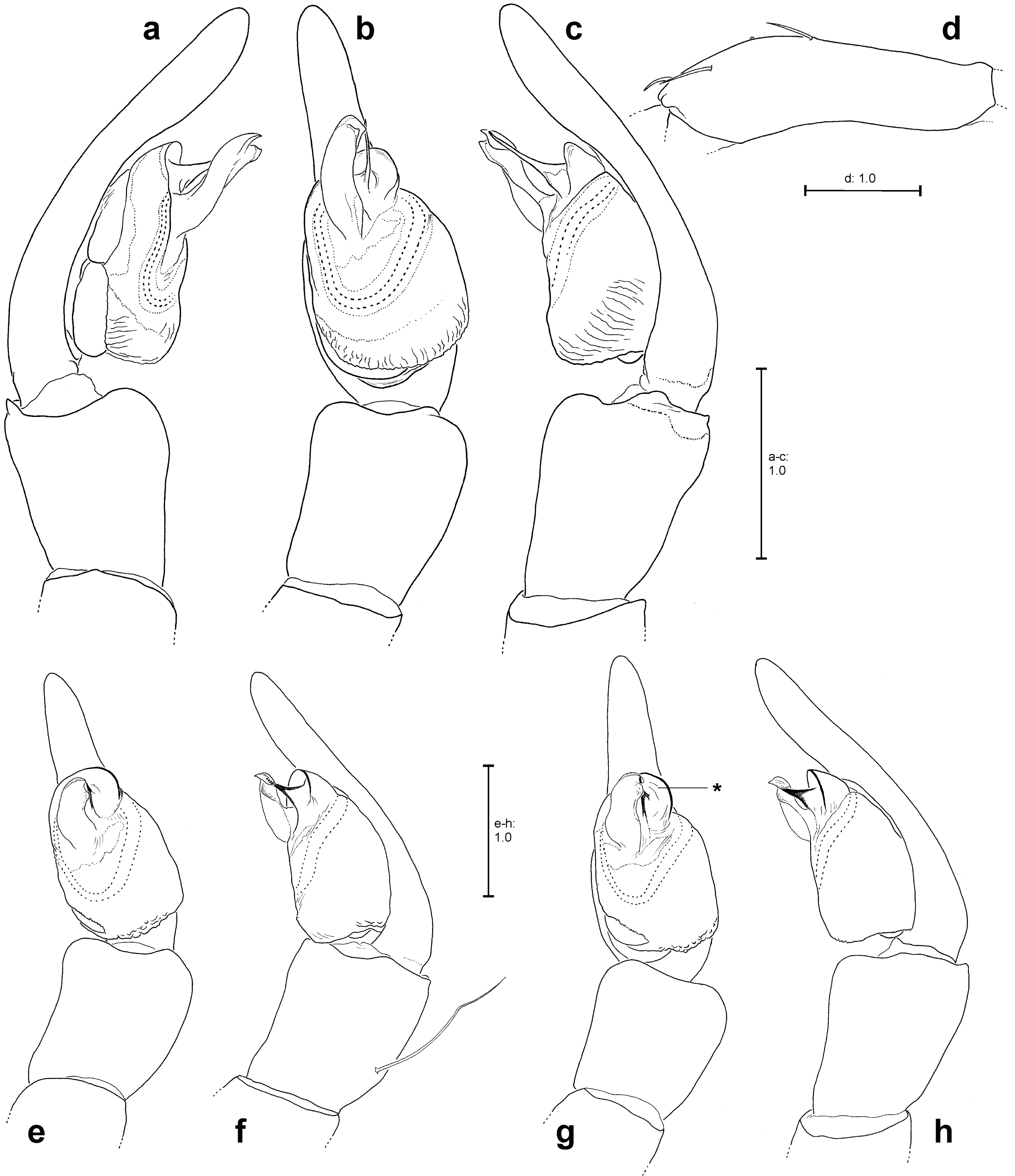
Body and eye measurements. Carapace length 6.2–9.4, carapace width 4.4–7.3, anterior width of carapace 2.3–3.3, opisthosoma length 7.7–12.9 , opisthosoma width 2.6–5.1. Eyes: AME 0.32–0.38, ALE 0.35–0.46, PME 0.39–0.47, PLE 0.37–0.47, AME–AME 0.13–0.17, AME–ALE 0.04–0.06, PME–PME 0.22–0.28, PME–PLE 0.24–0.35, AME–PME 0.53–0.57, ALE–PLE 0.38–0.54, clypeus height at AME 0.69–0.99, clypeus height at ALE 0.58–0.93.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.8–10.4 [2.9–3.7, 1.3–2.1, 1.2–1.5, 2.4–3.1]; Legs: I 46.0–61.3 [12.0–16.9, 2.8–4.4, 12.4–16.6, 12.8–16.4, 6.0–7.0], II 37.5–49.1 [10.0–14.3, 2.6–3.9, 9.8–12.9, 10.2–12.6, 4.9–5.4], III 26.3–34.3 [7.6–10.2, 2.0–3.1, 6.4–8.1, 6.9–8.8, 3.4–4.1], IV 39.5–51.3 [10.5–14.7, 2.4–3.6, 9.9–12.6, 11.3–14.0, 5.4–6.4].



FIGURES 38a–f. *Psechrus ghecuanus*, ♀ primordial copulatory organ. a s.a. ♀ syntype SB 222, e–f p.s.a. ♀ syntype SB 773, both from Myanmar, Kayin Prov. b–c s.a. ♀ SB 208 from Thailand, Chiang Rai Prov. d s.a. ♀ SB 2 from Laos, Luang Nam Tha Prov. a–b, d Pre-epigyne, ventral view. c Pre-vulva, dorsal view. f Pre-pre-epigyne, ventral view. e Pre-pre-vulva, dorsal view.



FIGURES 39a–h. *Psechrus ghecuanus*, ♂ palp and palpal femur. a–d ♂ SB 780 from Thailand, Mae Hong Son Prov. e–f ♂ SB 36 from Laos, Luang Nam Tha Prov. g–h ♂ SB 207 from Thailand, Chiang Rai Prov. a–c, e–h ♂ palp (a prolateral, b, e, g ventral, c, f, h retrolateral view). d ♂ left palpal femur, retrolateral view. The asterisk indicates the quite strongly sclerotised, semicircular extension apically on tegulum.

Spination (most common pattern, the second most common state in parentheses).

Palp: 131, 110 (010), 1101 (0000); legs: femur I 566 (666), II–III 555, IV 555 (565); patella I–IV 000; tibia I–II 3038, III 3034 (3134), IV 3036 (3034); metatarsus I 3035 (4035,4037), II–IV 3035.

Palpal femur without modification, broadest distally (Fig. 39d).

Copulatory organ (see also diagnosis and general description for *himalayanus*-group). Conductor slightly S-shaped medially, with flat protrusion subdistally (Figs 37a–c). Tegulum in lateral view apically pointed (Figs 37a,c, 39f,h). Palpal tibia in lateral view short to medium sized (Figs 37a,c). Cymbium dorsally without scopula.

Female:

Body and eye measurements. Carapace length 8.1–11.2, carapace width 5.5–7.8, anterior width of carapace 3.2–4.4, opisthosoma length 10.2–13.1, opisthosoma width 4.7–7.5. Eyes: AME 0.38–0.46, ALE 0.42–0.51, PME 0.47–0.53, PLE 0.46–0.53, AME–AME 0.20–0.29, AME–ALE 0.07–0.08, PME–PME 0.24–0.38, PME–PLE 0.40–0.48, AME–PME 0.71–0.81, ALE–PLE 0.52–0.64, clypeus height at AME 0.92–1.14, clypeus height at ALE 0.86–1.13.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.4–11.2 [3.1–4.0, 1.4–1.8, 1.8–2.0, 3.1–3.4]; Legs: I 47.3–53.6 [13.1–15.1, 3.6–4.6, 12.8–14.7, 12.3–13.4, 5.5–5.8], II 39.2–44.8 [11.4–13.3, 3.2–4.2, 10.2–11.6, 9.9–10.8, 4.5–4.9], III 28.2–32.3 [8.6–9.8, 2.6–3.3, 6.8–7.6, 6.9–7.8, 3.3–3.8], IV 40.1–46.0 [11.6–13.3, 2.8–3.6, 10.2–11.8, 10.3–12.0, 4.9–5.3]. Thus, legs in females, in relation to other *Psechrus* species, short: FEM-I+MTT-I/ CL : 2.5–3.1.

Palpal claw with 12–15 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 566 (556,667), II 566, III–IV 555; patella I–IV 000; tibia I–II 3038, III 3036 (3035,3026), IV 3036; metatarsus I–III 3035, IV 3035 (3024).

Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Epigyne with bulges in the regions of the CO. Median septum with fine transversal ridge with both ends curved anteriorly (Fig. 37d). Slit sense organs and epigynal muscle sigilla outside epigynal field (EF). Anterior to epigyne many slightly curved wrinkles.

Primordial copulatory organ. Pre-epigyne: In general shape cross rectangular (Figs 38a–b,d) and similar to *P. pakawini* **sp. nov.** Distinguished by the presence of an imhomogeneous pre-EF consisting of two parts (Figs 38a–b,d).

Pre-vulva: Pre-vulva similar to *P. pakawini* **sp. nov.** Distinguished by the further developed pre-SH (Fig. 38c).

Pre-pre-epigyne (Fig. 38f) resembles already the pre-epigyne, but pre-pre-EF (Fig. 38f) far less distinct than pre-EF (Fig. 38b).

Pre-pre-vulva: Less structured (Fig. 38e) than pre-vulva.

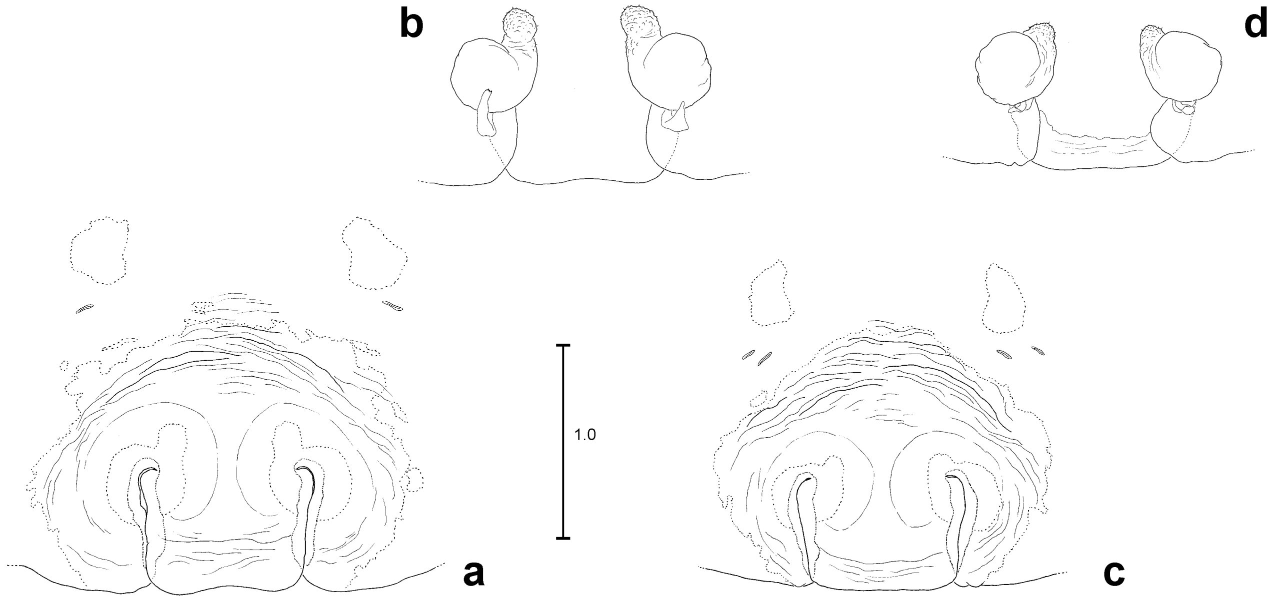
Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace serrated (Fig. 82e). Some specimens with narrow, dark extensions connecting them (median bands) with the lateral bands. Lateral bands narrow (ca. diameter of PME) and serrated (Fig. 82e). Light longitudinal line ventrally on opisthosoma continuous, its width medium-sized. If measured centrally on opisthosoma, its width is less than the width of one half of the cribellum (ca. 0.5–0.8 of one half of the cribellum).

Variation of copulatory organs. In males E and C may be a bit longer (Figs 39a–c) than is generally found (Figs 37a–c). Direction of semicircular extension of T slightly differs (Figs 37b, 39b,e,g). Females: Distal parts of margins of LL may be extending less medially (Fig. 40c). MS may be slightly longer (Fig. 40a). In vulva SH may be longer (Fig. 40b) than is generally found (Figs 37e, 40d).

Remarks: Levi (1982) was the first to illustrate the female copulatory organ of this species. He examined an adult female from Doi Suthep, Thailand and considered it conspecific with the subadult syntypes of *P. ghecuanus*. As a reason for that, he stated that “The leg proportions were identical...” and “...the recording localities of the mature females from Thailand are close to the type locality in Burma” (Levi 1982). In the present study eight females and five subadult females were examined. In some cases subadults and adults from exactly the same recording locality. In one case (SB 37) a subadult female was close to adult moult and the epigyne was already fully developed underneath the old cuticle. The pre-epigynes of all five subadults corresponded to those of the syntypes. Moreover, Thorell himself identified adult females from (the present) Kayin Prov., Myanmar sub *P. ghecuanus*. This material still exists, was examined for the present study (see SB 820–821 in material list, above) and the epigynes corresponded to the ones of the other females examined herein. So the females examined in Levi (1982, figs 30–31), Yin *et al.* (1985), Song *et al.* (1999), Wang and Yin (2001) and in the present study unambiguously belong to *P. ghecuanus*. Yin *et al.* (1985) first described and illustrated the male of *P. ghecuanus*. They identified female *Psechrus* specimens collected together with —at that time— unknown males from Southern China as *P. ghecuanus* by using the revision of Levi (1982). In the present study (among others) material from Chiang Rai

Province, Thailand was checked, a subadult female and an adult male from exactly the same locality. As the subadult female could be identified as *P. ghecuanus*, it is certain, that the males examined in Yin *et al.* (1985), in Song *et al.* (1999), in Wang and Yin (2001) and in the present study unambiguously belong to *P. ghecuanus*.

Distribution. Myanmar, China, Laos, Thailand (Fig. 98).



FIGURES 40a–d. *Psechrus ghecuanus*, from Laos, Luang Nam Tha Prov., ♀ copulatory organ. a–b ♀ SB 30, c–d ♀ SB 39. a, c Epigyne, ventral view. b, d Vulva, dorsal view.

Psechrus pakawini sp. nov.

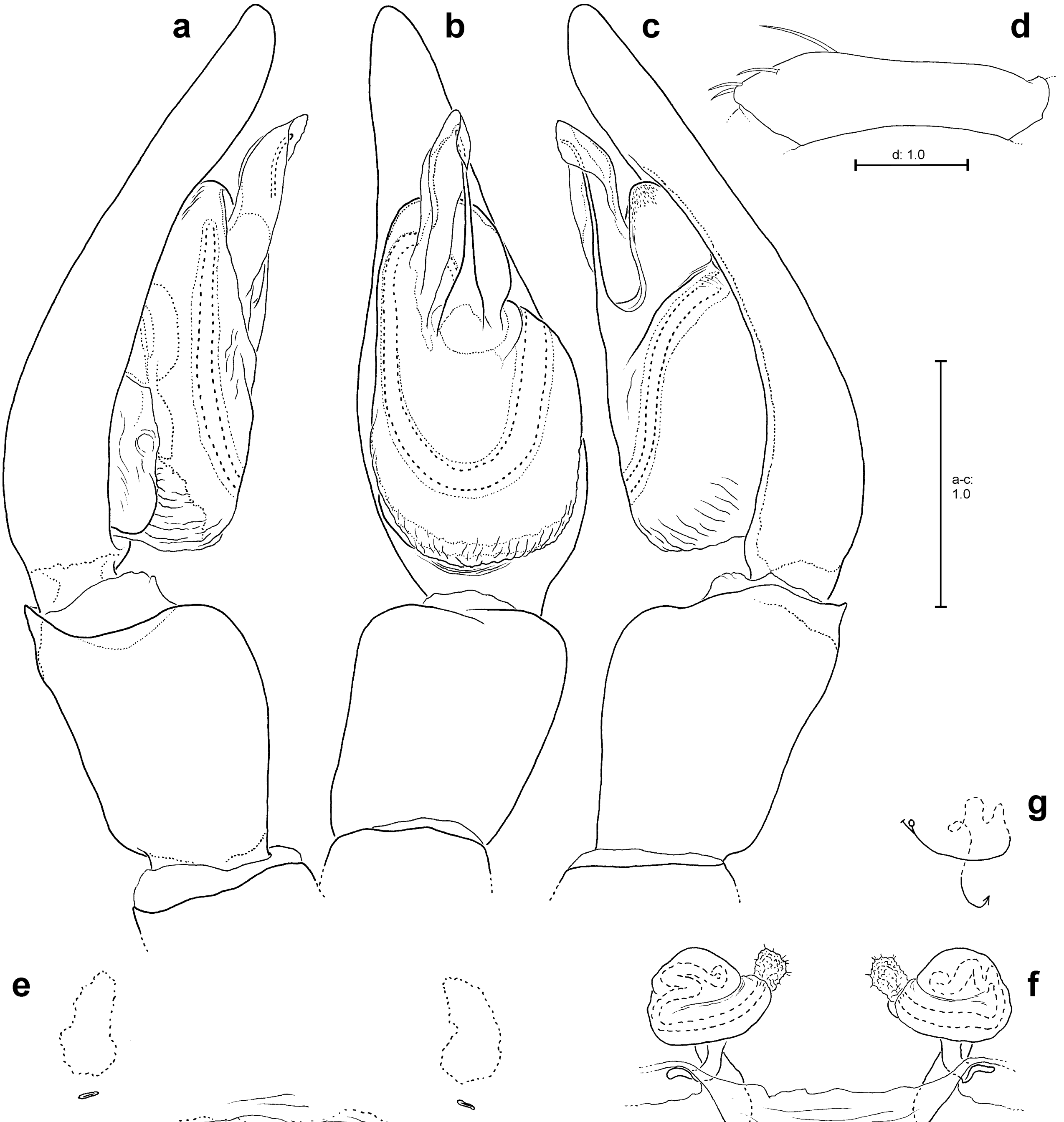
Figs 41a–h, 42a–e, 85k, 88j, 91j

Type material: Holotype ♂ (SB 140), **THAILAND: Chiang Mai Province:** Chiang Mai District, Doi Suthep, N 18°48'59", E 98°53'34", ca. 1600 m, mountainous rainforest; P. Schwendinger leg. 05.X.1993; MHNG; **Paratypes** (4 ♂♂, 9 ♀♀, 1 s.a. ♀)**: 4** ♀♀ (SB 197, 199: SMF; SB 198, 200: MHNG), **THAILAND: Chiang Mai Province:** Chiang Mai District, Doi Suthep-Pui National Park, Doi Pui, San Koo, 1450 m, evergreen rainforest, along a small trail to the summit; P. Dankittipakul leg. 27.I.2001; SMF & MHNG (see above); **1** ♂ (SB 139), **THAILAND: Chiang Mai Province:** Fang District, Doi Angkhang, Ban Luang, ca. 1600 m; P. Schwendinger leg. 02.XI.1990; MHNG; **1** ♂ (SB 142), **THAILAND: Chiang Mai Province:** Fang District, Doi Angkhang, ca. 1500 m; P. Schwendinger leg. 30.X.1987; MHNG; **4** ♀♀ (SB 209–210: MHNG, SB 213–214: SMF), **THAILAND: Chiang Mai Province:** Fang District, Doi Angkhang, Royal Agricultural Research Station, ca. 1500 m, at a stream; P. Dankittipakul leg. 02.V.2002; MHNG & SMF (see above); **2** ♂♂ (SB 146–147), **1** ♀ (SB 148, actually subadult, but close to adult moult; adult epigyne already fully developed; could be dissected and examined), **THAILAND: Chiang Mai Province:** Chomthong District, Doi Inthanon, ca. 1700 m, rain forest; P. Schwendinger leg. 08.X.1987; MHNG.

Additional doubtful material examined. MYANMAR: Kachin Province: Namti, Loglai; 1945; Coll. J.E.S.; 1 ♀ (SB 974), CAS 9032227.

Etymology. The specific name is a patronym in honour of the collector of part of the type material, Pakawin Dankittipakul; noun (first name) in genitive case.

Diagnosis (see also diagnosis for *himalayanus*-group above)**.** Males similar to *P. ghecuanus* in having a quite strongly sclerotised, semicircular extension apically on tegulum (T) (see asterisk in Fig. 39g). Distinguished by the longer embolus (E) and conductor (C) (the former with proximal section depress, in ventral view) (Figs 41a–c). Moreover, E arising proximal to the arising point of C (Fig. 41b) or at the same level on T. Females similar to *P. ghecuanus* in shape of epigyne and vulva. Distinguished by the margins of lateral lobes (LL) almost 180° curved anteriorly and pointing posteriorly (Figs 41e, 42c,e) and by the longer copulatory ducts (should be viewed from frontal, Fig. 41h) extending further medially.



FIGURES 41a–h. *Psechrus pakawini* **sp. nov.**, from Thailand, Chiang Mai Prov. a–d ♂ holotype SB 140. e–h ♀ paratype SB 148. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e Epigyne, ventral view. f Vulva, dorsal view. g Schematic course of internal duct system. h Vulva, frontal view.

Description. Male (measurements of holotype —largest male— first, those of paratype SB 139 —smallest— in parentheses)**:**

Body and eye measurements. Carapace length 6.8 (3.9), carapace width 4.9 (2.8), anterior width of carapace 2.6 (1.6), opisthosoma length 7.8 (4.6), opisthosoma width 3.0 (1.7). Eyes: AME 0.35 (0.24), ALE 0.43 (0.30), PME 0.46 (0.32), PLE 0.44 (0.28), AME–AME 0.14 (0.12), AME–ALE 0.03 (0.04), PME–PME 0.16 (0.14), PME–PLE 0.28 (0.22), AME–PME 0.47 (0.38), ALE–PLE 0.34 (0.23), clypeus height at AME 0.68 (0.47), clypeus height at ALE 0.63 (0.46).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp 8.2 (5.2) [3.0 (1.9), 1.3 (0.8), 1.2 (0.8), 2.7 (1.7)] , I 51.9 (38.1) [13.5 (10.5), 3.2 (1.9), 14.4 (10.6), 14.4 (10.2), 6.4 (4.9)], II 42.0 (28.0) [11.6 (9.0), 2.7 (1.4), 11.2 (7.7), 11.5 (7.0), 5.0 (3.9)], III 29.0 (19.5) [8.5 (5.7), 2.2 (1.3), 7.1 (4.9), 7.6 (4.9), 3.6 (2.7)], IV 42.2 (30.0) [12.1 (8.3), 2.5 (1.4), 10.4 (7.6), 11.7 (8.3), 5.5 (4.4)].

Spination. Palp: 131 (131), 110 (110, in both specimens prolateral spine very small), 1101 (1101, in both specimens all spines very small); legs: femur I 556 (556), II 556 (546) III 555 (545), IV 544 (545); patella I–IV 0000; tibia I 3038 (3038), II 3038 (4048), III–IV 3036 (3134); metatarsus I–III 3035 (3035), IV 3036 (3035).
Palpal femur without modification, broadest distally (Fig. 41d).

Copulatory organ (see also diagnosis and general description for *himalayanus*-group). Conductor fleshy, straight and distally in retrolateral section with longitudinal bending (Figs 41b–c). Sperm duct extending quite far proximally at T. Palpal tibia in lateral view short (Fig. 41c). Cymbium dorsally without scopula.

Female: Body and eye measurements. Carapace length 6.0–8.4, carapace width 4.3–6.1, anterior width of carapace 2.7–3.7, opisthosoma length 7.9–11.8, opisthosoma width 4.3–6.1. Eyes: AME 0.33–0.41, ALE 0.42–0.45, PME 0.46–0.48, PLE 0.41–0.48, AME–AME 0.18–0.26, AME–ALE 0.04–0.06, PME–PME 0.25–0.30, PME–PLE 0.36–0.39, AME–PME 0.48–0.63, ALE–PLE 0.41–0.51, clypeus height at AME 0.76–0.99, clypeus height at ALE 0.71–0.98.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.2–9.5 [2.3–3.4, 1.2–1.4, 1.3–1.6, 2.4–3.1]; Legs: I 33.7–45.7 [9.2–12.5, 2.6–3.5, 9.4–12.7, 8.2–11.7, 4.3–5.3], II 27.7–36.8 [7.9–10.2, 2.3–3.2, 7.3–9.7, 6.6–9.4, 3.6–4.3], III 19.4–26.1 [5.9–7.9, 1.7–2.4, 4.4–6.2, 4.8–6.4, 2.6–3.2], IV 27.7–37.2 [7.9–10.5, 2.0–3.0, 7.0–9.5, 6.9–9.6, 3.9–4.6]. Thus, legs in females, in relation to other *Psechrus* species, short: FEM-I+MTT-I/CL : 2.85–2.9.

Palpal claw with 12–14 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 566 (546), II 546 (545), III 545 (535), IV 544; patella I–IV 000; tibia I–II 3038, III 3034 (2024), IV 3036; metatarsus I–III 3035, IV 3035 (3033).
Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Slit sense organs (SO) and epigynal muscle sigilla (EM) outside epigynal field (EF). Anterior to epigyne many slightly curved wrinkles (Fig. 41e).

Primordial copulatory organ. Pre-epigyne: Similar to *P. ghecuanus.* Distinguished by the absence of a pre-EF and by two fine ridges medially (Fig. 42a).

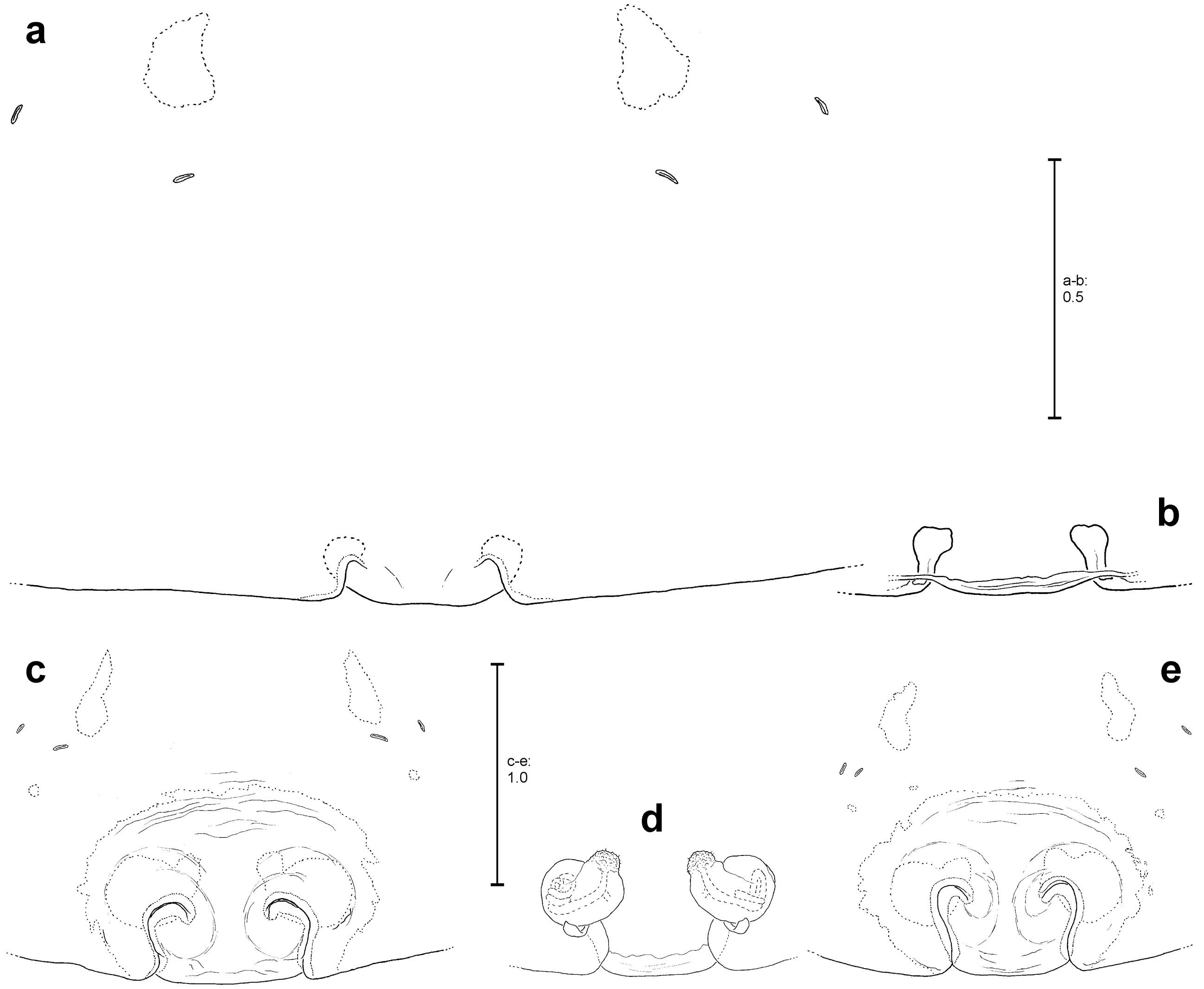
Pre-vulva: Similar to *P. ghecuanus*. Distinguished by the less developed pre-SH (Fig. 42b). It is difficult to discriminate pre-SH and pre-receptaculum in the s.a. ♀ of this species.

Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace serrated. Lateral bands narrow (at most 2/3 diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma may be continuous, broken subdistally or constricted subdistally and medium-sized. If measured centrally on opisthosoma, its width is less than the width of one half of the cribellum (ca. 0.5–0.8 of one half of the cribellum).

Variation of copulatory organs. In males E and C may be a bit longer (Fig. 85k) than in holotype (Fig. 41b). Females: Distal parts of margins of LL extending differently far posteriorly (Figs 41e, 42c,e, 88j). MS in a few specimens slightly shorter (Fig. 42c). In vulva SH may be longer (Fig. 41f, 91j) or shorter (Fig. 42d).

Remark: The female specimen SB 974 from Kachin Prov., Myanmar slightly differs from the type specimens. Its spermathecae have a rather inhomogeneous shape (not illustrated). With further material from this region, especially males, it may be possible to provide a definite identification.

Distribution. Thailand (Fig. 98).



FIGURES 42a–e. *Psechrus pakawini* **sp. nov.**, from Thailand, Chiang Mai Prov., ♀ primordial and adult copulatory organ. a–b s.a. ♀ paratype SB 148, c–d ♀ paratype SB 197, e ♀ paratype SB 199. a Pre-epigyne, ventral view. b Pre-vulva, dorsal view. c, e Epigyne, ventral view. d Vulva, dorsal view.

Psechrus luangprabang Jäger, 2007

Figs 43a–d, 44a–e, 45a–e, 81d, 83b, 85l, 88m, 91m, 93a

Psechrus luangprabang Jäger 2007: 45, figs 48–53, 68–72 (Description of ♂ and ♀, illustration of ♂ and ♀). [Holotype ♂ (SB 1030) from LAOS: Luangprabang Province: Xieng Ngeun District, Ban Keng Koung [L15], N 19°40'58", E 102°18'27", 372 m, disturbed forest at riverside of Nam Khan, between rocks; P. Jäger & J. Altmann leg. 07.III.2006; SMF 56389; Paratypes: 1 ♂ (SB 1031), 2 ♀♀ (SB 1032, 1034) with same data as for holotype; SMF 56390(SB 1031–1032), SMF 56392(SB 1034); 1 ♂ (SB 1033) with same data as for holotype, but: leg. 08.III.2006; SMF 56391, all type material examined]. Bayer and Jäger 2010: 72.

Additional material examined (13 ♂♂, 24 ♀♀, 6 s.a. ♂♂, 10 s.a. ♀♀, 5 juvs). **LAOS: Luang Nam Tha Province:** Nam Ha Protected Area |2|, N 21°06'43", E 101°20'36.1", 693 m, under bridge; P. Jäger leg. 06.III.2008; 2 ♂♂ (SB 21–22), SMF(SB 21), MHNG(SB 22). Nam Ha Protected Area |3|, N 21°08'17.6", E 101°24'07.3", 746 m, under bridge; P. Jäger leg. 06.III.2008; 1 ♀ (SB 6), SMF. Nam Ha Protected Area |6|, N 21°03'32.1", E 101°24'03", 590 m, under bridges; P. Jäger leg. 07.III.2008; 3 ♂♂ (48, 53–54), 3 ♀♀ (SB 49, 51–52), 4 s.a. ♀♀ (SB 50, 56–58), SMF. Same data as above, but: P. Jäger & S. Bayer leg. 19.XI.2009; 1 ♂ (SB 459), 2 s.a. ♂♂ (SB 352, 359), SMF. Ban Tavan |3| (near Luang Nam Tha), N 20°58'57.6", E 101°29'38", 586 m, small stream with steep slopes at both sides, between roots and stones; P. Jäger & S. Bayer leg. 18.XI.2009; 1 ♂ (SB 402), 1 ♀ (SB508), 1 juv. (SB 356), SMF. **Oudomxai Province:** Lipi Provincial Protected Area, ca. 3.7 km S of Oudomxai, N 20°39'39.8", E 101°59'47.3", 741 m, under rock; L. Nophaseud leg. 18.IV.2011; 2 ♀♀ (SB 1143–1144), SMF. **Luang Prabang Province:** Nong Khiao, near Tham Pathok Cave, N 20°33'05", E 102°37'55", ca. 350 m, between rocks and stones; P. Jäger & S. Bayer leg. 16.XI.2009; 1 ♂ (SB 353), 1 s.a. ♀ (SB 346), 1 s.a. ♂ (SB 358), SMF. Luang Prabang, Phou Si, N 19°53'23", E 102°08'04", ca. 300 m, small, dry secondary forest, between stones; P. Jäger & S. Bayer leg. 14.XI.2009; 1 juv. (SB 360), SMF. Xieng Ngeun District, Ban Keng Koung [L15], N 19°40'58", E 102°18'27", 372 m, disturbed forest at riverside of Nam Khan, between rocks; P. Jäger & J. Altmann leg. 07.III.2006; 1 s.a. ♂ (SB 1035), SMF 56391. Same data as above, but: P. Jäger leg. by night 23.II.2008; 2 ♀♀ (SB 41–42), SMF. Ban Ean, That Se [L 13], N 19°50'34", E 102°13'07", 304 m; P. Jäger & J. Altmann leg. 05.III.2006; 1 ♀ (SB 1036), SMF. Ban Pak Bak (at Nam Khan river), Houay Kho, N 19°44'09.1", E 102°16'37.5", 328 m, forest along stream; P. Jäger leg. by night 23.III.2007; 1 ♀ (SB 61), SMF. Ban Nong Di (at Nam Khan river), N 19°41'03.5", E 102°21'31.2", 280 m, forest along stream, between stones; P. Jäger leg. by night 21.III.2007; 1 ♂ (SB 67), 2 ♀♀ (SB 68–69), SMF. **Vientiane Province:** Ban Phoxay (near Vang Vieng), N 19°00'44", E 102°26'46", 260 m, in tunnel underneath the road; P. Jäger, M. Sandner & F. Steinmetz leg. 14.III.2007; 3 ♀♀ (SB 76, 91–92), SMF, except SB92 (MHNG). Same data as above, but: P. Jäger leg. 14.III.2008; 1 ♀ (SB 20), SMF. Same data as above, but: P. Jäger & S. Bayer leg. 12.XI.2009; 1 ♀ (SB 424), 1 s.a. ♀ (SB 362), 3 juvs (SB 332, 361, 363), SMF. Ban Don Makhay (near Vientiane), N 18°05'04", E 102°40'15", ca. 180 m, secondary forest; P. Jäger leg. by night 01.IV.2011; 2 ♂♂ (SB 997, 1001), 2 ♀♀ (SB 998, 1002), 1 s.a. ♀ (SB 1003), SMF, 1 ♂ (SB 999), 1 ♀ (SB 1000), CJW. **Bolikhamsay Province:** Nam Kading National Protected Area, Tad Vang Fong training centre, N 18°20'28.8", E 104°08'37.5", 150 m, disturbed secondary forest, in hole of a tree trunk; P. Jäger & L. Nophasead leg. 23.III.2011; 1 ♀ (SB 986), SMF. Lak Sao, N 18°13'38", E 104°44'47", ca. 530 m, between rocks, near cave entrance; P. Jäger & S. Bayer leg. 09.XI.2009; 1 s.a. ♀ (SB 375), SMF. Lak Sao, N 18°13'09.4", E 104°56'36.9", 556 m, rock wall; P. Jäger & S. Bayer leg. by night 08.XI.2009; 1 s.a. ♀ (SB 371), 1 s.a. ♂ (SB 342), SMF. Houay Khiao (W of Lak Sao), N 18°12'47.8", E 104°49'51.5", 500 m, paddy fields, between stones; P. Jäger & J. Martens leg. 04.III.2010; 2 ♀♀ (SB 516–517), SMF.

Revised diagnosis (see also diagnosis for *himalayanus*-group above)**.** Males: Embolus base (EB) with particular flat, elongated, distally curved extension (distally means here the section directed to the proximal margin of T [tegulum]). T clearly broader than palpal tibia (Fig. 43b). Females similar to *P. demiror* **sp. nov.** in the shape of anterior part of epigyne, actually the anterior (distal) margins of lateral lobes (LL). These strongly sclerotised, semicircular and extending anterio-laterally (Fig. 44a, 45a, 47a, 88l–m). Distinguished by the distal endings of margins of LL pointing posteriorly and by the two distinctly developed longitudinal edges below copulatory openings (CO) (Figs 44a, 45a, 88m). Vulva similar to *P. demiror* **sp. nov.** Distinguished by the larger (in relation to copulatory duct) and differently shaped spermatheca (Fig. 44b, 45b).

Description. Male (measurements of holotype first, those of other specimens given as ranges in parentheses)**:** Body and eye measurements. Carapace length 6.2 (5.7–8.4), carapace width 4.7 (4.1–6.1), anterior width of carapace 2.6 (2.2–3.2), opisthosoma length 8.8 (7.5–11.6), opisthosoma width 3.8 (2.8–4.0). Eyes: AME 0.32 (0.27–0.39), ALE 0.40 (0.35–0.44), PME 0.43 (0.37–0.47), PLE 0.42 (0.36–0.45), AME–AME 0.19 (0.17–0.20), AME–ALE 0.09 (0.04–0.09), PME–PME 0.22 (0.22–0.29), PME–PLE 0.30 (0.30–0.35), AME–PME 0.57 (0.49–0.58), ALE–PLE 0.43 (0.34–0.48), clypeus height at AME 0.77 (0.63–0.94), clypeus height at ALE 0.72 (0.58–0.92).

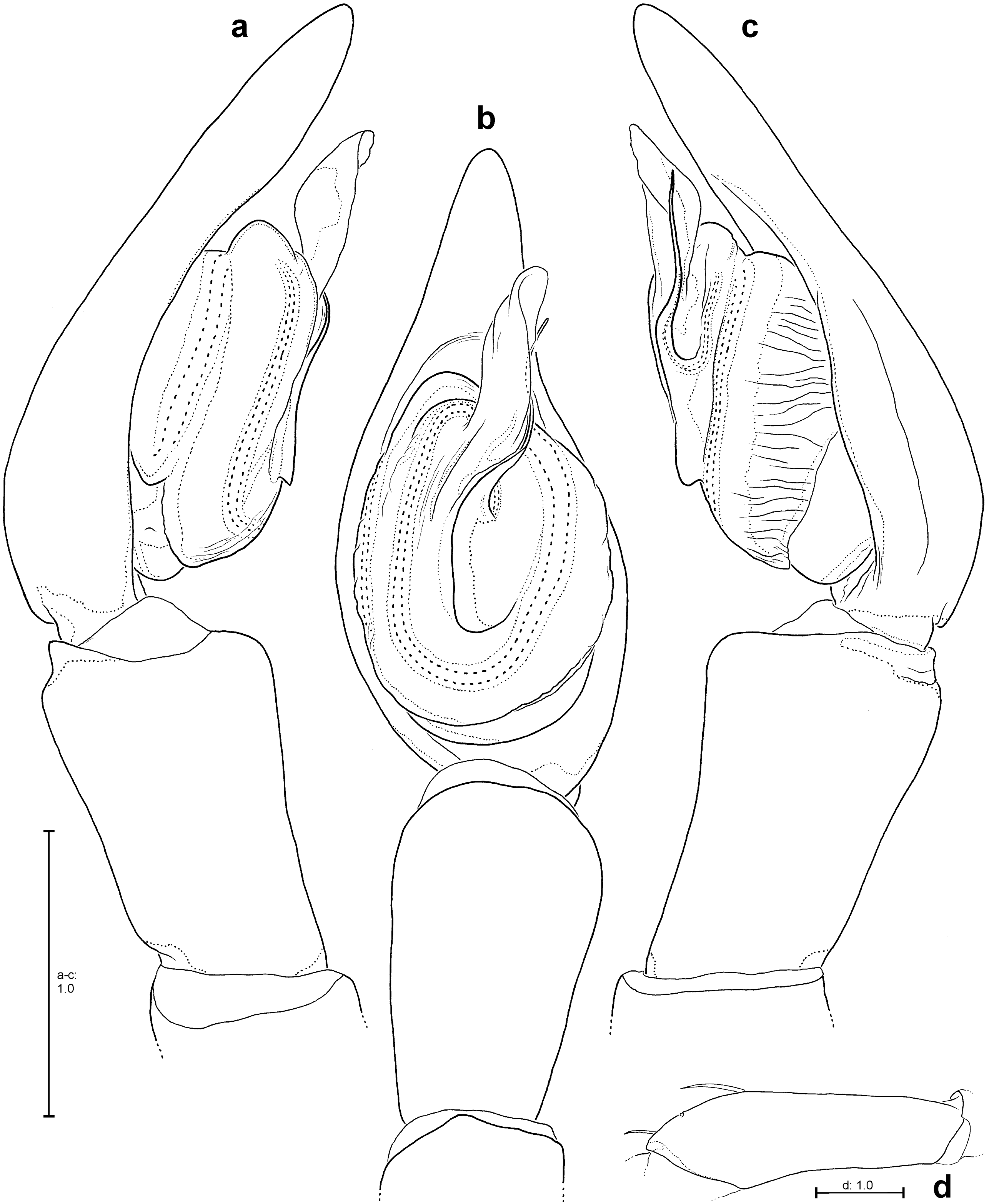
Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp 8.3 (7.2–10.0) [3.0 (2.8–3.6), 1.5 (1.2–1.7), 1.3 (1.2–1.7), 2.5 (2.0–3.0)], I 51.7 (46.0–66.8) [13.4 (11.5–17.2), 3.1 (2.6–4.1), 14.5 (13.0–19.0), 14.4 (12.8–18.9), 6.3 (5.8–7.6)], II 39.6 (35.5–51.6) [10.9 (9.7–14.0), 2.8 (2.2–3.5), 10.5 (9.4–14.0), 10.5 (9.4–14.4), 4.9 (4.7–5.7)], III 26.9 (24.0–35.5) [7.6 (7.0–10.4), 2.0 (1.8–2.6), 6.7 (5.7–8.8), 7.0 (6.2–9.4), 3.6 (3.3–4.3)], IV 42.1 (36.6–53.6) [11.2 (9.8–14.6), 2.4 (2.1–3.1), 10.5 (9.0–14.0), 12.2 (10.7–15.3), 5.8 (5.2–6.6)].

Spination. Palp: 131 (131), 110 (110), 1101 (1101); legs: femur I 566 (566), II 556 (566,567,667) III 555 (545), IV 554 (654); patella I–IV 000; tibia I–II 3038 (3038), III 3135{3034} (3136,3035), IV 3036 (3036,3037); metatarsus I–III 3035 (3035), IV 3036{3035} (3036,3035).

Palpal femur without modification, broadest distally (Fig. 43d).

Copulatory organ (see also diagnosis and general description for *himalayanus*-group). Conductor (C) and embolus (E) long, slightly S-shaped. T appears partly divided subdistally due to a curved ridge (Fig. 43b) and protruding quite distinctly out of cymbium alveolus (Figs 43a,c). Palpal tibia in lateral view medium sized (Fig. 43c). Cymbium dorsally with moderate dense scopula, covering 1/3 of cymbium (Fig. 83b).



FIGURES 43a–d. *Psechrus luangprabang.* a–c ♂ holotype SB 1030 from Laos, Luang Prabang Prov. d ♂ SB 402 from Laos, Luang Nam Tha Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

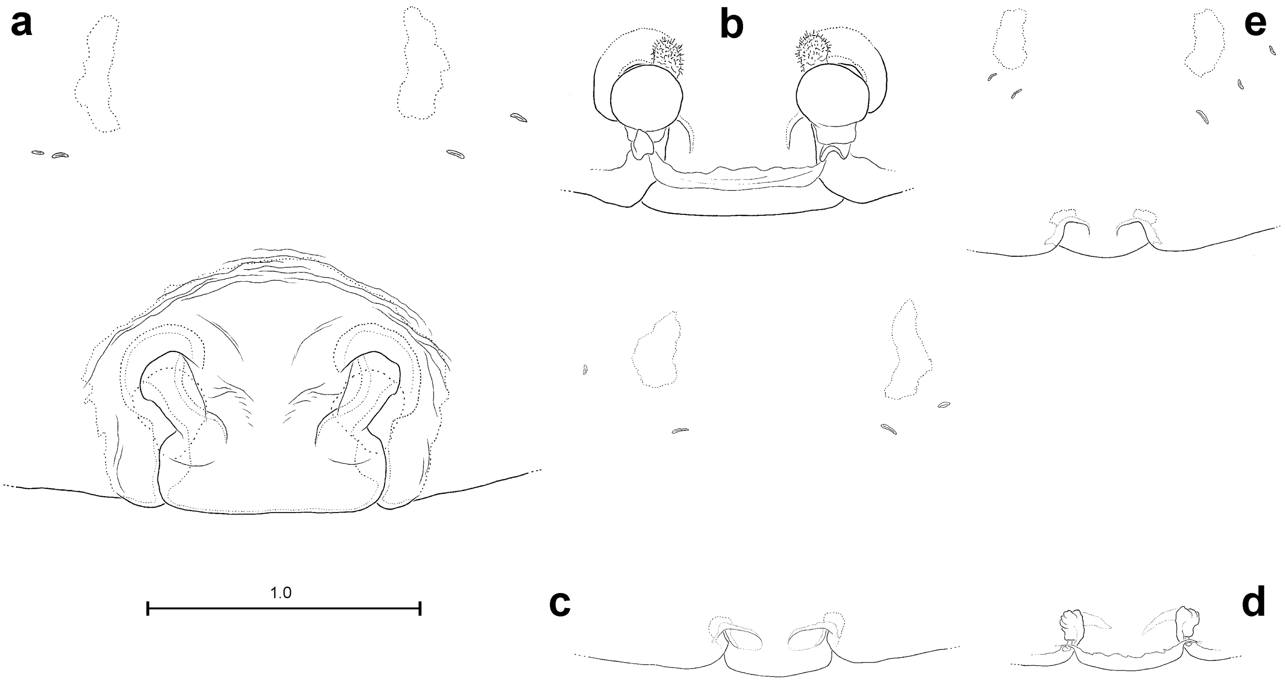
Female:

Body and eye measurements. Carapace length 6.6–9.8, carapace width 4.4–7.3, anterior width of carapace 2.7–4.1, opisthosoma length 10.9–14.4, opisthosoma width 4.6–6.9. Eyes: AME 0.34–0.39, ALE 0.42–0.47, PME 0.42–0.48, PLE 0.42–0.47, AME–AME 0.21–0.32, AME–ALE 0.03–0.10, PME–PME 0.27–0.42, PME–PLE 0.37–0.53, AME–PME 0.58–0.83, ALE–PLE 0.42–0.67, clypeus height at AME 1.03–1.53, clypeus height at ALE 1.00–1.32.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.2–11.4 [2.5–3.9, 1.0–1.7, 1.3–2.1, 2.4–3.7]; Legs: I 33.8–54.4 [9.0–14.9, 2.6–4.1, 9.3–15.2, 8.6–14.0, 4.3–6.2], II 29.9–44.1 [8.3–12.5, 2.4–3.8, 8.1–11.8, 7.4–11.0, 3.7–5.0], III 21.2–32.2 [6.2–9.8, 1.9–3.0, 5.2–7.7, 5.2–7.9, 2.7–3.8], IV 29.9–46.3 [8.4–13.3, 2.1–3.3, 7.8–12.1, 7.8–11.9, 3.8–5.7]. Thus, legs in females, in relation to other *Psechrus* species, short: FEM-I+MTT-I/CL: 2.6–2.9.

FIGURES 44a–e. *Psechrus luangprabang*, from Laos, Luang Prabang Prov., ♀ adult and primordial copulatory organ. a–c ♀ paratype SB 1034. d–e s.a. ♀ SB 346. a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system. d Pre-vulva, dorsal view. e Pre-epigyne, ventral view.



FIGURES 45a–e. *Psechrus luangprabang*, ♀ adult and primordial copulatory organ. a–b ♀ SB 508 from Laos, Luang Nam Tha Prov. c–d s.a. ♀ SB 56 from Laos, Luang Nam Tha Prov. e s.a. ♀ SB 362 from Laos, Vientiane Prov. a Epigyne, ventral view. b Vulva, dorsal view. c, e Pre-epigyne, ventral view. d Pre-vulva, dorsal view.

Palpal claw with 13–16 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 566, II 566 (556,555), III–IV 555; patella I–IV 000; tibia I–II 3038, III 3036 (3035,3034), IV 3036; metatarsus I–III 3035, IV 3035 (3036).

Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Median septum almost as long as broad (Fig. 44a). Slit sense organs and epigynal muscle sigilla outside epigynal field.

Primordial copulatory organ. Pre-epigyne: Pre-septum broader than long, with distal margins of pre-LL pointing posteriorly (Fig. 44e). Fine, transversal edges below pre-CO recognisable (Fig. 44e).

Pre-vulva: Pre-vulva similar to *P. marsyandi*. Distinguished by the longer pre-CD and the smaller pre-SH (in relation to pre-receptaculum) (Fig. 44d).

Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace serrated. Rarely with narrow, dark extensions connecting them with the lateral bands. Lateral bands narrow to medium sized (ca. 1–1.2 diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma may be continuous, broken subdistally or constricted subdistally and medium- sized. If measured centrally on opisthosoma, its width is less than the width of one half of the cribellum (ca. 0.5–0.7 of one half of the cribellum).

Variation of copulatory organs. Males: Without significant variation. Females: Anterio-lateral curves of distal margins of LL may be larger and extending further laterally (Fig. 45a, 88m). Main sections of margins of LL may be approximately straight (not illustrated). Vulva with less variation: Position and length of SH may differ slightly (Figs 44b, 45b, 91m) and margins of initial parts of CD may be less clearly visible (Fig. 45b). Transition zone between CD and spermatheca may differ in shape (Figs 44b, 45b, 91m).

Distribution. Laos (Fig. 98).

***Psechrus demiror* sp. nov.**

Figs 47a–c, 88l, 91l

Type material: Holotype ♀ (SB 331), **"INDOCHINA"**; Collection Constantin Dawydoff; Entrée No. 23, 18.XI.1960; MNHN.

Note: This female was deposited among unidentified spider material in the ‘Zoothek’ of the Muséum National de Histoire Naturelle, Paris. Unfortunately the label contained no information, except what is listed above. The region of ‘Indochina’ formerly included the (present) countries Vietnam, Cambodia and Laos. In order to get information about a detailed locality, where this specimen possibly could have been recorded, I tried to find publications where material collected by C. Dawydoff is listed. In Dawydoff (1952) the collector himself stated, that he stayed for a long period of time in a research station in Nha Trang, Vietnam. Denis (1934) treated representatives of Collembola, which were collected by C. Dawydoff in Vietnam, listed with detailed recording locality. Titova (1983) revised the Mecistocephalidae (Chilopoda) and listed some material collected by C. Dawydoff in Cambodia. It is likely that the *Psechrus* ♀ SB 331 was collected together with specimens of the above mentioned arthropods, which are also ground-dwelling. According to the literature mentioned above, it is possible, but not certain, that ♀ SB 331 had been recorded at one of the following locations:

1) VIETNAM: Lam Dong Province, Da Lat (South-Eastern part of Vietnam)
2) VIETNAM: Khanh Hoa Province, region of Nha Trang (South-Eastern part of Vietnam)
3) CAMBODIA: Kampot Province, Bokor (Southern part of Cambodia)
4) CAMBODIA: Kampong Thom Province, Kampong Thom (Central part of Cambodia)

Identification of the following, additional material examined not absolutely certain.

“INDOCHINA”; Collection Constantin Dawydoff; Entrée No. 23, 18.XI.1960; 1 ♂ (SB 329, was found in separate vial, not in the same vial as ♀ SB 331), MNHN.

Note: As this male was found in a different vial, it is not absolutely certain that it was from the same locality as the female holotype, which is not known either. Therefore, it is also not possible to be absolutely certain if the male is conspecific with the female holotype. However, it is certainly a representative of the *himalayanaus*-group as it shows the diagnostic characters. Additionally, its bulb (Fig. 46b) strongly resembles that of *P. himalayanus* (Fig. 31b) and lacks scopula dorsally on cymbium, like in *P. ghecuanus* and *P. jaegeri* **sp. nov.**, both of which are distributed in Laos (formerly part of Indochina).

Etymology. The specific name refers to the ‘open question’ concerning exact type locality (Latin “demiror” means “gladly wishing to know something”); term (verb) in apposition.

Diagnosis (see also diagnosis for *himalayanus*-group above)**.** Male (not absolutely certain if in fact conspecific with female holotype) with distinctly narrow and elongated tegulum (T) (narrower than and ca. as long as palpal tibia) and long embolus (E) and conductor (C) (ca. equal long as T) (Figs 46a–c). Females similar to *Psechrus luangprabang* in the shape of distal margins of lateral lobes (LL) —those strongly sclerotised, semicircular and extending anterio-laterally (Figs 44a, 47a)— and shape of vulva. Distinguished by the distal endings of margins of LL pointing medially (Fig. 47a) and by the smaller (in relation to copulatory duct) and differently shaped spermatheca (Fig. 47b).

Description. Male (not absolutely certain if in fact conspecific with female holotype)**:**

Body and eye measurements. Carapace length 5.1, carapace width 3.8, anterior width of carapace 2.1, opisthosoma length 7.5, opisthosoma width 3.2. Eyes: AME 0.32, ALE 0.36, PME 0.37, PLE 0.38, AME–AME 0.18, AME–ALE 0.04, PME–PME 0.22, PME–PLE 0.28, AME–PME 0.49, ALE–PLE 0.38, clypeus height at AME 0.59, clypeus height at ALE 0.56.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 6.5 [2.3, 1.0, 1.1, 2.1]; Legs: I 44.9 [12.1, 2.3, 12.2, 12.3, 6.0], II 35.3 [10.0, 2.0, 9.4, 9.3, 4.6], III 24.1 [7.0, 1.6, 5.9, 6.4, 3.2], IV 38.2 [10.9, 1.9, 9.4, 10.5, 5.5].
Spination. Palp: 131, 110 (prolateral one very small), 1101 (prolateral and ventral one very small); legs: femur I 566, II 556, III 545, IV 555{554}; patella I–IV 000; tibia I–II 3038, III 3134, IV 3036; metatarsus I–III 3035, IV 3036.

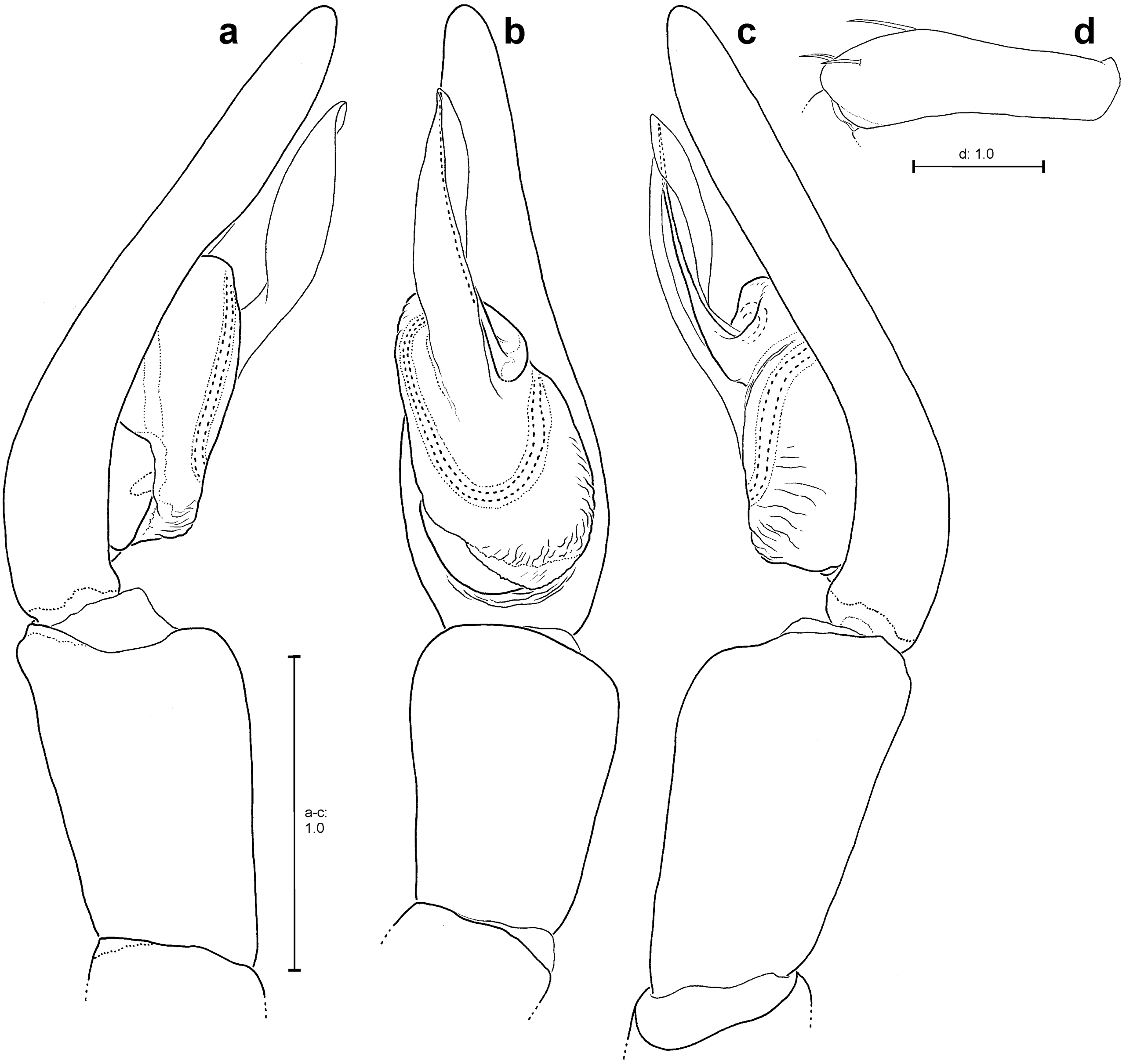
Palpal femur without modification, broadest subdistally (Fig. 46d).

Copulatory organ (see also diagnosis and general description for *himalayanus*-group). Semicircular embolus base (EB) sclerotised (Fig. 85m). Conductor surrounds E at its distal half almost completely (Figs 46b–c). Palpal tibia in lateral view medium sized (Figs 46a,c). Cymbium dorsally without scopula.

Female:

Body and eye measurements. Carapace length 6.8, carapace width 4.7, anterior width of carapace 3.0, opisthosoma length 8.8, opisthosoma width 4.5. Eyes: AME 0.40, ALE 0.46, PME 0.46, PLE 0.44, AME–AME

0.21, AME–ALE 0.07, PME–PME 0.31, PME–PLE 0.41, AME–PME 0.62, ALE–PLE 0.42, clypeus height at AME 0.83, clypeus height at ALE 0.79.



FIGURES 46a–d. *Psechrus demiror* **sp. nov.** (doubtful identification), ♂ SB 329 from "Indochina". a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

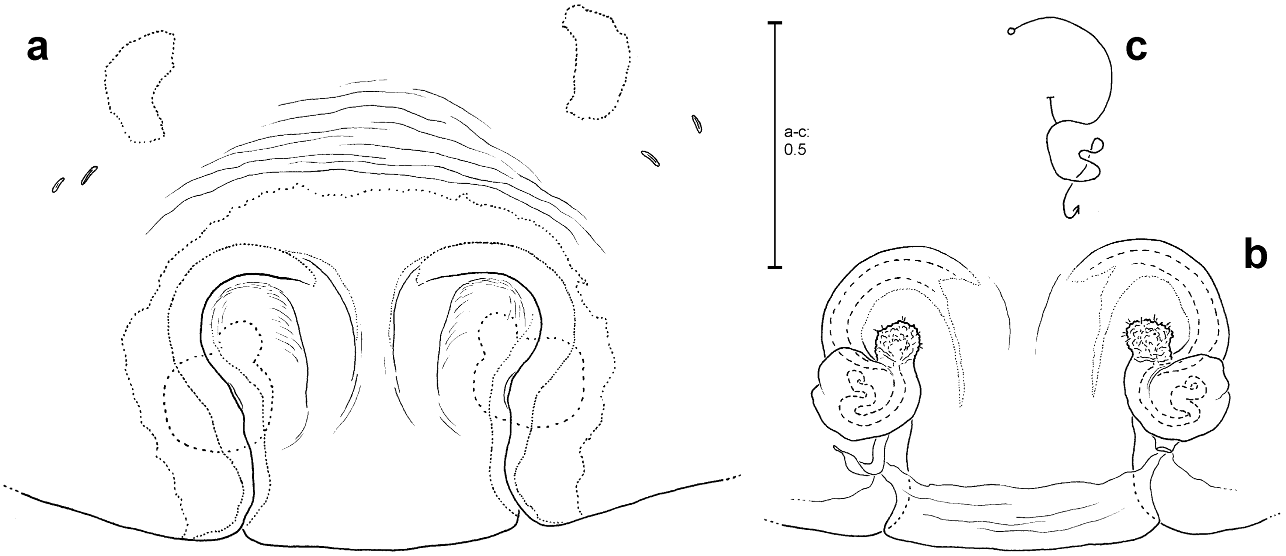
Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 8.2 [2.7, 1.2, 1.6, 2.7]; Legs: I 39.4 [10.8, 2.8, 10.9, 9.9, 5.0], II 31.3 [8.6, 2.6, 8.4, 7.8, 3.9], III 23.4 [6.8, 2.1, 5.7, 5.7, 3.1], IV 33.1 [9.2, 2.3, 8.5, 8.6, 4.5].
Palpal claw with 13 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 556, II 556{566}, III 545{555}, IV 544{545}; patella I–IV 000; tibia I–II 3038, III 3034, IV 3038; metatarsus I, III–IV 3035, II 3035{3033}.
Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Median septum almost as long as broad (Fig. 47a, 88l). Slit sense organs and epigynal muscle sigilla outside epigynal field. The latter relatively small.

Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace serrated. Lateral bands narrow (ca. ½ diameter of PME) and at most slightly lobed, not serrated. Light longitudinal line ventrally on opisthosoma continuous, subdistally constricted, its width medium-sized. If measured centrally on opisthosoma, its width is less than the width of one half of the cribellum (ca. 0.5 of one half of the cribellum).

Distribution. 'Indochina' (Vietnam and/or Cambodia and/or Laos) (Fig. 98).



FIGURES 47a–c. *Psechrus demiror* **sp. nov.**, ♀ holotype SB 331 from "Indochina". a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system.

Psechrus jaegeri sp. nov.

Figs 48a–d, 49a–g, 50f, 81g, 83c, 85n, 88n, 91n

Type material: Holotype ♀ (SB 530), **LAOS: Champasak Province:** Muang Bachieng, Ban Lak 38, That Fane, N 15°11'03.0", E 106°07'36.9", 952 m, very small, narrow valley in marginal primary forest, rock with moss; P. Jäger leg. 14.III.2010; SMF. **Paratypes** (1 ♂, 6 ♀♀, 3 s.a. ♀♀)**: 1** ♂ (SB 302), **5** ♀♀ (SB 531, 534, 536, 539, 905), same data as for holotype, except collectors: P. Jäger leg. 13.–17.III.2010 (all females), P. Jäger & S. Bayer leg. 27.XI.2009 (male); SMF; **1** ♀ (SB 300), **2 s.a.** ♀♀ (SB 301, 405), **LAOS: Champasak Province:** Muang Bachieng, Ban Lak 35, That Itou, N 15°11'37.7", E 106°06'06.3", 810 m, secondary forest, close to small river, in tree holes and between tree roots [SB 300 in tube underneath road]; P. Jäger & S. Bayer leg. 26.XI.2009; SMF; **1 s.a.** ♀ (SB 304), **LAOS: Champasak Province:** Muang Bachieng, That Paxuam, N 15°10'35.5", E 105°55'21.0", 197 m, secondary forest, in tree holes and between tree roots; P. Jäger & S. Bayer leg. 25.XI.2009; SMF.

Additional material examined (1 s.a. ♂, 2 s.a. ♀♀, 1 p.s.a. ♂, 1 p.s.a. ♀, 4 juvs)**. LAOS: Champasak Province:** Muang Bachieng, That Paxuam, N 15°10'35.5", E 105°55'21.0", 197 m, secondary forest, in tree holes and between tree roots; P. Jäger & S. Bayer leg. 25.XI.2009; 1 s.a. ♀ (SB 307), 1 p.s.a. ♀ (SB 347), 1 s.a. ♂ (SB 306), 1 p.s.a. ♂ (SB 399), 1 juv. (SB 309), SMF. **LAOS: Champasak Province:** Muang Pathoumphone, Ban Tha Hou, N 14°46'09.6", E 105°59'34.5", 132 m, rock wall; P. Jäger & S. Bayer leg. 22.XI.2009; 3 juvs (SB 311–312, 348), SMF.

Doubtful material examined: THAILAND: Kanchanaburi Province: Si Sawat, Erawan National Park, Cave Phra Dath; C.L. & P.R. Deeleman leg. 13.III.1986; 1 ♀ (SB 121), Deeleman Coll. in RMNH.

Etymology. The specific name is a patronym in honour of the collector of the type material, Peter Jäger, who I admire for his great knowledge and special skills in arachnology; noun (name) in genitive case.

Diagnosis (see also diagnosis for *himalayanus*-group above)**.** Males similar to *P. vivax* **sp. nov.** in having strongly curved embolus (E) with several ridges and an almost square course of sperm duct (Figs 48a–c, 50a–c). Distinguished by the narrower, distinctly curved distal section of E and the flat lobe ventrally at its subdistal part (Fig. 50f). Moreover, in the tegulum (T) the distal half is narrower than the basal half (Fig. 48b). Females similar to *P. vivax* **sp. nov.** in having mushroom-like shape of median septum (MS) (Fig. 49a, 51a,f), very short copulatory ducts (CD) and compact spermathecae with their heads (SH) on top (Fig. 49b, 51b,g). Distinguished by the broader anterior part of MS (ratio anterior part / posterior part > 2.6) (Fig. 49a) and the even more compact spermatheca (Fig. 49b).

Description. Male:

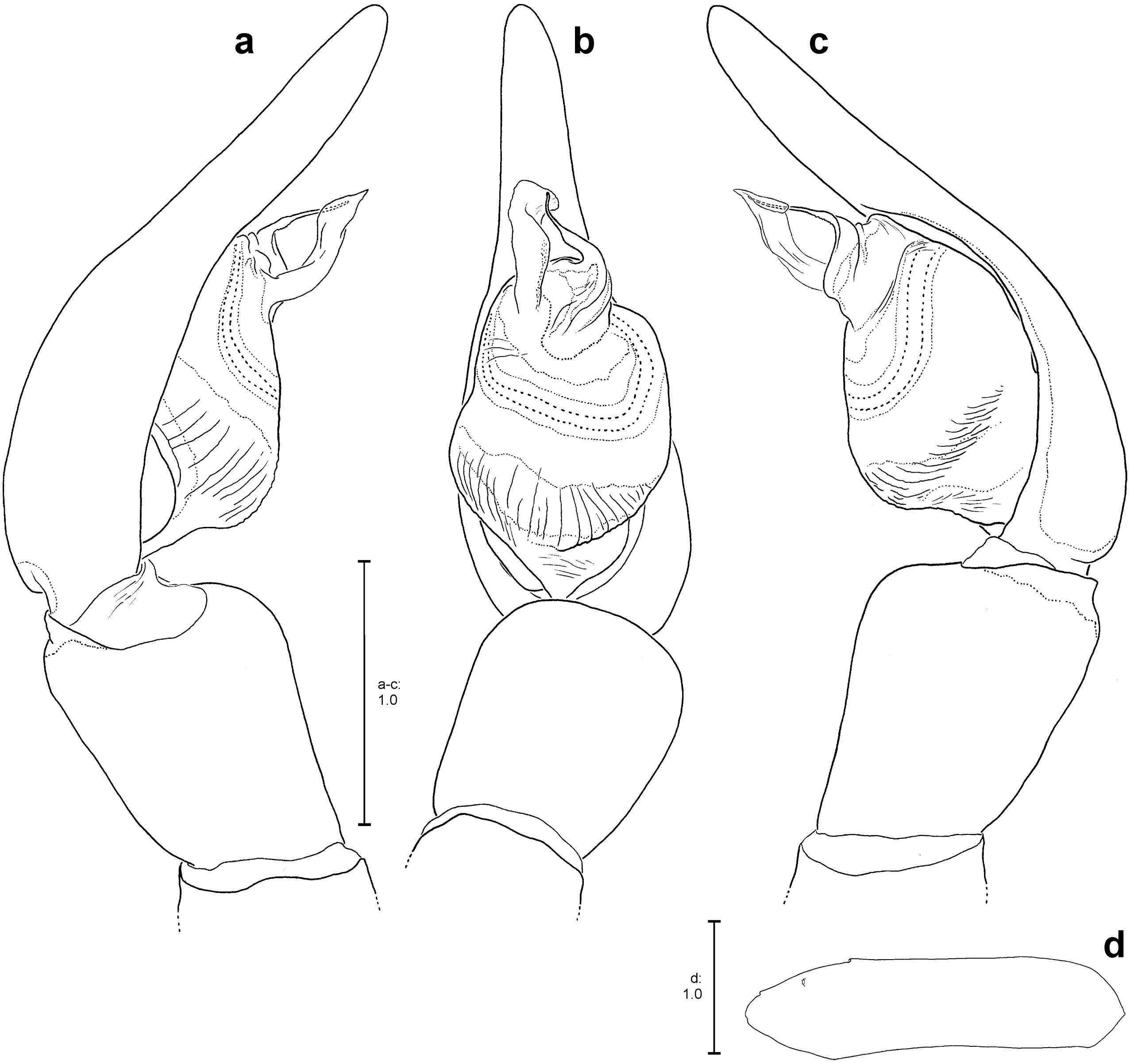
Body and eye measurements. Carapace length 6.4, carapace width 4.7, anterior width of carapace 2.6, opisthosoma length 9.1, opisthosoma width 3.4. Eyes: AME 0.36, ALE 0.43, PME 0.43, PLE 0.42, AME–AME 0.16, AME–ALE 0.06, PME–PME 0.24, PME–PLE 0.33, AME–PME 0.55, ALE–PLE 0.40, clypeus height at AME 0.73, clypeus height at ALE 0.66.

Cheliceral furrow with three promarginal and four retromarginal teeth.

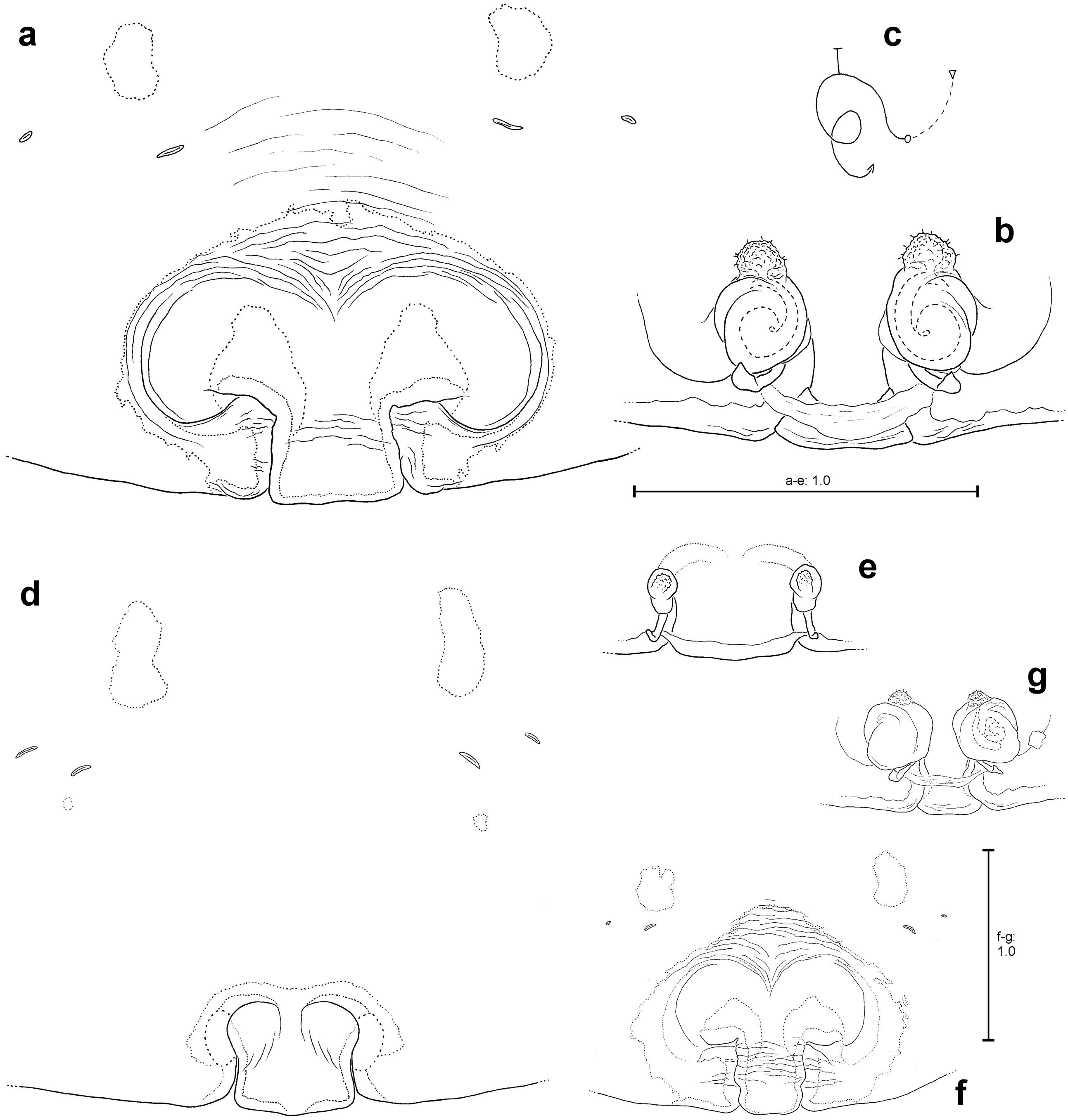
Measurements of palp and legs. Leg formula: 1423. Palp: 8.1 [2.9, 1.4, 1.1, 2.7]; Legs: I 57.0 [15.2, 3.1, 15.7, 16.1, 6.9], II 43.9 [12.9, 2.8, 12.2, 11.5, 4.5], III 30.6 [8.8, 1.9, 7.7, 8.2, 4.0], IV 47.3 [12.7, 2.6, 12.4, 13.5, 6.1]. Spination. Palp: 131, 010, 0100; legs: femur I–III 566, IV 555; patella I–IV 000; tibia I–II 3038, III 3035, IV 3035{3036}; metatarsus I–II, IV 3035, III 3034.

Palpal femur without modification (Fig. 48d).

Copulatory organ (see also diagnosis and general description for *himalayanus*-group). Conductor (C) narrow, distal section slightly broader (Fig. 48b). Palpal tibia in lateral view short (Fig. 48a,c). Cymbium dorsally without scopula (Fig. 83c).



FIGURES 48a–d. *Psechrus jaegeri* **sp. nov.**, ♂ paratype SB 302 from Laos, Champasak Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.



FIGURES 49a–g. *Psechrus jaegeri* **sp. nov.**, ♀ adult and primordial copulatory organ. a–c ♀ holotype SB 530, d–e s.a. ♀ paratype SB 301, both from Laos, Champasak Prov. f–g ♀ SB 121 (doubtful identification) from Thailand, Kanchanaburi Prov. a, f Epigyne, ventral view. b, g Vulva, dorsal view. c Schematic course of internal duct system. d Pre-epigyne, ventral view. e Pre-vulva, dorsal view.

Female (Measurements of holotype first, those of paratype females as range in parentheses)**:**

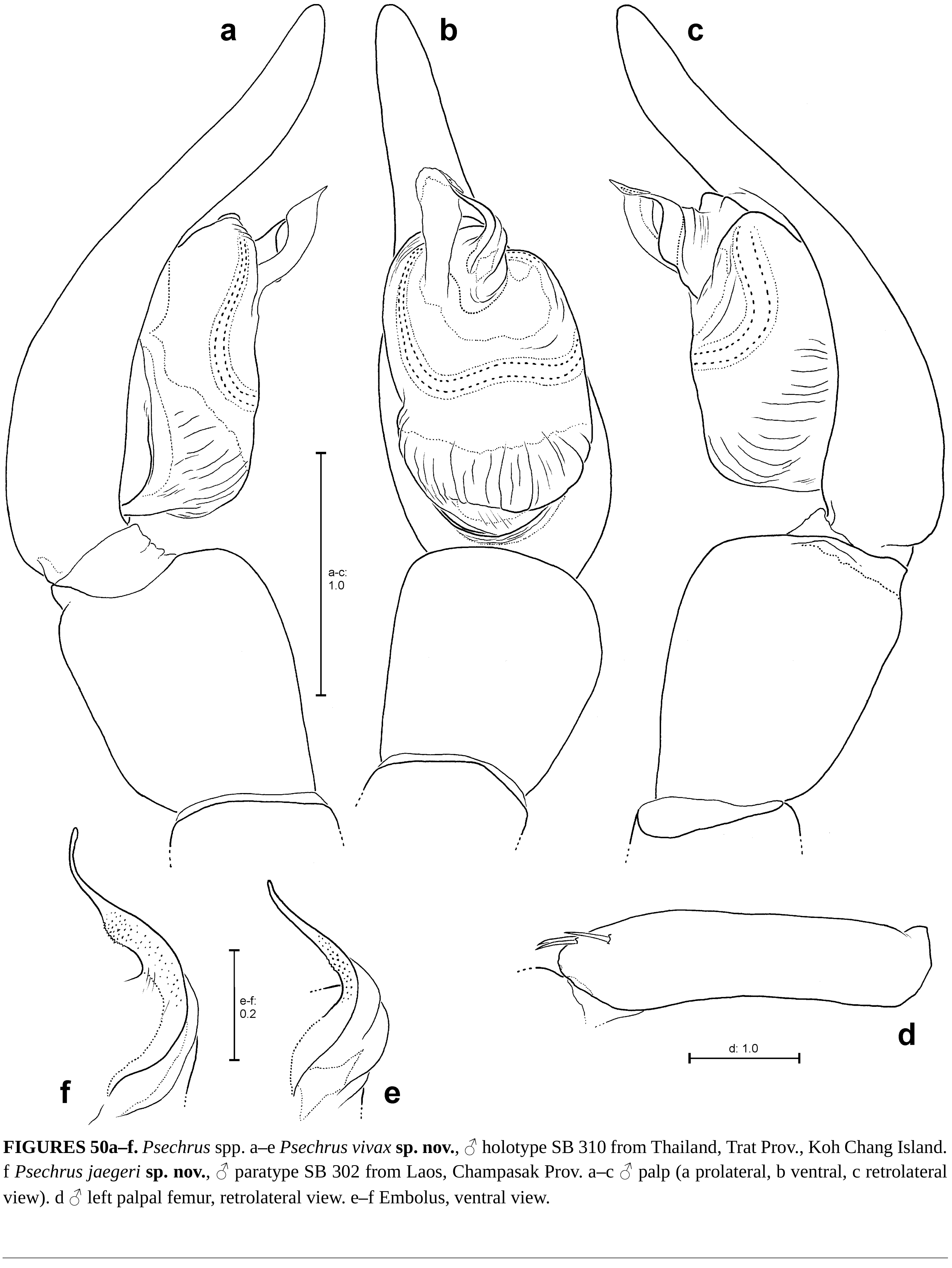
Body and eye measurements. Carapace length 8.5 (7.0–8.4), carapace width 5.6 (3.3–5.8), anterior width of carapace 3.2 (2.1–3.5), opisthosoma length 10.2 (6.6–10.4), opisthosoma width 5.2 (3.6–5.8). Eyes (only those of holotype listed, no significant size variation in paratype females): AME 0.39, ALE 0.50, PME 0.53, PLE 0.49, AME–AME 0.24, AME–ALE 0.06, PME–PME 0.28, PME–PLE 0.43, AME–PME 0.65, ALE–PLE 0.50, clypeus height at AME 0.97, clypeus height at ALE 0.86.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.7 (8.8–9.9) [3.3 (3.0–3.3), 1.4 (1.3–1.5, 1.8 (1.7–1.9), 3.2 (2.8–3.2)]; Legs: I 47.8 (42.2–49.3) [12.8 (11.4–13.1), 3.7 (3.1–3.9), 13.0 (11.3–13.2), 12.5

(11.2–13.1), 5.8 (5.2–6.0)], II 38.5 (34.7–38.6) [10.7 (9.8–10.9), 3.2 (2.7–3.4), 10.0 (9.2–10.1), 9.9 (8.9–10.3), 4.7 (4.1–4.9)], III 28.0 (24.7–28.8) [8.3 (7.2–8.3), 2.5 (2.1–2.5), 6.7 (6.0–6.9), 7.0 (6.3–7.5), 3.5 (3.1–3.6)], IV 40.4 (36.0–41.7) [11.5 (10.1–11.5), 2.8 (2.5–3.1), 10.1 (9.1–10.5), 10.8 (9.6–11.3), 5.2 (4.7–5.3)]. Thus, legs in females, in relation to other *Psechrus* species, quite short: FEM-I+MTT-I/CL : 2.9–3.0.

Palpal claw with 15 (13–15) teeth.



FIGURES 50a–f. *Psechrus* spp. a–e *Psechrus vivax* **sp. nov.**, ♂ holotype SB 310 from Thailand, Trat Prov., Koh Chang Island. f *Psechrus jaegeri* **sp. nov.**, ♂ paratype SB 302 from Laos, Champasak Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e–f Embolus, ventral view.

Spination. Palp: 131 (131), 110{010} (110,010), 1101 (1101), 1014 (1014); legs (—except for patella—variable, only most common states noted): femur I 567{566} (566,655), II 656{556} (566) III 555 (555), IV 555 (555,554); patella I–IV 000; tibia I 4038{3038} (3038), II 3038 (3038), III 3034 (3034,3035), IV 3036{3035} (3036,3035); metatarsus I 3037{3035} (3037,3035), II 3035 (3037,3035), III 3035 (3035), IV 3034 (3034,3035). Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Spermathecal heads (Fig. 49b) shorter than in *P. vivax* **sp. nov.** (but in *P. vivax* only two ♀♀ available). MS smooth and glossy (Fig. 88n). Slit sense organs and epigynal muscle sigilla outside epigynal field (Fig. 49a).

Primordial copulatory organ. Pre-epigyne: Similar to *P. vivax* **sp. nov.** in shape of pre-MS. The latter almost as long as broad and with curved anterior margins (Figs 49d, 51d). Distinguished by the broader anterior part of pre-MS (Fig. 49d).

Pre-vulva: Similar to *P. vivax* **sp. nov.** Distinguished by the more voluminous pre-spermatheca and the less extending pre-SH (Fig. 49e).

Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace may be slightly serrated or not. Lateral bands narrow (ca. 0.7 diameter of PME) and not serrated. Light longitudinal line ventrally on opisthosoma continuous and rather narrow. If measured centrally on opisthosoma, its width is less than the width of one half of the cribellum (ca. 0.3–0.6 of one half of the cribellum).

Variation of copulatory organs. Females: Width of median septum varies slightly (Figs 49a, 88n). In vulva the length of SH may differ slightly (Figs 49b, 91n).

Remark: In the female SB121 from Kanchanaburi Province, Thailand, the MS (Fig. 49f) is narrower than in the specimens from Laos. The spermatheca are even a bit more compact and located closer to each other (Fig. 49g). It cannot be fully excluded that this specimen belongs to a closely related, different species. However, it is more likely that those differences fall in the range of intraspecific variation of *P. jaegeri* **sp. nov.**, as they are just small in regards to interspecific differences. To confirm this, more material —especially males— from that region and from Thailand in general are required.

Distribution. Laos, Thailand(?) (Fig. 98).

***Psechrus vivax* sp. nov.**

Figs 50a–e, 51a–g, 85o, 88o, 91o

Type material: Holotype ♂ (SB 310), **THAILAND: Trat Province:** Koh Chang Island, Klong Plu School, N 12°03'25.5", E 102°18'31.2", 78 m, jungle stream, rocks/ rock wall besides stream; P. Jäger & S. Bayer leg. 01.XI.2009; SMF. **Paratypes** (3 ♂♂, 2♀♀, 4 s.a. ♀♀)**: 2** ♂♂ (SB 291–292), **3 s.a.** ♀♀ (SB 308, 336, 366[with fully developed epigyne underneath cuticula of subadult specimen]), same data as for holotype; SMF; **1** ♂ (SB 364), **1** ♀ (SB 293), **1 s.a.** ♀ (SB 365), **THAILAND: Trat Province:** Koh Chang Island, Kheeri Phet Waterfall, N 12°00'27.6", E 102°21'09.2", 50–150 m, (secondary) jungle forest, between rocks, boulder and roots of trees; P. Jäger & S. Bayer leg. 02.XI.2009 (SB 293: 31.X.2009); SMF.

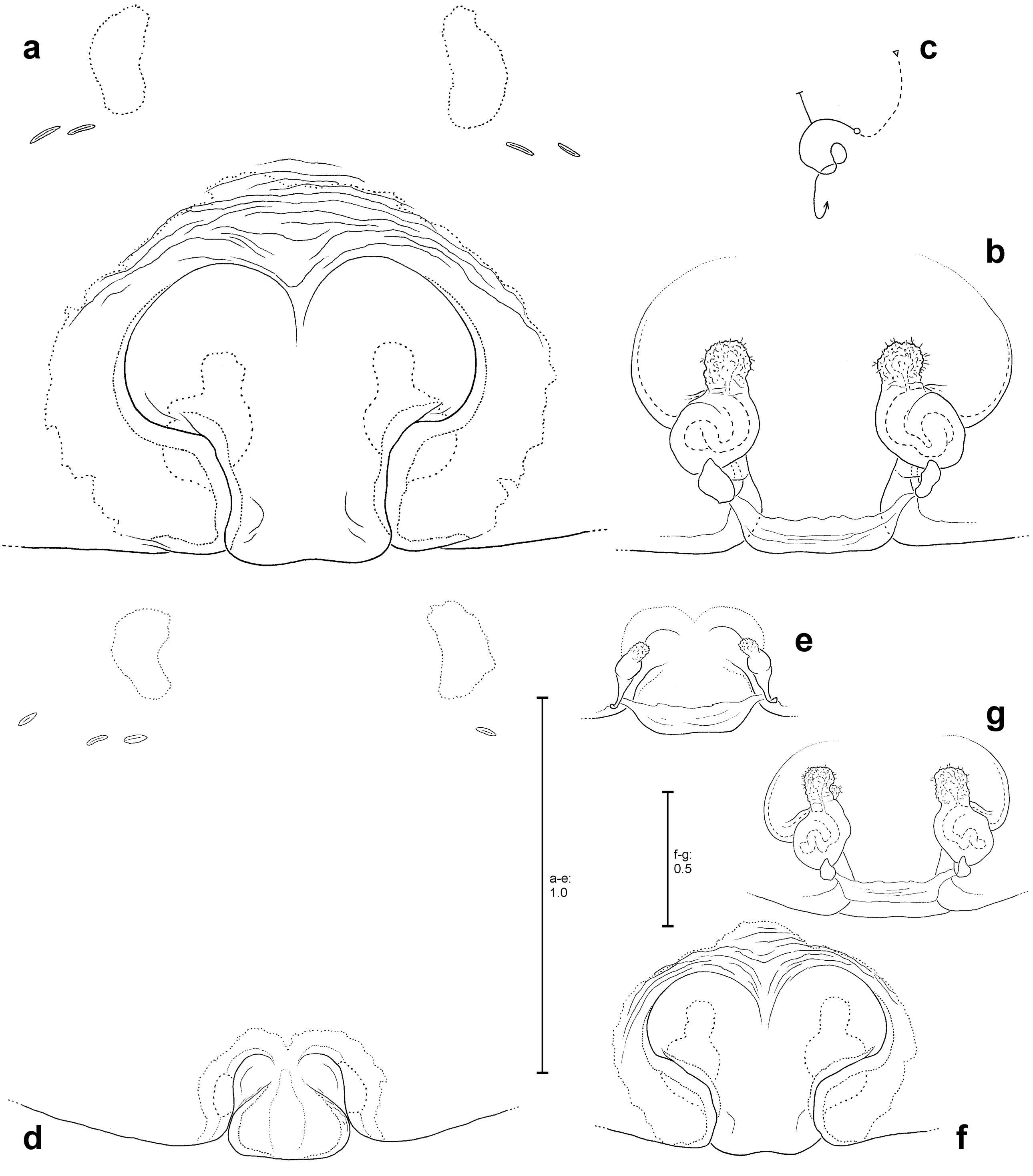
Etymology. The specific name refers to the durability of the type specimens. After collecting they were kept alive in small boxes and endured therein for more than five weeks (Latin "vivax" means "long-living, durable"); term (adverb) in apposition.

Diagnosis (see also diagnosis for *himalayanus*-group above)**.** Males similar to *P. jaegeri* **sp. nov.** in having strongly curved embolus (E) with several ridges and an almost square course of sperm duct (Figs 48a–c, 50a–c). Distinguished by the E with continuous shape, its distal section (Fig. 50e) slightly broader than in *P. jaegeri* **sp. nov.** Moreover, tegulum (T) with distal half slightly broader than basal half (Fig. 50b). Females similar to *P. jaegeri* **sp. nov.** in having mushroom-like shape of median septum (MS) (Fig. 49a, 51a,f), very short copulatory ducts (CD) and compact spermatheca with their heads (SH) on top (Fig. 49b, 51b,g). Distinguished by the narrower anterior part of MS (ratio 'anterior part / posterior part' < 2.2) (Fig. 51a,f) and the less compact spermathecae (Fig. 51b,g).

Description. Male (measurements of holotype first, those of male paratypes given as ranges in parentheses)**:**

Body and eye measurements. Carapace length 6.4 (6.2–7.6), carapace width 4.6 (4.4–5.5), anterior width of carapace 2.4 (2.4–2.9), opisthosoma length 9.3 (8.7–10.5), opisthosoma width 2.6 (2.5–3.6). Eyes: AME 0.34 (0.33–0.38), ALE 0.41 (0.39–0.43), PME 0.40 (0.39–0.44), PLE 0.36 (0.37–0.44), AME–AME 0.22 (0.20–0.22), AME–ALE 0.04 (0.04–0.06), PME–PME 0.28 (0.22–0.29), PME–PLE 0.34 (0.33–0.38), AME–PME 0.62

(0.49–0.62), ALE–PLE 0.44 (0.42–0.45), clypeus height at AME 0.81 (0.79–0.95), clypeus height at ALE 0.68 (0.67–0.73).



FIGURES 51a–g. *Psechrus vivax* **sp. nov.**, from Thailand, Trat Prov., Koh Chang Island, ♀ adult and primordial copulatory organ. a–c ♀ paratype SB 366, d–e s.a. ♀ paratype SB 366, f–g ♀ paratype SB 293. a, f Epigyne, ventral view. b, g Vulva, dorsal view. c Schematic course of internal duct system. d Pre-epigyne, ventral view. e Pre-vulva, dorsal view. Remark: SB 366: subadult female with already completely developed epigyne underneath cuticle bearing pre-epigyne, so it is listed here sub s.a. ♀ and ♀.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp 8.2 (7.7–8.6) [3.0 (2.8–3.2), 1.3 (1.2–1.5), 1.2 (1.1–1.3), 2.7 (2.6–2.8)], I 57.1 (53.7–65.2) [14.7 (14.1–17.1), 3.1 (3.0–3.6), 15.6 (14.5–17.9), 16.6 (15.6–19.1), 7.1 (6.5–7.5)], II 44.8 (44.2–51.3) [12.1 (11.8–13.9), 2.8 (2.8–3.2), 11.7 (11.4–13.8), 12.6 (12.6–14.3), 5.6 (5.6–6.1)], III 31.4 (30.7–35.9) [8.9 (8.8–10.2), 2.2 (2.2–2.6), 7.8 (7.5–8.9), 8.5 (8.3–9.9), 4.0 (3.9–4.3)], IV 47.9 (46.3–53.9) [12.9 (12.5–14.9), 2.5 (2.4–2.9), 12.1 (11.7–14.0), 13.9 (13.5–15.2), 6.5 (6.2–6.9)].

Spination. Palp: 131 (131), 110{010} (110,010), 1101 (0000); legs: femur I 566 (566), II 566{556} (566,556) III 555 (555), IV 555 (555,556); patella I–IV 000; tibia I–II 3038 (3038), III 3136 (3136), IV 3136 (3136,3036); metatarsus I–IV 3035 (3035).

Palpal femur without modification (Fig. 50d).

Copulatory organ (see also diagnosis and general description for *himalayanus*-group). Conductor (C) narrow, distal section slightly broader (Fig. 50b). Tegulum extending slightly further apically than in *P. jaegeri* **sp. nov.** (Fig. 50c). Palpal tibia in lateral view short (Figs 50a,c). Cymbium dorsally without scopula.

Female:

Body and eye measurements. Carapace length 6.4, carapace width 4.3, anterior width of carapace 2.8, opisthosoma length 9.3, opisthosoma width 4.3. Eyes: AME 0.35, ALE 0.42, PME 0.44, PLE 0.42, AME–AME 0.23, AME–ALE 0.05, PME–PME 0.26, PME–PLE 0.33, AME–PME 0.55, ALE–PLE 0.44, clypeus height at AME 0.84, clypeus height at ALE 0.66.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 8.1 [2.8, 1.2, 1.5, 2.6]; Legs: I 44.5 [11.7, 3.0, 12.4, 11.7, 5.7], II 36.0 [9.9, 2.5, 9.7, 9.4, 4.5], III 25.0 [7.3, 2.1, 6.1, 6.3, 3.2], IV 36.9 [10.3, 2.4, 9.5, 9.8, 4.9].

Palpal claw with 14 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 666, II 566, III 555, IV 554; patella I–IV 000; tibia I–II 3038, III 2016, IV 3036; metatarsus I–III 3035, IV 3034.

Copulatory organ (see also diagnosis and general description of *himalayanus*-group). Spermathecal heads (Fig. 51b) longer than in *P. jaegeri* **sp. nov.** (but only two adult females examined). Median septum smooth and glossy (Fig. 88o). Slit sense organs and epigynal muscle sigilla outside epigynal field (Fig. 51a).

Primordial copulatory organ. Pre-epigyne: Similar to *P. jaegeri* **sp. nov.** in shape of pre-MS. The latter almost as long as broad and with curved anterior margins (Fig. 49d, 51d). Distinguished by the broader posterior part of pre-MS (Fig. 51d).

Pre-vulva: Similar to *P. jaegeri* **sp. nov.** Distinguished by the less voluminous pre-spermatheca and the slightly more extending pre-SH (Fig. 51e).

Colouration of male and female (see also description for *himalayanus*-group and *Psechrus*). Median bands on carapace slightly serrated. Lateral bands narrow (0.5–0.7 diameter of PME) and (slightly) serrated. Light longitudinal line ventrally on opisthosoma continuous and narrow. If measured centrally on opisthosoma, its width is less than the width of one half of the cribellum (ca. 0.3–0.5 of one half of the cribellum).

Variation of copulatory organs. Females: The two females examined show less variation. In SB 293 from Kheeri Phet the posterior part of MS is slightly narrower (Fig. 51f). This female also shows slightly narrower receptacula (Fig. 51g).

Distribution. Thailand (Fig. 98).

sinensis-group

Diagnosis. Males with complex conductor and embulus: Conductor (C) with pointed distal ending(s) and numerous small or very small, short spines or tubercles (Figs 52a–b, 54a–b, 56a–b, 61a–b, 66a); Embolus (E) always with distinct base (EB) containing either ridges (Fig. 66c) and/or serrated margins (Figs 56b, 62b) and/or very small tubercles (Fig. 52c, 54b–c). In females, median septum (MS) generally longer than broad (Figs 53a, 62a) (alternatively almost as long as broad, Fig. 55e); copulatory ducts (CD) long and with bulbous (Figs 53b, 63b, 64b) and/or twisted (Figs 55f, 59b) sections.

Description. Sternum yellowish brown at lateral margins and with brown, tapered patch centrally. Median bands on carapace may be slightly serrated (Fig. 82d) or not. Lateral bands mostly very narrow or not even recognisable (one species as exception) and not or slightly serrated (Fig. 82d) (one species as exception). Dorsal spines on tibia III and IV absent. Legs rather short in relation to other species-groups: FEM-I+MTT-I/CL : Males: ca. 3.7–4.8; Females: 2.7–3.3.

Sperm duct in males with different courses (see each species description). Cymbium dorsally with very dense scopula, covering ca. ½ of cymbium. Palpal femur with modification, generally a ventral bulge. Macrosetae ventrally on coxae of leg I (MC-I) present, but only as apical row (Fig. 82q), those of trochanter of leg I (MT-I) may be present, indistinct or missing.

Males mostly with at least one apophysis or protrusion at EB (Fig. 54b, 56b–c). Tegulum mostly elongated (almost 2 times as long as broad). Palpal tibia short (Figs 52a–c, 54a–c, 61a–c).

In females, spermathecal heads always associated with spermathecae and often with stalks (Fig. 55f, 65b). The latter never as long as in females of the *argentatus*-group.

Psechrus sinensis **Berland & Berland, 1914**

Figs 52a–d, 53a–d, 86a, 89a, 92a

Psechrus sinensis Berland, J. and Berland, L. 1914: 131, figs 1–3 (Description of ♂, illustration of ♂). [Syntypes: 2 ♂♂ (SB 521–522) from CHINA: Guizhou Province ("Kouy-Tchéou"): region of Guiyang ("Env. de Kouy-Yang"), ca. N 26°30'–26°40', E 106°30'–106°40', 1100–1350 m; P. Cavalerie leg. 1909, 1913; MNHN AR171, all type material examined]. Fage 1929: 360. Schenkel 1963: 20, fig. 3 (Description of s.a. ♀ [?], illustration of s.a. ♀ [?]). Lehtinen 1967: 261 (Syn. with *P. singaporensis*, rejected by subsequent authors), fig. 474 (illustration of ♂). Levi 1982: 123, figs 34–39, ad part, figs 36–39 misidentified (Description of ♂, figs 34–35: illustration of ♂). Song *et al.* 1999: 397, figs 232G–H, S (illustration of ♂ and ♀). Wang and Yin 2001: 339, figs 24–28 (Description of ♂ and ♀, illustration of ♂ and ♀). Silva 2003: 45, fig. 16a (Non SEM photo of ♂ palp, misidentification, see *P. rani*). Yang *et al.* 2003: 44.

Psechrus guiyangensis Yin, Wang and Zhang 1985: 24, figs 4A–D (Description of ♀, illustration of ♀). [Holotype ♀ from CHINA: Guizhou Province: Guiyang; Y.J. Zhang leg. 04.VII.1983; HBI; Paratypes: 4 ♀♀ (one of which SB 524), with same data as for holotype; HBI, only 1 paratype (SB 524) examined, remaining type material not available on request, thus not examined]. Song *et al.* 1999: 397 (Syn.).

Additional material examined. CHINA: Guizhou Province: Guiyang; X.P. Wang leg. 30.IX.1997; 1 ♀ (SB 1176), AMNH. Anshun, dryland of Giyangio; X. Xu leg. 02.VII.1999; 1 ♀ (SB 523), HBI.

Doubtful material examined. CHINA: Guizhou Province ("Kouy-Tchéou")**:** Reg. de Pin-Fa; P. Cavalerie leg. 1908; E. Schenkel det. 1946; 1 s.a. ♀ (SB 15), 1 p.s.a. ♂ (SB 606), MNHN AR186.

Revised diagnosis (see also diagnosis for *sinensis*-group above)**.** Males similar to *P. triangulus* Yang, Zhang, Zhu & Song 2003 in having long embolus base (EB) (longer than conductor [C]), possessing numerous tubercles distally (Figs 52a–c, 54a–c). Distinguished by the filiform distal part of embolus (E) and by the tip of C pointing prolaterally (Fig. 52b). Females similar to *P. triangulus* in having median septum (MS) with posterior part at least four times broader than anterior part (Figs 53a, 54e). Copulatory ducts (CD) without twist, the bulbous sections of CD about as broad as spermatheca (Figs 53b, 54f). Distinguished by the anteriorly rounded posterior section of MS (Fig. 53a), the broader copulatory ducts and the spermathecae laterally just slightly extending beyond CD (Fig. 53b).

Description. Male (both male syntypes in bad condition and cut in many pieces; one [SB 521] was in a slightly better condition than the other and all limbs were still available, could be assigned respectively and could be measured; for SB 522 carapace measurements are listed in parentheses)**:**

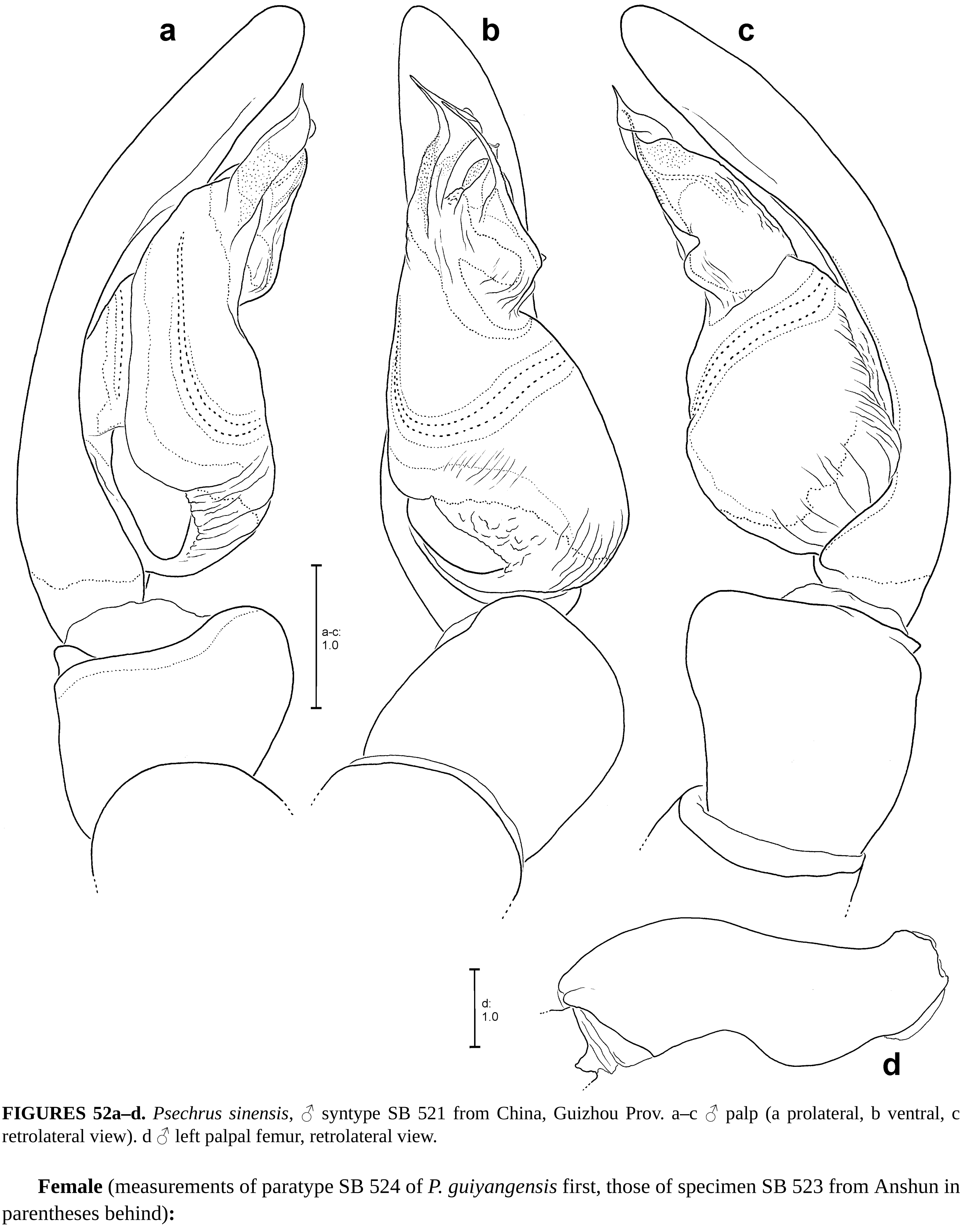
Body and eye measurements. Carapace length 11.1 (11.0), carapace width 8.0 (7.3), anterior width of carapace 4.5 (4.2), opisthosoma length 12.7 (11.8), opisthosoma width 6.6 (6.0). Eyes: AME 0.56, ALE 0.54, PME 0.61, PLE 0.56, AME–AME 0.26, AME–ALE 0.10, PME–PME 0.40, PME–PLE 0.43, AME–PME 0.71, ALE–PLE 0.57, clypeus height at AME 1.39, clypeus height at ALE 1.22.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 14.0 [4.8, 2.4, 1.9, 4.9]; Legs: I 86.6 [23.3, 5.5, 24.5, 24.1, 9.2], II 69.4 [19.1, 4.8, 18.5, 19.4, 7.6], III 45.9 [13.5, 3.6, 11.3, 12.5, 5.0], IV 69.0 [18.1, 4.3, 17.7, 18.9, 7.4]. Spination. Palp: 131, 000, 0000; legs: femur I 525{525}, II 545{645}, III 545, IV 544; patella I–IV 000; tibia I–II 3038, III 2035, IV 3036; metatarsus I 2025{3035}, II 3035, III 3036, IV 4034.

Palpal femur ventrally modified with rounded bulge (Fig. 52d).

Copulatory organ (see also diagnosis and general description for *sinensis*-group). Conductor (C) with pointed tip (Figs 52a–c). Sperm duct with broad V- shaped course. Embolus (E) basally with rounded apophysis, folded retrolaterally (Fig. 52c). Palpal tibia short (Figs 52a–c).



FIGURES 52a–d. *Psechrus sinensis*, ♂ syntype SB 521 from China, Guizhou Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

Female (measurements of paratype SB 524 of *P. guiyangensis* first, those of specimen SB 523 from Anshun in parentheses behind)**:**

Body and eye measurements. Carapace length 8.7 (7.4), carapace width 6.2 (5.3), anterior width of carapace 4.0 (3.6), opisthosoma length 11.9 (11.1), opisthosoma width 6.3 (4.6). Eyes: AME 0.47 (0.45), ALE 0.48 (0.41), PME 0.52 (0.43), PLE 0.48 (0.42), AME–AME 0.23 (0.20), AME–ALE 0.04 (0.04), PME–PME 0.35 (0.34), PME–PLE 0.50 (0.48), AME–PME 0.65 (0.66), ALE–PLE 0.59 (0.59), clypeus height at AME 1.07 (0.82), clypeus height at ALE 1.02 (0.81).

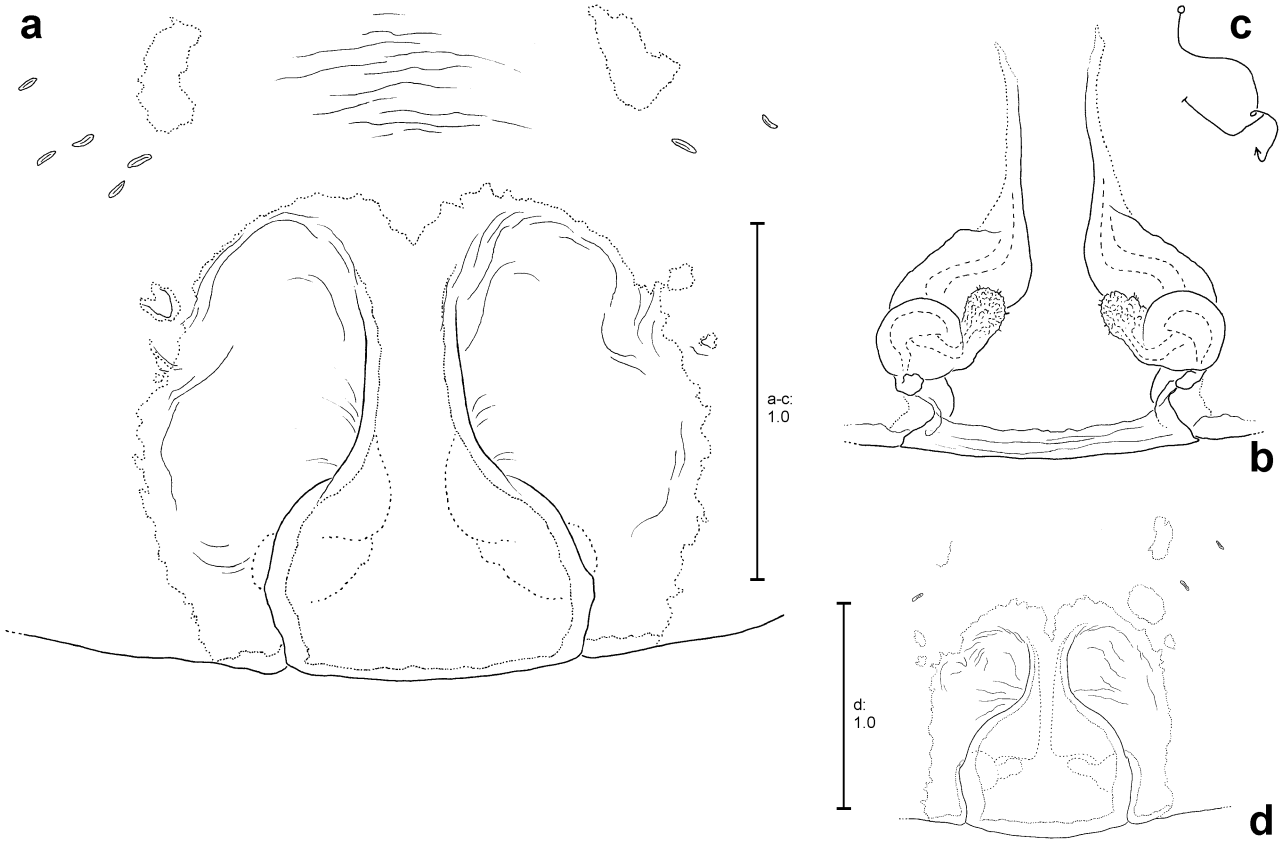
Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 10.3 (9.0) [3.6 (3.0), 1.5 (1.4), 1.9 (1.6), 3.3 (3.0)]; Legs: I 46.6 (40.7) [11.4 (11.3), 3.6 (3.1), 13.5 (11.2), 12.3 (10.3), 5.8 (4.8)], II 37.8 (32.8) [10.4 (9.4), 3.4 (2.9), 10.0 (8.6), 9.4 (8.1), 4.6 (3.8)], III 25.6 (23.5) [6.2 (7.2), 2.6 (2.1), 6.6 (5.6), 6.9 (5.7), 3.3 (2.9)], IV 37.8 (32.2) [10.4 (9.5), 3.0 (2.5, 9.8 (8.2), 9.8 (8.2), 4.8 (3.8)].

Palpal claw with 14 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 546 (546), II 546 (545), III 545 (546), IV 545{544} (544); patella I–IV 000; tibia I–II 3038 (3038), III 2035{2024} (2035), IV 2034 (2034); metatarsus I–III 3035 (3035), IV 3035 (3036).

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Slit sense organs and epigynal muscle sigilla outside epigynal field (Fig. 53a). In comparison to *P. triangulus* spermathecal heads arising a bit more ventrally at spermatheca (Fig. 53b).



FIGURES 53a–d. *Psechrus sinensis*, from China, Guizhou Prov., ♀ copulatory organ. a–c ♀ SB 524 (paratype of *P. guiyangensis*), d ♀ SB 523. a, d Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system.

Colouration of male and female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace not serrated. Lateral bands extremely narrow or absent (if present, at most 0.2 diameter of PME) and not serrated. Light longitudinal line ventrally on opisthosoma mostly broken subdistally (rarely strongly constricted subdistally) and medium-sized to broad. If measured centrally on opisthosoma, its width is slightly less than the width of one half of the cribellum (ca. 0.6–0.9 of one half of the cribellum). Distal part (patch) broader than main section.

Variation of copulatory organs. Males: The two syntype males examined showed no significant variation. Females: Posterior part of MS a bit longer in SB 523 from Anshun (Fig. 53d). Vulvae without significant variation.

Remarks: Schenkel (1963) described a subadult female and a pre-subadult male under *P. sinensis*. Apparently, he actually intended to describe a new species based on these specimens (as types), which are deposited in the arachnid collection of MNHN: 1 s.a. ♀ (SB 15) and 1 p.s.a. ♂ (SB 606) (both MNHN AR 186). The label of the respective vial contains the note "*Psechrus cavaleriei* Schenkel TYPE!". It goes without saying that this name (and so the “types”) is not valid, as Schenkel had never published a description of a “*Psechrus cavaleriei*”. To date the pre-epigyne of *P. sinensis* is unknown, consequently I cannot confirm if the two specimens really belong to *P. sinensis*. I have been unable to check subadult females collected at exactly the same locality as adult material of *P. sinensis*. The same problem concerns *P. kunmingensis* Yin, Wang & Zhang, 1985 (see respective species description herein). The s.a. ♀ examined by Schenkel shows some similarities to subadult females collected just a few km away from type locality of *P. kunmingensis*.

Distribution. China (Fig. 96).

Psechrus triangulus **Yang, Zhang, Zhu & Song, 2003**

Figs 54a–g, 86b, 89b, 92b

Psechrus triangulus Yang, Zhang, Zhu and Song 2003: 43, figs A–F (Description of ♂ and ♀, illustration of ♂ and ♀). [Holotype ♀ (SB 881) from CHINA: Yunnan Province: Yunlong County, Jiancao, ca. N 26°00', E 99°21', 1700–2500 m; E.B. Yang leg. 30.IV.2002; MHBU; Paratypes: 1 ♂ (SB 882), 5 ♀♀, with same data as for holotype; MHBU, holotype and male paratype examined, female paratypes not available on request, thus not examined].

Revised diagnosis (see also diagnosis for *sinensis*-group above)**.** Males similar to *P. sinensis* in having long embolus base (EB) (longer than conductor [C]), possessing numerous tubercles distally (Figs 52b–c, 54b–c). Distinguished by the broad distal part of embolus (E), the two semicircular, platform-like apophyses at EB and the tip of C pointing apically (Fig. 54b). Females similar to *P. sinensis* in having median septum (MS) with posterior part at least four times broader than anterior part (Figs 53a, 54e). Copulatory ducts (CD) without twist, the bulbous sections of CD about as broad as spermatheca (Figs 53b, 54f). Distinguished by the triangular shape of MS (Fig. 54e), the narrower copulatory ducts and the spermatheca laterally clearly extending beyond CD (Fig. 54f). Additionally, in epigyne the anterior margins of the lateral lobes are visible (Fig. 54e).

Description. Male:

Body and eye measurements. Carapace length 7.4, carapace width 5.4, anterior width of carapace 2.9, opisthosoma length 9.5, opisthosoma width 4.7. Eyes: AME 0.38, ALE 0.40, PME 0.42, PLE 0.42, AME–AME 0.17, AME–ALE 0.08, PME–PME 0.26, PME–PLE 0.36, AME–PME 0.52, ALE–PLE 0.44, clypeus height at AME 0.96, clypeus height at ALE 0.81.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 10.0 [3.6, 1.7, 1.2, 3.5]; Legs: I 51.5 [13.6, 3.0, 14.3, 13.9, 6.3], II 40.2 [11.0, 3.0, 10.9, 10.7, 4.6], III 27.8 [8.2, 2.2, 6.6, 7.4, 3.4], IV 40.5 [11.4, 2.6, 10.5, 11.3, 4.7]. Spination. Palp: 131, 110(both spines very small), 1101(all spines very small); legs: femur I 516, II 526, III 536{335}, IV 524; patella I–IV 000; tibia I 3037, II 3036, III 2026{2036}, IV 2036; metatarsus I–IV 3035.

Palpal femur ventrally modified with rounded bulge (Fig. 54d).

Copulatory organ (see also diagnosis and general description for *sinensis*-group). Conductor (C) apically distinctly narrower than centrally but its tip rounded (Fig. 54b), not pointed. Embolus (E) strangely folded. Sperm duct with broad V-shaped course (Fig. 54b). Palpal tibia distinctly short (Figs 54a–c).

Female:

Body and eye measurements. Carapace length 7.3, carapace width 4.1, anterior width of carapace 2.2, opisthosoma length 9.9, opisthosoma width 5.8. Eyes: AME 0.38, ALE 0.42, PME 0.43, PLE 0.43, AME–AME 0.17, AME–ALE 0.08, PME–PME 0.24, PME–PLE 0.38, AME–PME 0.62, ALE–PLE 0.47, clypeus height at AME 1.08, clypeus height at ALE 0.94.

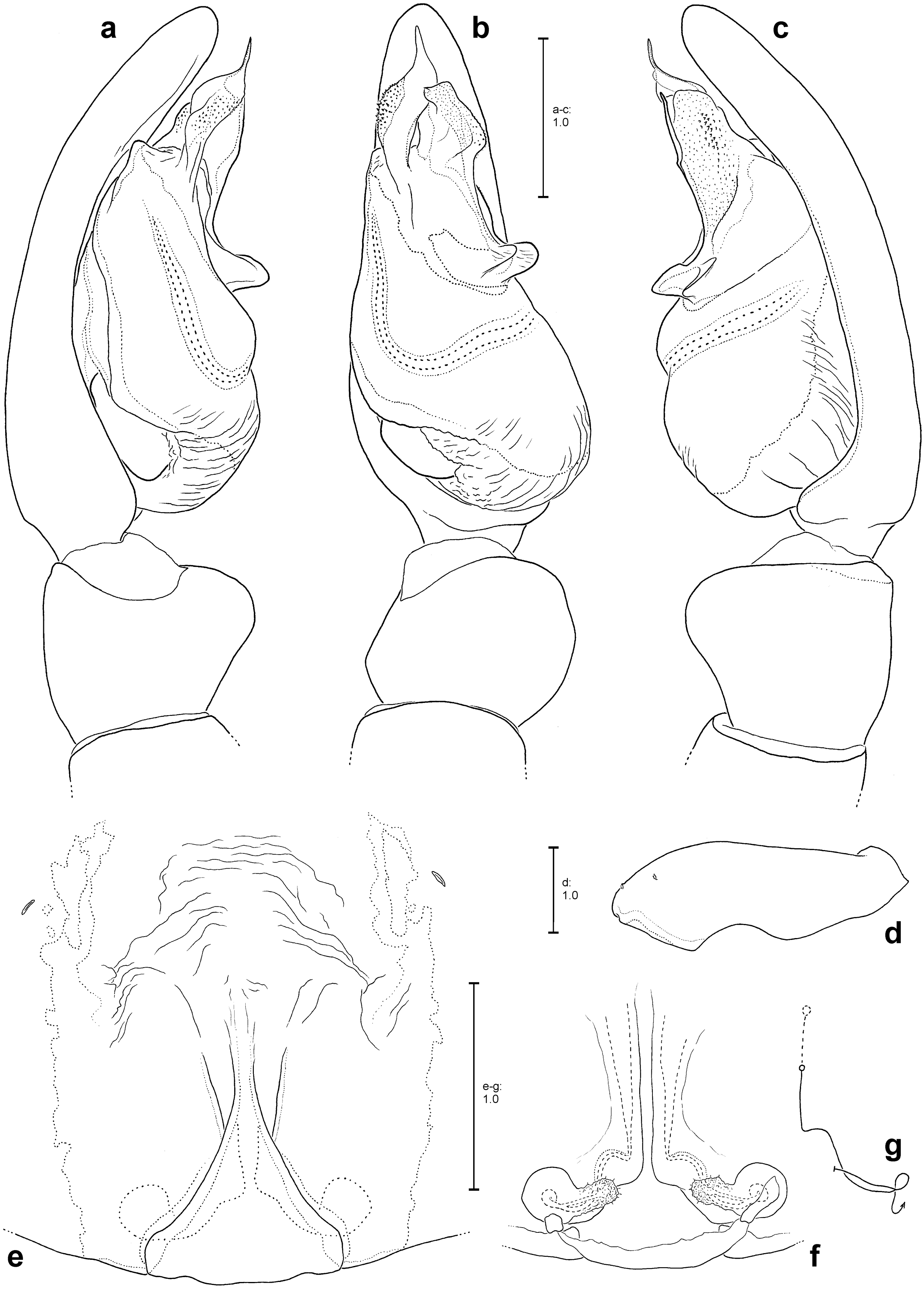
Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.2 [3.1, 1.4, 1.6, 3.1]; Legs: I 40.8 [11.2, 3.3, 11.3, 10.2, 4.8], II 33.0 [9.6, 2.9, 9.0, 7.6, 3.9], III 23.3 [6.9, 2.2, 5.5, 5.8, 2.9], IV 33.2 [9.5, 2.6, 8.8, 8.3, 4.0].

Palpal claw with 15 teeth.

Spination. Palp: 131, 110, 2101{1101}, 1014; legs: femur I 516, II 515, III 535, IV 524; patella I–IV 000; tibia I 3038, II 3036{3037} III 2034, IV 2035; metatarsus I–IV 3035.

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Epigynal field with anterio-lateral extensions, associated with the long and narrow epigynal muscle sigilla. Slit sense organs outside EF (Fig. 54e). In comparison to *P. sinensis* spermathecal heads arising further dorsally at spermathecae (Fig. 54f).



FIGURES 54a–g. *Psechrus triangulus*, from China, Yunnan Prov. a–d ♂ paratype SB 882. e–g ♀ holotype SB 881. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e Epigyne, ventral view. f Vulva, dorsal view. g Schematic course of internal duct system.

Colouration of male and female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace at most slightly serrated. Lateral bands very narrow (at most 0.3 diameter of PME) and at most slightly lobed. Light longitudinal line ventrally on opisthosoma strongly constricted subdistally and quite broad. If measured centrally on opisthosoma, its width is slightly less than or as broad as the width of one half of the cribellum (ca. 0.8–1.0 of one half of the cribellum). Distal part (patch) broader than main section.

Distribution. China (Fig. 96).

Psechrus tingpingensis Yin, Wang & Zhang, 1985

Figs 55a–g, 56a–f, 86c, 89c, 92c

Psechrus tingpingensis Yin, Wang and Zhang 1985: 23, figs 3A–D (Description of ♀, illustration of ♀). [Holotype ♀ from CHINA: Hunan Province: Chengbu, Tingping; J.F. Wang & Y.J. Zhang leg. 31.VII.1982; HBI; Paratypes: 2 ♀♀ (one of which SB 194), with same data as for holotype; HBI; 12 ♀♀, CHINA: Guangxi Province: Longsheng; J.F. Wang & Y.J. Zhang leg. 07.VIII.1982; HBI, only one female paratype (SB 194) from Tingping examined, remaining type material not available on request, thus not examined]. Feng 1990: 34, figs 9.1–5, ad part, figs 9.3–5 misidentified [see remark below] (Description of ♀, figs 9.1–2: illustration of ♀ [?]). Song *et al.* 1999: 398, figs 232I–J (Illustration of ♀). Wang and Yin 2001: 341: figs 31–47 (Non description & illustration of ♂ and ♀ and SEM photos of somatic characters, misidentification, see *Psechrus obtectus* **sp. nov.**). Chen *et al.* 2002: 10.

Psechrus xinping Chen, Zhang, Song & Kim 2002: 10, figs A–G (Description of ♂ and ♀, illustration of ♂ and ♀). [Holotype ♀ (SB 883) from CHINA: Guizhou Province, Taijiang County, Nangong Mountain; H.M. Chen leg. 14.V.2001; MHBU; Paratypes: 1 ♂ (SB 884), 1 ♀, same data as for holotype; MHBU, female holotype and male paratype examined, female paratype not available on request, thus not examined]. **Syn. nov.**

Additional material examined. CHINA: Hunan Province: Shimen, Mt. Huping; X.J. Peng & L.P. Xie leg. 25.VI.–05.VII.1992; 1 ♂ (SB 529), HBI.

Revised diagnosis (see also diagnosis for *sinensis*-group above)**.** Males with apically forked conductor (C) with two pointed tips and one flat, semicircular lobe (Figs 55a–c, 56a–c). Embolus (E) with two sclerotised apophyses at distal half (Figs 55b–c, 56b–c), one of which pointed and directed towards long tip of C (Fig. 56c). Females very similar to *P. obtectus* **sp. nov.** in having trapezoid median septum (MS), the latter not, or not distinctly longer than broad (Figs 55e, 56d, 58a), and with twisted copulatory ducts (CD) with their initial sections running transversally medially (Fig. 55f, 56f, 58b). Distinguished by the anterior, twisted section of the copulatory duct (CD). In fact, the short section beyond the transversal, initial section of CD, almost as long as the diameter of one receptaculum (Figs 55f, 56f), whereas in *P. obtectus* **sp. nov.** it is shorter than half the diameter.

Description. Male (measurements of paratype of *P. xinping* first, those of SB 529 from Shimen in parentheses behind)**:**

Body and eye measurements. Carapace length 8.5 (9.4), carapace width 5.8 (6.6), anterior width of carapace 3.5 (3.8), opisthosoma length 10.2 (10.7), opisthosoma width 5.1 (4.6). Eyes: AME 0.38 (0.44), ALE 0.47 (0.49), PME 0.51 (0.46), PLE 0.49 (0.49), AME–AME 0.24 (0.21), AME–ALE 0.08 (0.13), PME–PME 0.27 (0.35), PME–PLE 0.44 (0.49), AME–PME 0.68 (0.64), ALE–PLE 0.58 (0.63), clypeus height at AME 0.92 (1.07), clypeus height at ALE 0.83 (0.97).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 10.6 (11.6) [3.4 (3.8), 2.0 (2.1), 1.6 (1.6), 3.6 (4.1)]; Legs: I 68.7 (73.7) [17.7 (19.8) , 3.9 (4.4), 19.2 (20.1), 19.8 (21.1), 8.1 (8.3)], II 53.0 (56.4) [14.5 (15.5), 3.4 (4.0), 14.1 (15.0), 14.8 (15.3), 6.2 (6.6)], III 35.3 (?) [10.3 (10.9), 2.5 (2.9), 8.6 (8.7), 9.7 (-), 4.2 (-)], IV 54.2 (56.7) [15.1 (16.0), 3.0 (3.3), 14.1 (14.0), 15.2 (16.7), 6.8 (6.7)].

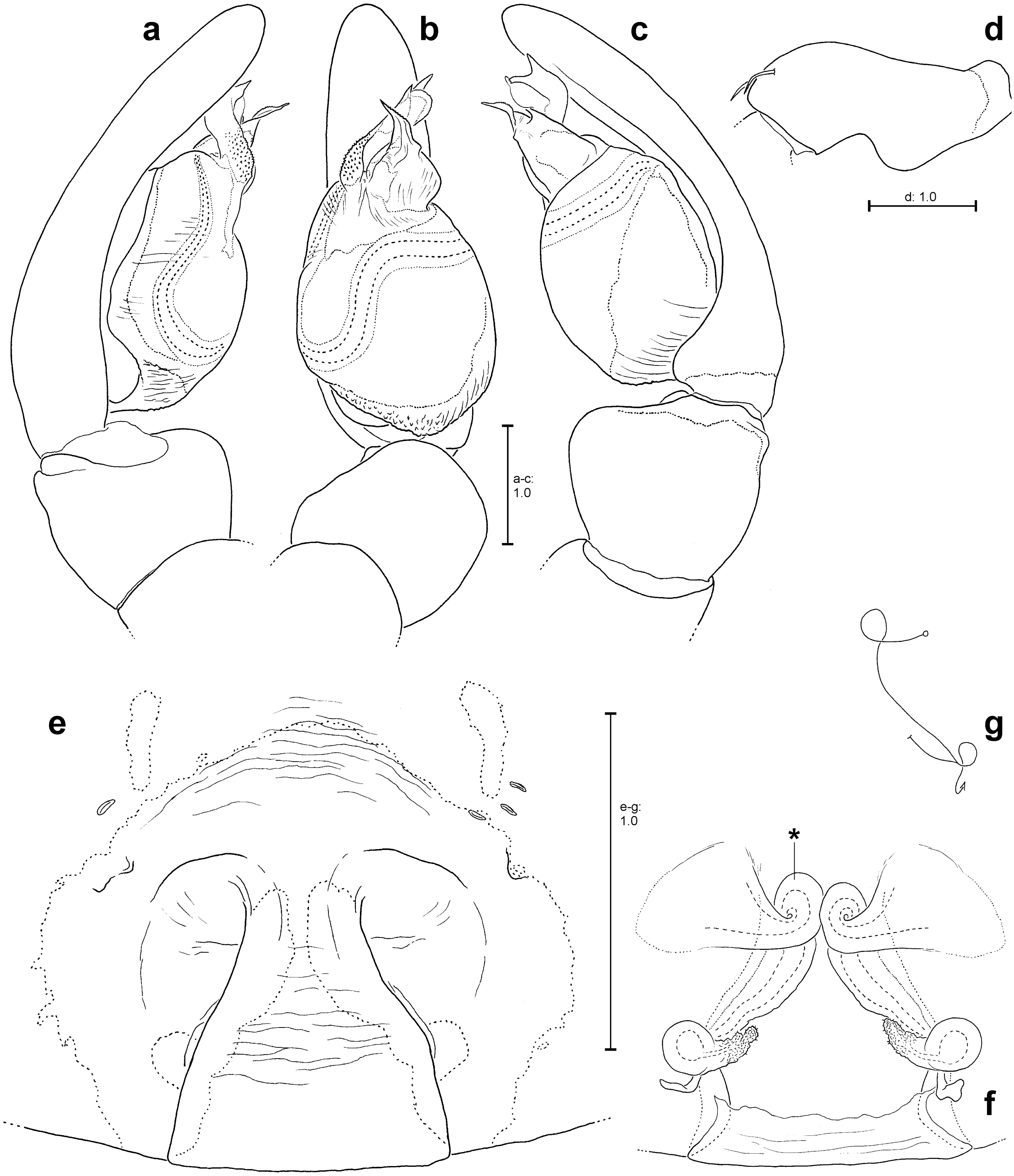
Spination. Palp: 131, 000, 0000 (both); legs: femur I 525 (526), II 524{536} (536), III 545 (545), IV 544 (544); patella I–IV 000; tibia I 3036 (3036), II 3035 (3036), III 3022 (2034), IV 3034 (2034); metatarsus I 3045 (3035), II, IV 3035 (3035), III 3035 (-).

Palpal femur ventrally modified with strongly extending, rounded bulge (Fig. 55d).

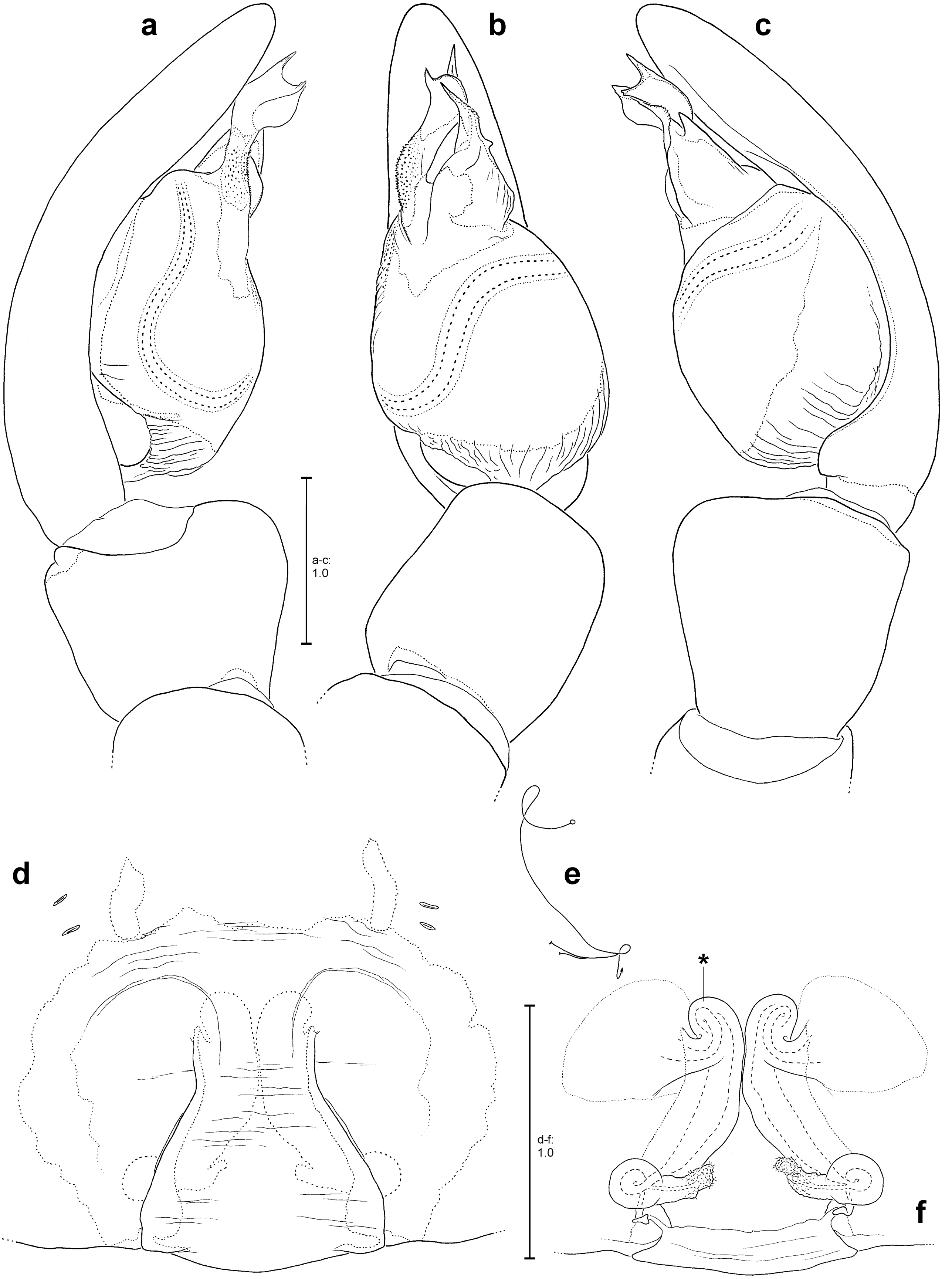
Copulatory organ (see also diagnosis and general description for *sinensis*-group). E dorsally slightly serrated (Figs 56b–c). Sperm duct with transversal section in retrolateral distal half of T and with loop in prolateral half. Palpal tibia short (Figs 56a–c) to very short (Figs 55a–c).

Female (measurements of paratype ♀ [SB 194] of *P. tingpingensis* first, those of holotype of *P. xinping* in parentheses behind)**:**

Body and eye measurements. Carapace length 5.9 (7.7), carapace width 4.4 (5.1), anterior width of carapace 3.2 (3.4), opisthosoma length 8.7 (10.1), opisthosoma width 3.7 (5.3). Eyes: AME 0.34 (0.41), ALE 0.39 (0.47), PME 0.43 (0.47), PLE 0.41 (0.47), AME–AME 0.18 (0.24), AME–ALE 0.10 (0.08), PME–PME 0.37 (0.40), PME–PLE 0.36 (0.46), AME–PME 0.58 (0.68), ALE–PLE 0.63 (0.61), clypeus height at AME 0.87 (1.15), clypeus height at ALE 0.74 (0.92).



FIGURES 55a–g. *Psechrus tingpingensis*, from China, Hunan Prov. a–d ♂ SB 529. e–g ♀ paratype SB 194. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e Epigyne, ventral view. f Vulva, dorsal view. g Schematic course of internal duct system. Asterisk indicates twisted section of CD, located anteriorly beyond transversal, initial section of CD.



FIGURES 56a–f. *Psechrus tingpingensis*, from China, Guizhou Prov. a–c ♂ SB 884 (paratype of *P. xinping*). d–f ♀ SB 883 (holotype of *P. xinping*). a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d Epigyne, ventral view. f Vulva, dorsal view. e Schematic course of internal duct system. Asterisk indicates twisted section of CD, located anteriorly beyond transversal, initial section of CD.

Cheliceral furrow with three promarginal and four (five, left) retromarginal teeth (holotype of *P. xinping* three promarginal and four retromarginal).

Measurements of palp and legs. Leg formula: 1243. Palp: 7.9 (9.2) [2.6 (3.2), 1.1 (1.4), 1.4 (1.6), 2.8 (3.0)]; Legs: I 39.3 (43.4) [10.3 (11.7), 2.8 (3.0), 11.1 (12.3), 10.3 (11.2), 4.8 (5.2)], II 30.9 (35.1) [8.7 (9.9), 2.5 (2.8), 8.1 (9.6), 7.9 (8.6), 3.7 (4.2)], III 22.0 (25.2) [6.5 (7.4), 1.8 (2.3), 5.1 (6.2), 5.7 (6.1), 2.9 (3.2)], IV 31.1 (35.5) [8.7 (10.0), 2.2 (2.6), 8.0 (9.3), 8.1 (9.1), 4.1 (4.5)].

Palpal claw with 14 (13) teeth.

Spination. Palp: 131, 110, 1101, 1014 (both); legs: femur I 536 (535{534}), II 425 (525{535}), III 545 (535), IV 554{544} (534); patella I–IV 000; tibia I 3036 (3035), II 2036 (3036), III 2022 (2024), IV 2033{2023} (2034); metatarsus I 3035 (2027), II–III 3035 (3035), IV 3034 (3034).

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Epigynal field (EF) may be associated with long and narrow epigynal muscle sigilla (Fig. 56d). Slit sense organs mostly outside EF (Fig. 56d, but see also Fig. 55e). Spermathecal heads upon stalks (Fig. 55f), the latter shorter than the ones of females of *argentatus*-group.

Colouration of male and female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace not serrated. Lateral bands very narrow (at most 0.3 diameter of PME) and not serrated. Light longitudinal line ventrally on opisthosoma broken subdistally or strongly constricted subdistally and broad. If measured centrally on opisthosoma, its width is 0.8–1.2 of one half of the cribellum. Distal part (patch) broader than main section.

Remarks: *Psechrus xinping* Chen, Zhang, Song & Kim, 2002 is recognised as synonym of *P. tingpingensis* because the female copulatory organs of its holotype from Nangong Mountain and the paratype (SB 194) (holotype of *P. tingpingensis* was not available on request, but it was collected at exactly the same locality as this paratype, see above) of *P. tingpingensis* from Tingping match (Figs 55e–f, 56d,f). The diagnosis for the female of *P. xinping* in Chen *et al.* (2002) is not cogent. The diagnosis for the male, however, is cogent. It is obvious that they relied on the description and illustration of the male *P. tingpingensis* sensu Wang and Yin (2001, figs 31–32). They discriminated their male *P. xinping* from the one in that publication with good reason. However, the male illustrated in Wang and Yin is not at all conspecific with *P. tingpingensis*. According to their material list, Wang and Yin examined just one male from Shimen (a “real” *P. tingpingensis*, examined in the present study, too, see Figs 55a–d). The other males were collected in Guangxi Prov., ca. 550 air km S SW, and in Vietnam, ca. 700 air km S SW of type locality of *P. tingpingensis*. The males and females from Vietnam were examined in the present study and have been recognised as representatives of a new, different species, *P. obtectus* **sp. nov.** (see below). In Wang and Yin (2001) only one male of the specimens they had considered as *P. tingpingensis* was illustrated, in fact one from Vietnam, as the examination of the respective material for the present study had shown. Hence, Chen *et al.* (2002) were the first (though unwittingly) to describe the male of *P. tingpingensis*, namely sub *P. xinping*.

Feng (1990) provided a description of a ♂ and ♀ of *Psechrus*, which he identified as *P. tingpingensis*. According to the illustration in his fig. 9.2 the ♀ may be a *P. tingpingensis*. Wang and Yin (2001), however, listed this “*P. tingpingensis*”-reference (Feng 1990) in their synonymic list of *P. kunmingensis*, with the annotation “(female only) (misidentification)”. Maybe they did not recognise that, in fact, the male in Feng (1990, fig. 9.3–5) was misidentified. According to those illustrations the respective male with its simple, filiform embolus and the simple, distally rounded conductor is definitely a different species. I believe that it belongs to the *ancoralis*-group. There are some similarities with *P. khammouan*, but it is more likely that it belongs to a new species. The ♀ illustrated in Feng (1990, fig. 9.2) is either a *P. tingpingensis* or a *P. kunmingensis*, like Wang and Yin (2001) stated. In my opinion, however, *P. kunmingensis* is less likely, as the two characteristical lobes at posterior margin of median septum are missing in Feng’s illustration. Unfortunately Feng (1990) did not list the material he examined for his study. His illustrations are not informative enough to definitely identify the species he dealt with.

Distribution. China (Fig. 96).

Psechrus obtectus sp. nov.

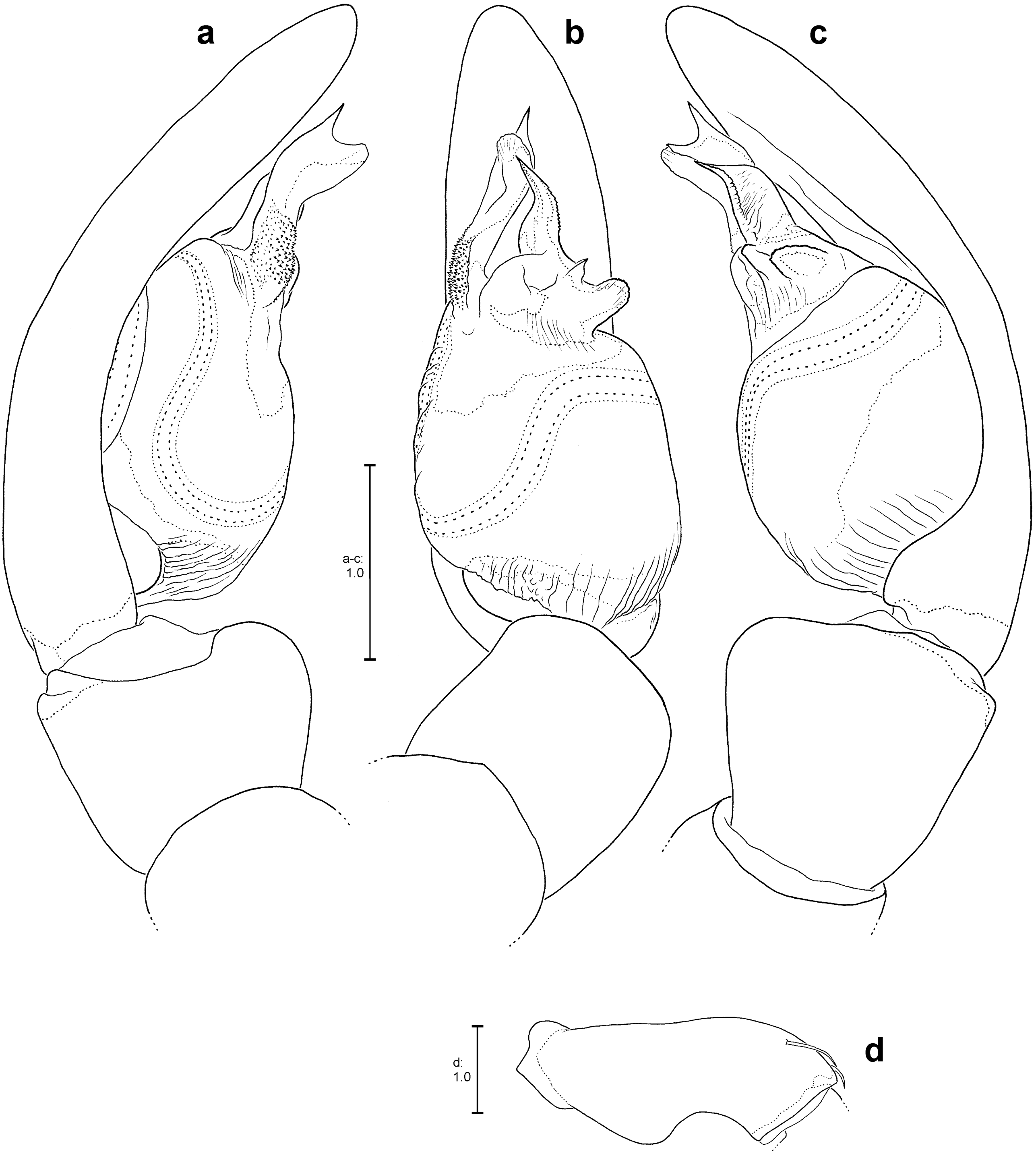
Figs 57a–d, 58a–g, 86d, 89d, 92d

Psechrus tingpingensis — Wang and Yin 2001: 341, figs 31–47 (Description & illustration of ♂ and ♀ and SEM photos of somatic characters, misidentified).

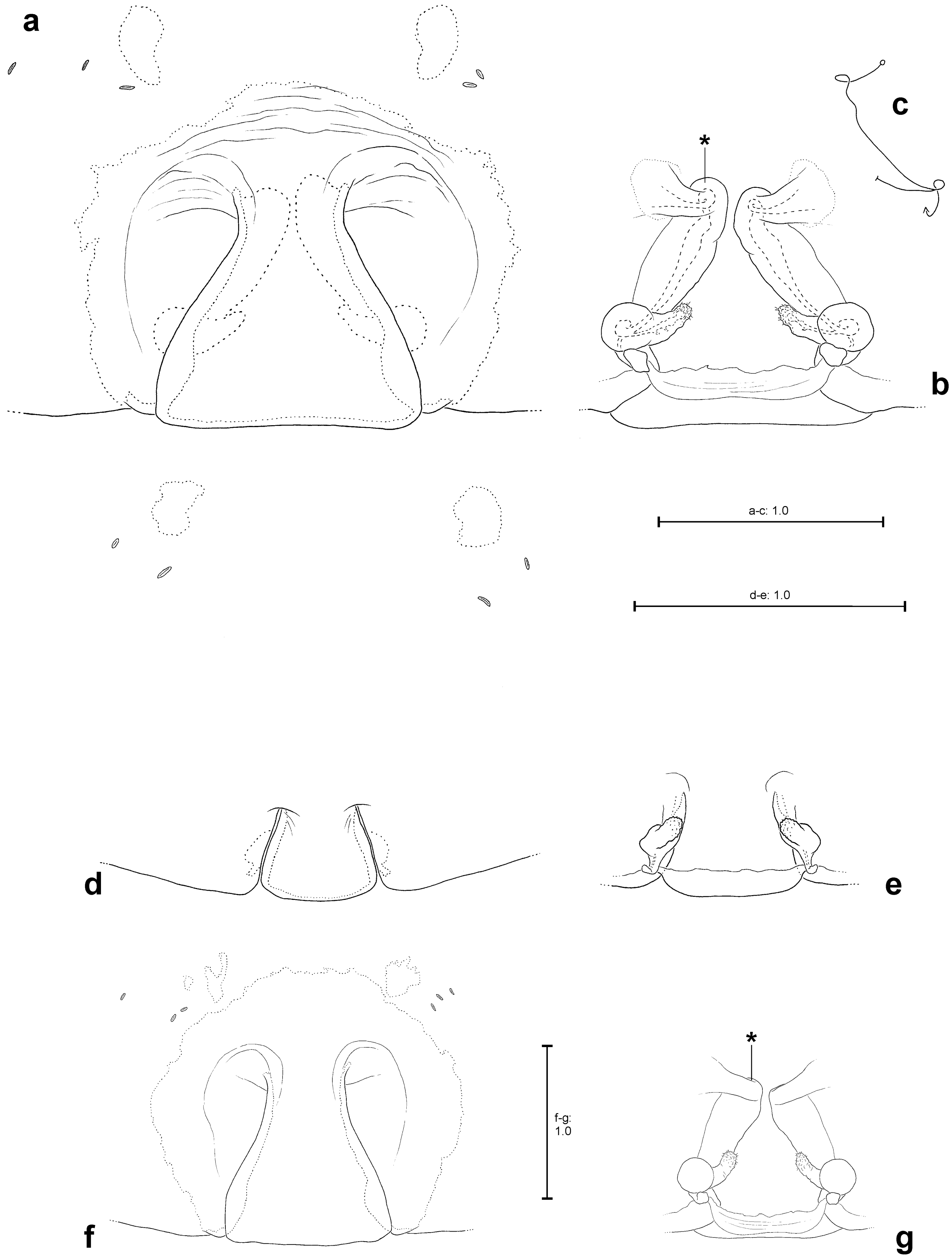
Type material. Holotype ♂ (SB 1151), **VIETNAM: Bac Thai Province:** Tam Dao Mountain Forest Park (ca. 45 km NW of Hanoi), ca. N 21°27', E 105°40', 500–1000 m; X.P. Wang leg. 02.V.1999; AMNH. **Paratypes: 1** ♂ (SB 1150), **4** ♀♀ (SB 1152–1155), **1 s.a.** ♀ (SB 1156), same data as for holotype; AMNH.

Etymology. The specific name refers to the fact, that the distinct species status of this new species was undetected (thus concealed) for several years, due to its similarity to *Psechrus tingpingensis* (Latin "obtectus" means "concealed" or "hidden"); Perfect participle passive; adjective.

Diagnosis (see also diagnosis for *sinensis*-group above)**.** Males similar to *P. tingpingensis* in general shape of embolus and tegulum and in having apically forked conductor (C). Distinguished by the two strongly sclerotised



FIGURES 57a–d. *Psechrus obtectus* **sp. nov.** from Vietnam, Bac Thai Prov. a–c ♂ holotype SB 1151, d ♂ paratype SB 1150. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ right palpal femur, retrolateral view.



FIGURES 58a–g. *Psechrus obtectus* **sp. nov.** from Vietnam, Bac Thai Prov., female adult and primordial copulatory organ. a–c ♀ paratype SB 1152, d–e s.a. ♀ paratype SB 1156, f–g ♀ paratype SB 1154. a, f Epigyne, ventral view. b, g Vulva, dorsal view. c Schematic course of internal duct system. d Pre-epigyne, ventral view. e Pre-vulva, dorsal view. Asterisk indicates twisted section of CD, located anteriorly beyond transversal, initial section of CD.

apophyses (the smaller of which more exactly an extension) at proximal half of embolus base (EB) and by the absence of apophyses at distal section of EB (Figs 57a–c). Females very similar to *P. tingpingensis* in shape of epigyne and general shape of vulva (see description of *P. tingpingensis*). Distinguished by the anterior, twisted section of copulatory duct (CD), in fact the short section beyond the transversal, initial section of CD, being shorter than half the diameter of one receptaculum (Figs 58b,g, 92d), whereas in *P. tingpingensis* it is almost as long as one diameter.

Description. Male (measurements of holotype first, those of paratype SB 1150 in parentheses behind)**:**

Body and eye measurements. Carapace length 8.1 (8.5), carapace width 4.5 (6.1), anterior width of carapace 3.5 (3.6), opisthosoma length 9.4 (in paratype distal section of opisthosoma cut), opisthosoma width 4.1 (4.9). Eyes: AME 0.39 (0.42), ALE 0.46 (0.48), PME 0.49 (0.48), PLE 0.49 (0.48), AME–AME 0.22 (0.22), AME–ALE 0.04 (0.06), PME–PME 0.27 (0.26), PME–PLE 0.32 (0.37), AME–PME 0.63 (0.62), ALE–PLE 0.47 (0.46), clypeus height at AME 1.03 (1.04), clypeus height at ALE 0.93 (0.97).

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 10.7 (10.5) [3.5 (3.6), 1.9 (1.8), 1.4 (1.4), 3.9 (3.7)]; Legs: I 64.0 (69.9) [16.7 (18.2), 3.9 (4.1), 17.7 (19.5), 18.2 (20.0), 7.5 (8.1)], II 48.1 (50.2) [13.1 (13.0), 3.4 (3.5), 13.0 (13.8), 13.1 (14.2), 5.5 (5.7)], III 33.3 (34.1) [9.6 (9.8), 2.6 (2.8), 7.9 (8.2), 9.2 (9.3), 4.0 (4.0)], IV 49.6 (52.4) [13.6 (14.4), 3.1 (3.2), 12.5 (13.2), 14.3 (15.1), 6.1 (6.5)].

Spination. Palp (both specimens): 131, 110 (spines very small), 1101 (spines very small); legs: femur I 546 (654{546}), II 546 (556{546}), III 555 (545), IV 544 (545{665}); patella I–IV 000; tibia I–II 3036 (3036), III 2022 (2022), IV 3033{2031} (2030{3032}); metatarsus I–III 3035 (3035), IV 3034 (3035).

Palpal femur ventrally modified with quite strongly extended, rounded bulge (Fig. 57d). However, the extension slightly less distinct than in *P. tingpingensis.*

Copulatory organ (see also diagnosis and general description for *sinensis*-group). Embolus (E) dorsally slightly serrated (Figs 57b–c). Proximal apophysis of EB quite broad. Sperm duct with transversal section in retrolateral apical half of T and with loop in prolateral half. Palpal tibia short (Figs 57a–c).

Female:

Body and eye measurements. Carapace length 8.7–9.7, carapace width 4.2–6.6, anterior width of carapace 3.7–4.3, opisthosoma length 12.9–13.6, opisthosoma width 6.8–7.8. Eyes: AME 0.41–0.49, ALE 0.50–0.53, PME 0.48–0.54, PLE 0.49–0.53, AME–AME 0.27–0.28, AME–ALE 0.09–0.11, PME–PME 0.39–0.42, PME–PLE 0.43–0.49, AME–PME 0.66–0.74, ALE–PLE 0.61–0.69, clypeus height at AME 1.31–1.36, clypeus height at ALE 1.03–1.12.

Cheliceral furrow with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 10.2–11.5 [3.5–3.9, 1.5–1.8, 1.8–1.9, 3.4–3.9]; Legs: I 48.0–52.8 [12.7–14.3, 3.7–4.0, 13.4–15.4, 12.6–13.2, 5.6–5.9], II 37.3–40.2 [10.3–11.4, 3.2–3.5, 10.3–10.7, 9.2–10.0, 4.3–4.6], III 26.8–28.9 [8.0–8.3, 2.3–2.9, 6.6–6.8, 6.6–7.2, 3.3–3.7], IV 38.2–41.7 [10.5–12.0, 2.9–3.4, 10.1–10.7, 10.0–10.5, 4.7–5.1].

Palpal claw with 15–16 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 546, II 545 (556,545), III 545 (555), IV 554; patella I–IV 000; tibia I–II 3036, III 2022 (2032), IV 2023 (2032); metatarsus I–III 3035, IV 3034.

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Epigynal field (EF) may be associated with epigynal muscle sigilla (EM) (Fig. 58f). The latter mostly slightly broader than in *P. tingpingensis.* Slit sense organs (SO) outside EF (Fig. 58a, 58f). Initial section of CD (Figs 58b,g) mostly slightly narrower than in *P. tingpingensis*, mesal section mostly slightly broader. Spermathecal heads like in *P. tingpingensis.*

Primordial copulatory organ. Pre-epigyne: Pre-septum about as long as broad and posteriorly broader than anteriorly (Fig. 58d). With small, slightly curved transversal edges in front of pre-CO.

Pre-vulva: Pre-CD longer than pre-receptacula (Fig. 58e) and narrower than in *P. senoculatus*.

Colouration of male and female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace slightly serrated. Lateral bands absent or very narrow (at most 0.2 diameter of PME) and not serrated. Light longitudinal line ventrally on opisthosoma broken subdistally or strongly constricted subdistally and broad. If measured centrally on opisthosoma, its width is 0.7–0.9 of one half of the cribellum. Distal part (patch) broader than main section.

Distribution. Vietnam (Fig. 96).

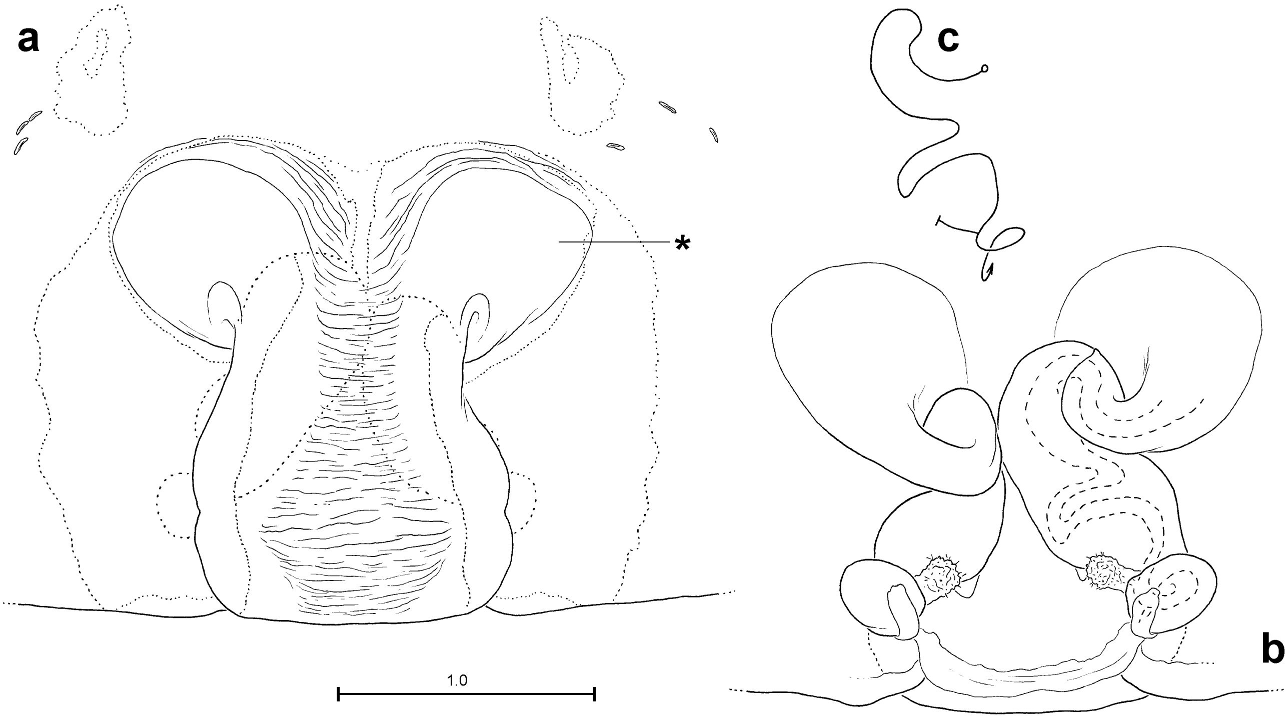
Psechrus fuscai sp. nov.

Figs 59a–c, 82d, 89e, 92e

Type material. Holotype ♀ (SB 954), **CHINA: Yunnan Province:** Gongshan Co., Bingzhongluo Township, trail between Niwaluo and Fuscai, N 28°01'24", E 98°32'59", 2345 m; J.A. Miller leg. 16.VIII.2006; field no. JM 06081601, |GLGS06-006|; CAS 9032230.

Etymology. The specific name refers to the type locality; term (name of village) in apposition.

Diagnosis (see also diagnosis for *sinensis*-group above)**.** Female similar to *P. tingpingensis* in having median septum (MS), not longer than broad (Fig. 59a) but minimally broader than long, and twisted copulatory ducts (CD) with their initial sections running more or less transversally medially (Fig. 59b). Distinguished by the sack-like MS, the peculiar, flattened, glossy fields in the areas of copulatory openings (CO) (Fig. 59a, 89e) and the clearly broader distal sections (in comparison with the proximal sections) of copulatory ducts (CD) (Fig. 59b).



FIGURES 59a–c. *Psechrus fuscai* **sp. nov.**, ♀ holotype SB 954 from China, Yunnan Prov. a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system. The asterisk indicates the peculiar, flattened, glossy field anterior to copulatory openings.

Description. Male: unknown.

Female:

Body and eye measurements. Carapace length 10.0, carapace width 6.9, anterior width of carapace 4.3, opisthosoma length 12.5, opisthosoma width 6.6. Eyes: AME 0.46, ALE 0.51, PME 0.51, PLE 0.51, AME–AME 0.29, AME–ALE 0.09, PME–PME 0.42, PME–PLE 0.50, AME–PME 0.83, ALE–PLE 0.70, clypeus height at AME 1.22, clypeus height at ALE 1.18.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 12.5 [4.3, 1.8, 2.2, 4.2]; Legs: I 56.9 [16.3, 4.2, 15.5, 14.7, 6.2], II 45.6 [13.2, 3.8, 12.3, 11.4, 4.9], III 32.6 [9.9, 3.0, 8.1, 7.9, 3.7], IV 43.8 [12.7, 3.4, 11.5, 11.4, 4.8].

Palpal claw with 14 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I–II 516, III 435, IV 434; patella I–IV 000; tibia I 3036, II 3036{3035} III 2034, IV 2035; metatarsus I–IV 3035.

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Slit sense organs and epigynal muscle sigilla outside epigynal field (Fig. 59a). Spermathecal heads upon short stalks. Entire vulva irregularly shaped, right CD distinctly larger than left one (Fig. 59b).

Colouration (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace hardly serrated (Fig. 82d). Lateral bands very narrow (at most 0.3 diameter of PME) and —if at all— slightly serrated (Fig. 82d). Light longitudinal line ventrally on opisthosoma constricted subdistally and medium sized to broad. If measured centrally on opisthosoma, its width is ca. 0.7 of one half of the cribellum. Distal part of longitudinal line slightly broader than main section.

Remarks: At present it cannot be clarified if the irregular shape of the vulva is a species-specific character or if it should be regarded as malformation of this particular female. The latter seems more likely because in all other *Psechrus* species, the female copulatory organ is bilaterally symmetrical.

Distribution. China (Fig. 96).

Psechrus kunmingensis **Yin, Wang & Zhang, 1985**

Figs 60a–g, 81i, 86m–o, 89f, 92f

Psechrus kunmingensis Yin, Wang and Zhang 1985: 25, figs 5A–D (Description of ♀, illustration of ♀). [Holotype ♀ (SB 192) from CHINA: Yunnan Province: Kunming; J.F. Wang leg. 05.IV.1979; HBI; Paratypes: 2 ♀♀ (one of which SB 193), CHINA: Yunnan Province: Kunming; M. Liu leg. VII.1983; HBI, holotype and one female paratype (SB 193) examined, other paratype not available on request, thus not examined]. Song *et al.* 1999: 397, figs 232C–D, O–P (Illustration of ♀, illustration of ♂). Wang and Yin 2001: 334: figs 9–10 (Description of ♀, illustration of ♀).

Note on holotype female: Posterior part of median septum cut, due to vulva preparation for the study published in Yin *et al.* (1985).

Additional material examined. CHINA: Yunnan Province: Kunming Prefecture, Kunming – Heilongtan District, Kunming Institute of Botany, botanical gardens, N25°08'20", E 102°44'28", 1950 m; D. Kavanaugh & C. Griswold leg. 21.–23.IV.2000; 1 ♀ (SB 953), CAS 9032233.

Additional doubtful material examined. CHINA: Yunnan Province: Kunming Prefecture, Xi Shan, N 24°58'00", E 102°37'30", 2000–2300 m, forest, between rocks; P. Jäger leg. 02.IV.1999; 1 s.a. ♀ (SB 843), SMF. Xi Shan, Dragon Gate, ca. N 24°57'45", E 102°37'30", 2000–2400 m; P. Beron leg. 26.XII.1988; 1 s.a. ♀ (SB 1029), Deeleman Coll. in RMNH.

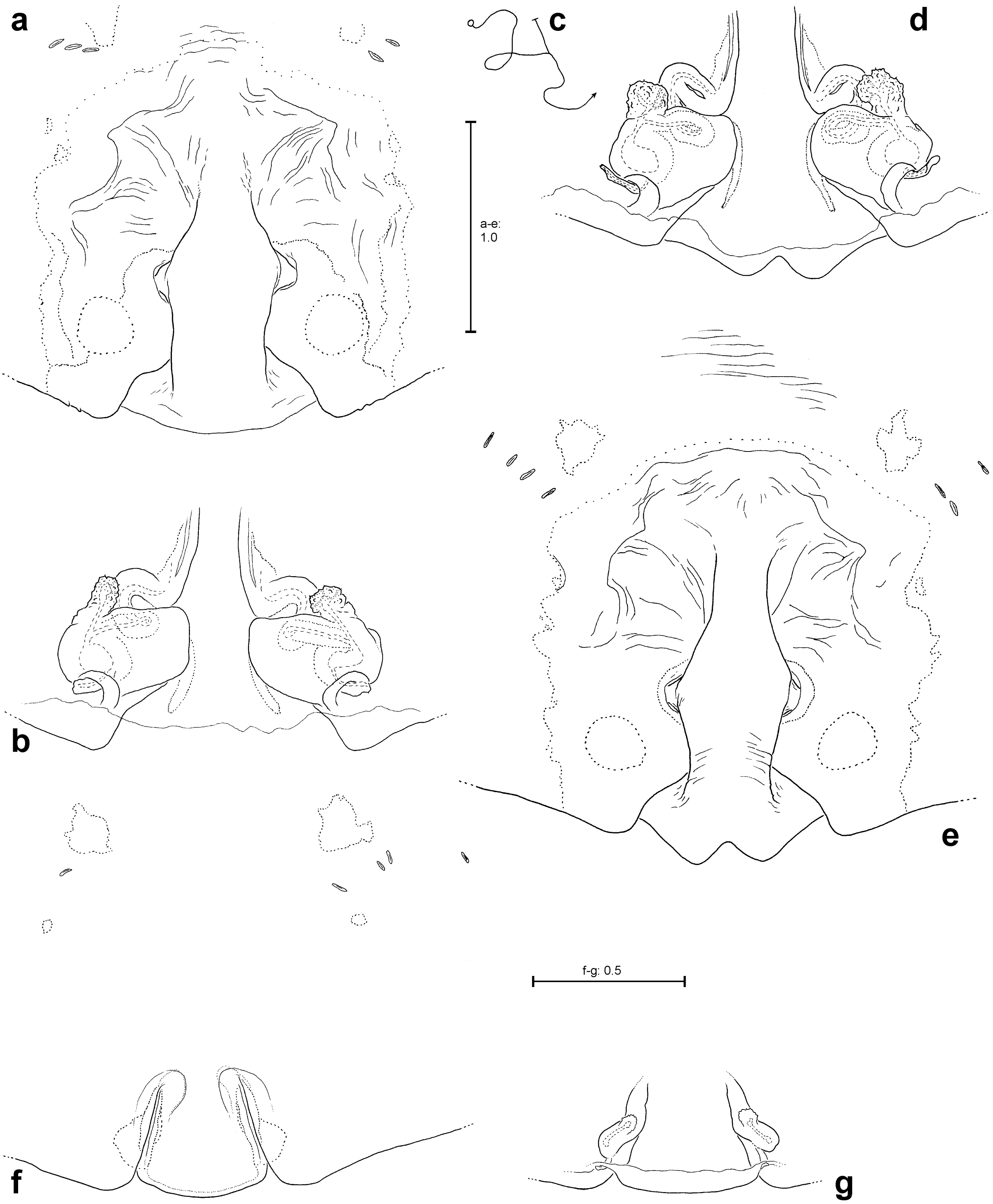
Revised diagnosis (see also diagnosis for *sinensis*-group above)**.** Male with longer embolus (E) (even without embolus base [EB] more than half as long as width of tegulum [T]) than in the remaining species of *sinensis*-group and with a long, apically bifurcated apophysis on EB (Figs 86m–o). Females with complex epigyne. Median septum (MS) and lateral lobes (LL) with complex, interleaved folds. Posterior margin of MS with two lobes (Figs 60e, 89f). Vulva with infolded parts of lateral lobes partially covering the round receptacula (Figs 60b,d). Spermathecal heads (SH) arising anteriorly at spermathecae.

Description. Male: No male specimen was available for the present study. However, Ping Feng, Zi-Zhong Yang (both Dali, China) and colleagues found 6 males and 14 females of this species (partly males and females together at the same site) at Kunming (N 24°57'12", E 102°37'59"; material deposited in DUY). Ping Feng prepared male palps and provided photos of one palp (Figs 86m–o). He and Prof. Yang kindly gave their permission to include these photos in the present work. They enable me to give a brief description of the male palp:

Copulatory organ (see also diagnosis and general description for *sinensis*-group). Embolus (E) distally perpendicularly curved (Fig. 86o). EB basally with broad and rounded apophysis, sperm duct with broad U-shaped course and palpal tibia short (Figs 86m, o). Cymbium dorsally with very dense scopula, covering slightly more than 1/3 of cymbium (Fig. 86n). Palpal femur ventrally modified with rounded bulge (not illustrated), similar to that of *P. triangulus* (Fig. 54d).

Female (measurements of holotype and paratype ♀ [SB 193] almost identical, so those of the latter are not listed; those of holotype are given first, those of ♀ SB 953 in parentheses behind; the same with leg measurements; the spinations of paratype SB 193 are given at first positions in parentheses, those of SB 953 at second positions)**:** Body and eye measurements. Carapace length 8.7 (8.8), carapace width 6.0 (6.1), anterior width of carapace 4.1 (4.1), opisthosoma length 12.5 (12.9), opisthosoma width 8.8 (6.1). Eyes: AME 0.45 (0.41), ALE 0.49 (0.52), PME 0.48 (0.52), PLE 0.52 (0.49), AME–AME 0.21 (0.19), AME–ALE 0.03 (0.07), PME–PME 0.31 (0.28), PME–PLE 0.38 (0.44), AME–PME 0.63 (0.66), ALE–PLE 0.54 (0.54), clypeus height at AME 1.02 (1.26), clypeus height at ALE 1.00 (1.14).

Cheliceral furrow with three promarginal and five (holotype) or four (remaining ♀♀ examined) retromarginal teeth.



FIGURES 60a–g. *Psechrus kunmingensis*, from China, Yunnan Prov., ♀ adult and primordial copulatory organ. a–b ♀ holotype SB 192, c–e ♀ paratype SB 193. f–g s.a. ♀ SB 843 (doubtful identification). a, e Epigyne, ventral view. b, d Vulva, dorsal view. c Schematic course of internal duct system. f Pre-epigyne, ventral view. g Pre-vulva, dorsal view. Remark: In ♀ holotype SB 192 posterior, lobed section of median septum cut.

Measurements of palp and legs. Leg formula: 1423. Palp: 10.8 (10.9) [3.8 (3.8), 1.5 (1.5), 1.9 (2.0), 3.6 (3.6)]; Legs: I 45.6 (49.1) [12.5 (13.6), 3.7 (3.9), 12.7 (13.8), 11.4 (12.1), 5.3 (5.7)], II 36.8 (39.6) [10.2 (11.3), 3.3 (3.5), 9.6 (10.4), 9.4 (10.0), 4.3 (4.4)], III 27.4 (28.5) [8.3 (8.6), 2.6 (2.7), 6.5 (6.9), 6.9 (6.9), 3.1 (3.4)], IV 37.2 (40.0) [10.7 (11.9), 3.1 (3.1), 9.7 (10.4), 9.2 (10.0), 4.5 (4.6)].

Palpal claw with 14 [holotype] (14 [paratype SB 193], 16 [other female]) teeth.

Spination. Palp: 131 (131,131), 110 (110,110), 1101 (1101,1101), 1023 (1023,1014); legs: femur I 525{526} (526,526), II 525 (526,535), III 628 (435,535), IV 524 (423,534); patella I–IV 000; tibia I 3038 (3036,3038), II 3036 (3036,3036), III 3034 (2026,2036), IV 2035 (3026,2025); metatarsus I–II 3035 (3035,3035), III 3037 (3035,3036), IV 3036 (3035,3036).

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Anterior border of epigynal field (EF) hard to recognise as such (Figs 60a,e, 89f), epigynal muscle sigilla (MS) and slit sense organs outside EF. Epigyne anterior to MS also quite strongly sclerotised and with long, partly curved ridges and wrikles (Figs 60a,e). Copulatory ducts similar to *P. sinensis*, but more strongly curved (Figs 60b,d).

Colouration of female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace slightly serrated. Lateral bands narrow to medium sized (at most diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma broken subdistally or strongly constricted subdistally and broad (Fig. 81i). If measured centrally on opisthosoma, its width is 0.7–1.2 of one half of the cribellum. Distal part (patch) broader than main section.

Variation of copulatory organs. Females: Some specimens with MS slightly broader (Fig. 89f). Copulatory ducts may be less curved and SH slightly smaller (Fig. 92f).

Remarks: Song *et al.* (1999) were the first to illustrate the male of *Psechrus kunmingensis*. Unfortunately, in that publication there was neither any information about the material examined given, nor a reason for assigning that type of male to *P. kunmingensis*. A comparison of the photos of the male *P. kunmingensis* from Kunming (Figs 86m–o) with the illustrations in Song *et al.* (1999) indicate that they did indeed examine *P. kunmingensis*.

The two subadult females (SB 843, 1029) examined in the present study could not be definitely identified as *P. kunmingensis*, as they were collected without additional adult material. The pre-epigyne and pre-vulva of SB 843 are shown in Figs 60f and 60g. As the localities (see above) are very close to the type locality of *P. kunmingensis*, it is at least possible that they belong to this species.

As the holotype female is partly damaged (see note on holotype above) I have included additional illustrations of the epigyne (Fig. 60e) and vulva (Figs 60c–d) of paratype ♀ SB 193.

Distribution. China (Fig. 96).

Psechrus jinggangensis **Wang & Yin, 2001**

Figs 61a–b

Psechrus jinggangensis Wang and Yin 2001: 334, figs 11–12 (Description of ♀, illustration of ♀). [Holotype ♀ from CHINA: Jiangxi Province: Jinggangshan, N 26°30', E 114°06'; C.M. Yin leg. 04.X.1996; HBI, not available on request, thus not examined].

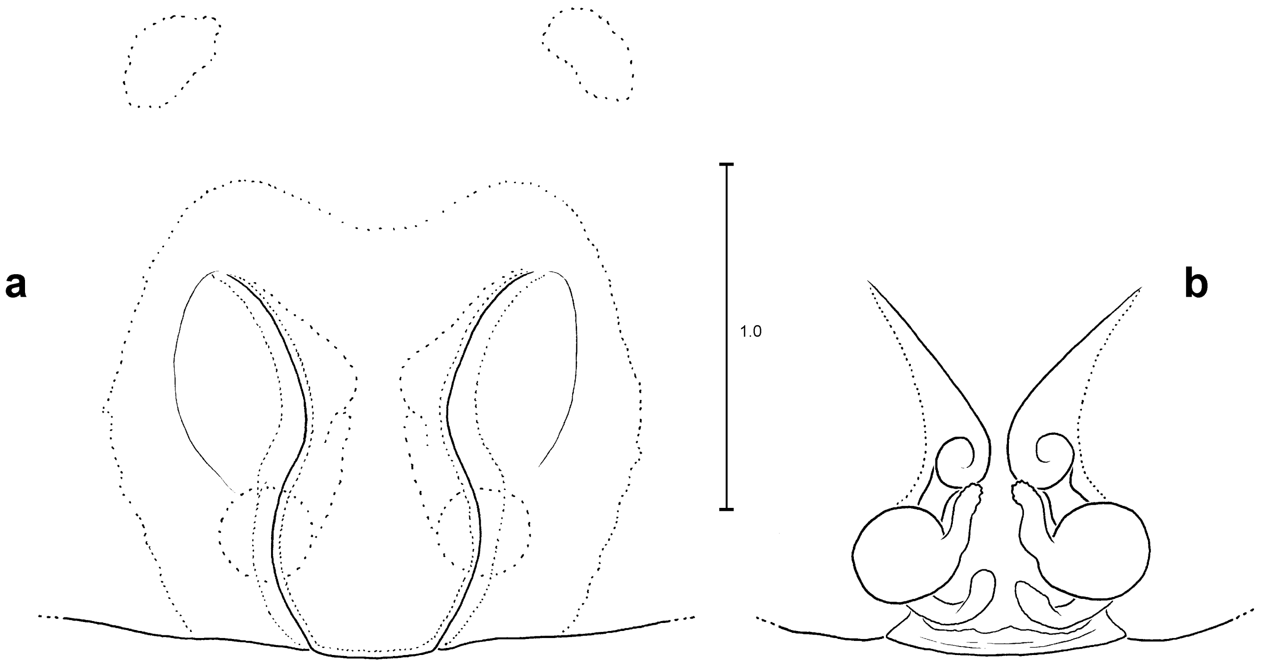
Revised diagnosis (see also diagnosis for *sinensis*-group above)**.** This revised diagnosis is based on the illustrations in Wang and Yin (2001, figs 11–12), which have been reproduced for the present study (Figs 61a–b). Female with S-shaped margins of median septum (MS) diverging anteriorly (Fig. 61a). Vulva similar to *P. tingpingensis* in having twisted copulatory ducts (CD). Distinguished by the larger spermathecae (clearly broader than CD) (Fig. 61b).

Description. Male: unknown.

Female [Holotype ♀ not available on request, thus not examined; Wang and Yin (2001, p. 334,335) listed some measurements, but no spination pattern].

Colouration of female. According to Wang and Yin (2001) light longitudinal line ventrally on opisthosoma broken subdistally, leaving a patch in front of cribellum.

Distribution. China (Fig. 96).



FIGURES 61a–b. *Psechrus jinggangensis*, ♀ holotype from China, Jiangxi Prov. a Epigyne, ventral view. b Vulva, dorsal view. Illustrations reproduced after Wang and Yin (2001).

Psechrus senoculatus Yin, Wang & Zhang, 1985

Figs 62a–d, 63a–g, 82q, 86e, 89g, 92g, 93b

Psechrus senoculata Yin, Wang & Zhang 1985: 21, figs 2A–J (Description of ♂ and ♀, illustration of ♂ and ♀). [Holotype ♀ from CHINA: Hunan Province: Sangzhi; Y.J. Zhang leg. 21.IV.1984; HBI; Paratypes: 1 ♂ (SB 537), CHINA: Hunan Province: Daiyong, Zhangjiajian, Mt. Zhengjaijie; Y.J. Zhang leg. 20.IX.1984; HBI; 1 ♂, 1♀, CHINA: Zhejiang Province: Hangzhou, Huanglongdong; Z.F. Chen leg. 16.V.1983; HBI; 2 ♀♀ (one of which SB 538), CHINA: Hunan Province: Chengbu; X.C. Ouyang leg. VII.1982; HBI, one paratype ♂ (SB 537) and one paratype ♀ (SB 538) examined, holotype and remaining paratypes not available on request, thus not examined]. Song 1988: 133 (Syn. with *P. mimus*). Feng 1990: 33, figs 8.1–5 (Description of ♂ and ♀, illustration of ♂ and ♀). Wang and Yin 2001: 330, 336, figs 19–23 (Description of ♂ and ♀, illustration of ♂ and ♀, removed from syn. with *P. mimus*).

Note: The ♂ paratype SB 537 was originally designated as ‘Allotype’, a term which is not “vorgesehen” (intended, destined) by the ‘International Code of Zoological Nomenclature’, which means the code strongly recommends avoiding its use. It definitely does not consitute a name-bearing type, thus herein it is regarded as paratype.

Psechrus argentatus — Lendl 1898: 561, misidentified.

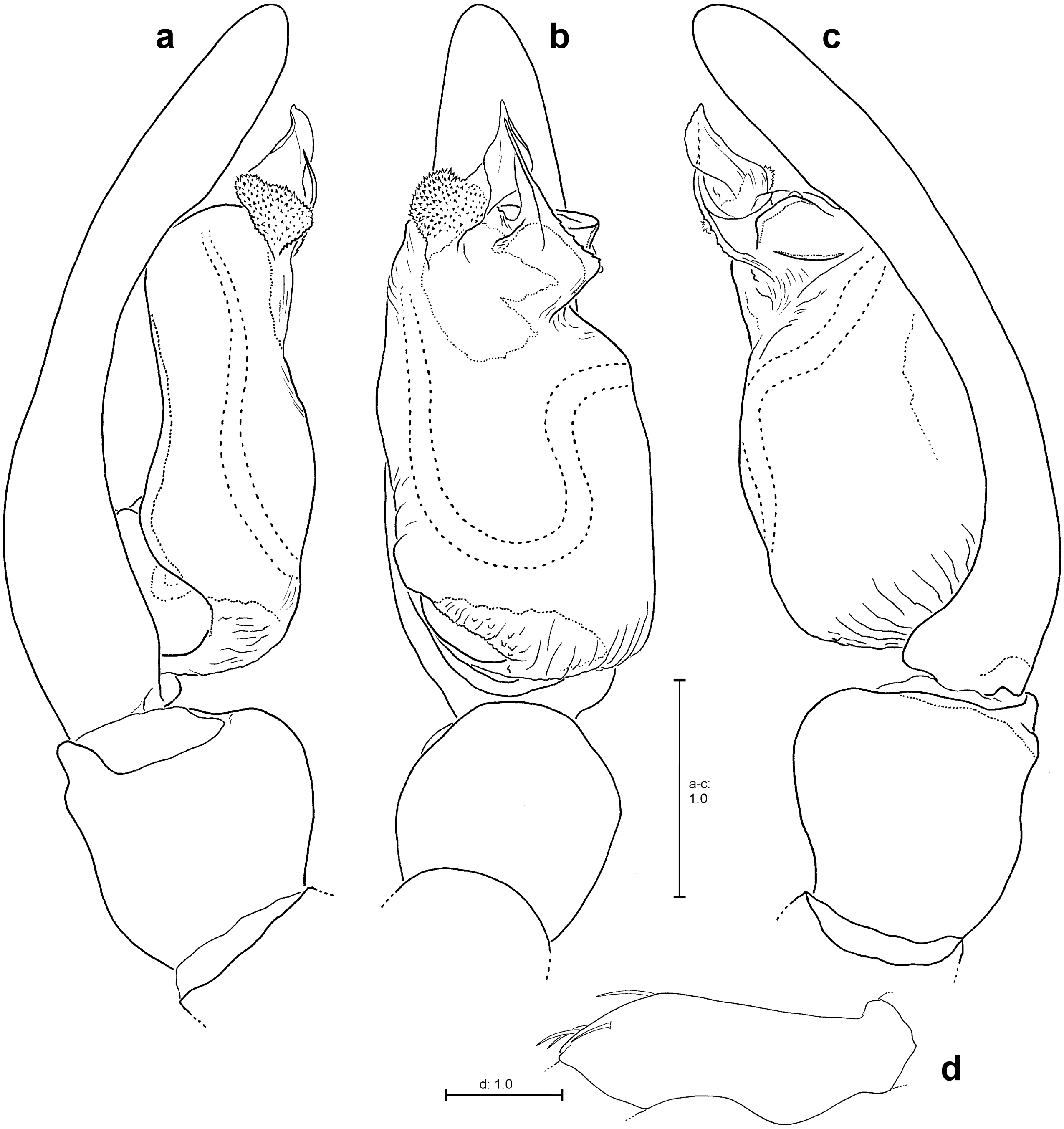
Psechrus mimus — Xu and Wang 1983: 35, figs 1–7 (Description of ♂ and ♀, illustration of ♂ and ♀). Song 1987: 68, fig. 34 (Illustration of ♂ and ♀). Chen and Zhang 1991: 40, figs 31.1–4 (Illustration of ♂ and ♀). Song *et al.* 1999: 397, figs 232E–F, Q–R (Illustration of ♂ and ♀). Wang and Yin 2001: 337 (Considered *P. mimus* as numen dubium).

Psechrus sinensis — Hu 1984: 55, figs 50.1–4 (Description of ♂ and ♀, illustration of ♂ and ♀, misidentified). Chen and Gao 1990: 25, figs 27a–b (Description of ♂ and ♀, illustration of ♂ and ♀, misidentified).

Psechrus senoculatus — Platnick 1989: 429 (Emendation). Zhang 2011: 106 (Photos of dorsal and ventral habitus of ♀). Zhu and Zhang 2011: 333, figs 241A–B (Description of ♀, illustration of ♀ in reproducing the respective figures in Wang and Yin [2001: 337, figs 22–23]).

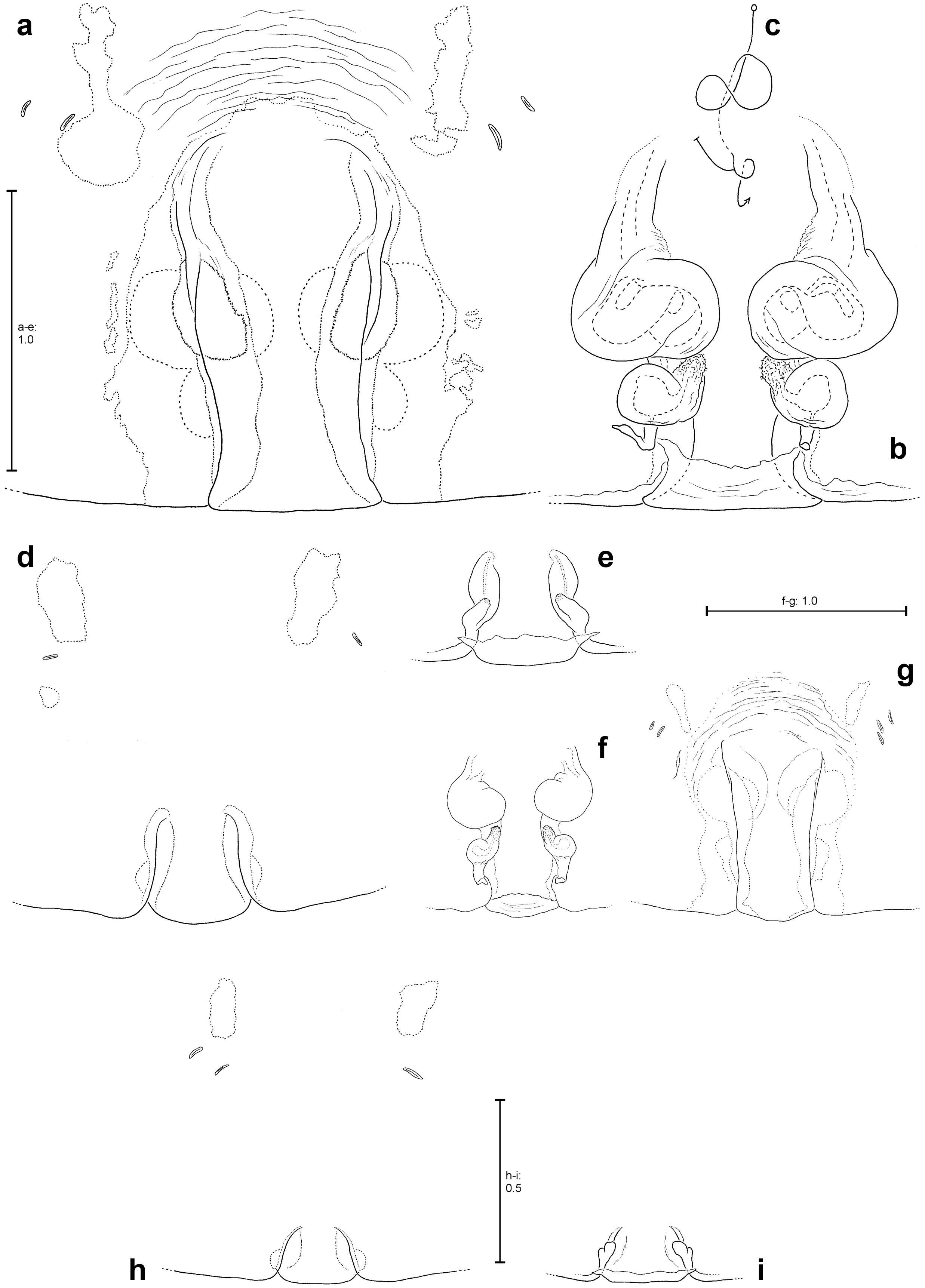
Additional material examined (5 ♂♂, 15 ♀♀, 5 s.a. ♀♀, 1 s.a. ♂)**. CHINA: Shaanxi Province:** Zhouzhi, Louguantai National Forest Park; X.P. Wang leg. VI.1991; 3 ♂♂ (SB 1164–1166), 3 ♀♀ (SB 1167–1169), AMNH. **Sichuan Province:** Yachow (Dazhou?), 800–2400 m; D.C. Graham leg. V.1928; 1 s.a. ♀ (SB 605), USNM. Mt. on the Shiao Shiang Fisa (Ziyang?), 1950–3300 m; D.C. Graham leg. 22.–23.VII.1928; 1 ♀ (SB 178), USNM. Ya’an, Omihsien (Mt. Omi), ca. N°29°29'–29°35', E 102°44'–103°02', 1400–3100 m; IV.–10.V.1915; Coll. Dr. Weigold; 1 ♀ (SB 886), ZMB. Chunqing, Jinyunshan; X.P. Wang leg. 26.IX.1997; 1 ♀ (SB1170), AMNH. Eimei, Eimei Shan, Wannian Temple, N 29°34'53", E 103°22'56", 1000 m; P. Jäger leg. by night 20.–21.III.1999; 2 s.a. ♀♀ (SB 840, 842), 1 s.a. ♂ (SB 841), SMF. Shuifu (forest beyond the river), ca. 300 m; D.C. Graham leg. V.1924; 1 ♀ (SB 189), 1 s.a. ♀ (SB 190), USNM. Same data as above but leg. 1923; 1 s.a. ♀ (SB 604), USNM. **Hubei Province:**

Wudangshan, from Zixiao to Nanya; X.P. Wang leg. 23.IX.1997; 1 ♂ (SB 1148), 4 ♀♀ (SB 1149, 1171–1173), AMNH. **Jiangsu Province:** Nanjing; leg. before 1928; S-No. 25; 1 ♀ (SB 236), NHM 1928·3·16·1–34. **Hunan Province:** Linwu County, Nanqiang country, Dengjia, Wuming hole, N 25°26'22", E 112°59'08.4", 282 m; X. Xu, Z.Q. Zhou, X.P. Tan & X.G. Hu leg. 02.XI.2008; 2 ♀♀ (SB 9–10), SMF. **Guizhou Province:** Zunyi; X.P. Wang leg. 22.IX.1997; 1 ♀ (SB 1163), AMNH. Kaili; X.P. Wang leg. 03.X.1997; 1 ♂ (SB 1174), 1 ♀ (SB 1175), AMNH.



FIGURES 62a–d. *Psechrus senoculatus*, ♂ paratype SB 537 from China, Hunan Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

Revised diagnosis (see also diagnosis for *sinensis*-group above)**.** Males with hemispherical bulge at basal half of conductor (C) (Fig. 62b). Dorsal part of embolus base (EB) platform-like (Fig. 62b). Females with strongly elongated median septum (MS) (ca. 2 times longer than broad). The latter broadest in the anterior half (Fig. 63a). Lateral margins of MS anteriorly not distinctly diverging like in *P. jinggangensis* (in many specimens even converging). Initial section of copulatory duct (CD) long and straight, central and distal section of CD including (constituting) a voluminous extension (Fig. 63b).



FIGURES 63a–i. *Psechrus* spp., ♀ adult and primordial copulatory organs. a–g *Psechrus senoculatus.* h–i *Psechrus mimus* (nomen dubium). a–c ♀ paratype SB 538 of *Psechrus senoculatus* from China, Hunan Prov. d–e s.a. ♀ SB 190 from China, Sichuan Prov. f–g ♀ SB 236 from China, Jiangsu Prov. h–i p.s.a. ♀ holotype SB 191 of *Psechrus mimus* from China, Jiangsu Prov. a, g Epigyne, ventral view. b, f Vulva, dorsal view. c Schematic course of internal duct system. d Pre-epigyne, ventral view. e Pre-vulva, dorsal view. h Pre-pre-epigyne, ventral view. i Pre-pre-vulva, dorsal view.

Description. Male:

Body and eye measurements. Carapace length 7.2, carapace width 5.0, anterior width of carapace 3.0, opisthosoma length 9.2, opisthosoma width 4.2. Eyes: AME 0.36, ALE 0.41, PME 0.44, PLE 0.44, AME–AME 0.18, AME–ALE 0.06, PME–PME 0.29, PME–PLE 0.40, AME–PME 0.58, ALE–PLE 0.52, clypeus height at AME 0.93, clypeus height at ALE 0.90.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 9.6 [3.3, 1.6, 1.2, 3.5]; Legs: I 62.6 [16.4, 3.1, 16.8, 18.2, 8.1], II 48.9 [13.3, 3.0, 12.7, 13.8, 6.1], III 32.7 [9.7, 2.3, 7.7, 8.9, 4.1], IV 48.7 [13.2, 2.7, 12.2, 14.3, 6.3]. Spination. Palp: 131, 000, 0000; legs: femur I 625{333}, II 526{536}, III 535, IV 534; patella I–IV 000; tibia I 3036{4036}, II 3036{2023}, III 2022, IV 3034; metatarsus I 3037, II–III 3035, IV 3037.

Palpal femur ventrally modified with rounded bulge (Fig. 62d).

Copulatory organ (see also diagnosis and general description for *sinensis*-group). Ventral part of EB dorsally serrated (Fig. 62b). Sperm duct with transversal section in retrolateral half of T and with loop in prolateral half. Palpal tibia very short (Figs 62a–c).

Female:

Body and eye measurements. Carapace length 6.0–7.6, carapace width 3.9–5.4, anterior width of carapace 2.6–3.5, opisthosoma length 7.5–11.8, opisthosoma width 2.8–6.3. Eyes: AME 0.31–0.37, ALE 0.37–0.41, PME 0.38–0.43, PLE 0.38–0.40, AME–AME 0.17–0.20, AME–ALE 0.08–0.11, PME–PME 0.20–0.28, PME–PLE 0.36–0.44, AME–PME 0.51–0.66, ALE–PLE 0.37–0.57, clypeus height at AME 0.59–0.83, clypeus height at ALE 0.58–0.81.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.5–9.2 [2.5–3.1, 1.1–1.2, 1.4–1.6, 2.5–3.3]; Legs: I 37.0–45.9 [10.2–12.5, 2.5–3.1, 10.4–13.1, 9.3–11.7, 4.6–5.5], II 29.4–36.6 [8.6–10.5, 2.2–2.8, 7.7–9.7, 7.1–9.3, 3.8–4.3], III 20.8–26.9 [6.3–8.0, 1.7–2.1, 5.1–6.3, 4.9–6.3, 2.8–3.2], IV 30.5–38.0 [8.9–10.9, 2.0–2.5, 7.9–10.1, 7.5–9.8, 4.2–4.7].

Palpal claw with 13–15 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs (—except for patella— variable, only most common states noted): femur I 526 (536), II 526 (546), III 545 (555), IV 544 (554); patella I–IV 000; tibia I–II 3036 (4035), III 3036 (3024,3035), IV 3034; metatarsus I 3035 (3037), II 3035 (3025), III 3034 (2034), IV 3034 (3024).

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Slit sense organs and epigynal muscle sigilla outside epigynal field (EF) (Fig. 63a). Bulbous parts of CD broader than long (Fig. 63b) and clearly larger than receptacula.

Primordial copulatory organ. Pre-epigyne: Similar to *P. clavis* **sp. nov.** in shape of pre-MS. The latter longer than broad and with (almost) parallel margins (Fig. 63d). Distinguished by the even longer pre-MS (Fig. 63d). Pre-vulva: Similar to *P. clavis* **sp. nov.** Distinguished by the longer pre-CD (Fig. 63e).

Colouration of male and female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace not serrated. Lateral bands either absent or extremely narrow (if present, at most 0.3 diameter of PME) and not serrated. Light longitudinal line ventrally on opisthosoma mostly broken subdistally, rarely strongly constricted subdistally and medium-sized to broad. If measured centrally on opisthosoma, its width is slightly less than the width of one half of the cribellum (ca. 0.7–0.9 of one half of the cribellum). Distal part (patch) broader than main section.

Variation of copulatory organs. The females examined show a few variations in epigynal characters (Figs 63a,g, 89g). In vulvae the lengths of CD may vary (Figs 63b,f, 92g), as well as the shape of the bulbous sections of CD (Figs 63b,f, 92g).

Remarks: Song (1988) considered *P. senoculatus* as junior synonym of *P. mimus* Chamberlin, 1924. Wang and Yin (2001) removed *P. senoculatus* from synonymy and considered *P. mimus* as nomen dubium. I concur with Wang and Yin (2001), but to this see also remark below under “Nomen dubium: *P. mimus*”.

Lendl (1898) reported *Psechrus argentatus* from “China, Prov. Se-tschuen” [today: CHINA: Sichuan Prov.] and stated it was a juvenile specimen. Even though I have not checked the respective specimen, which is deposited in HNHM and was not available for the present study, there are no doubts that it once had been misidentified. To date *P. argentatus* had never been found outside Indonesia and Papua New Guinea. On the other hand, to date no other *Psechrus* species than *P. senoculatus* had been found in Sichuan province of China.

Zhang (2011, p. 106) showed photos of dorsal and ventral habitus of a female *Psechrus* he had identified as *P. senoculatus*. One should have in mind that an identification only by colouration is not possible as there are no differences to other *Psechrus* species out of the *sinensis*-group in this respect. Identification is only possible by checking the specific characters of the copulatory organs.

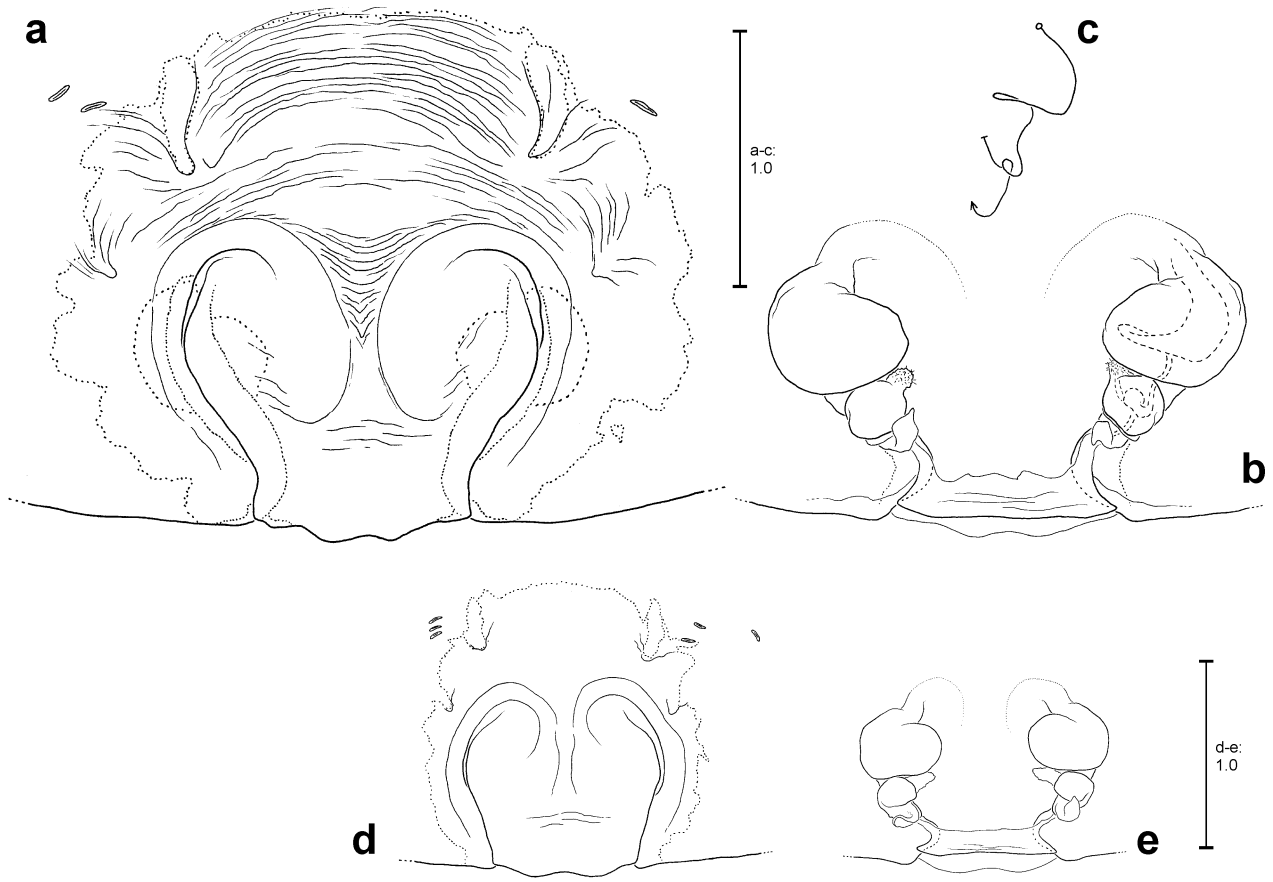
Distribution. China (Fig. 96).

Psechrus kenting **Yoshida, 2009**

Figs 64a–e, 82c, 89i, 92i

Psechrus kenting Yoshida 2009: 9, figs 11–13 (Description of ♀, illustration of ♀). [Holotype ♀ (SB 615) from TAIWAN: Pingtung county: Kenting, ca. N 22°00', E 120°45'; H. Yoshida leg. 13.VII.1977; NMST 8381; Paratypes: 1 ♀, with same data as for holotype; no statement concerning deposition; 1 ♀ (SB 618), TAIWAN: Taitung county: Chihpen spa., ca. N 22°42', E 121°00'; H. Yoshida leg. 17.VII.1977; NMST 8382, all type material examined, except for the paratype ♀ without statement concerning deposition].

Revised diagnosis (see also diagnosis for *sinensis*-group above)**.** Females very similar to *P. taiwanensis* Wang & Yin, 2001 in having a relatively broad median septum (MS) (as broad as long, or slightly broader than long) (Figs 64a,d, 65a), narrow and curved initial sections of copulatory ducts (CD) and the bulbous sections of CD in contact with the receptacula (Fig. 64b,e, 65b). Distinguished by the posteriorly narrower MS (Figs 64a,d), the slightly shorter bulbous sections of CD and the spermathecal heads (SH) with shorter stalks (Figs 64b,e).



FIGURES 64a–e. *Psechrus kenting*, ♀ copulatory organ. a–c ♀ holotype SB 615 from Taiwan, Pingtung County. d–e ♀ paratype SB 618 from Taiwan, Taitung County. a, d Epigyne, ventral view. b, e Vulva, dorsal view. c Schematic course of internal duct system.

Description. Male: unknown.

Female (measurements of holotype first, those of paratype in parentheses)**:**

Body and eye measurements. Carapace length 10.1 (7.7), carapace width 6.9 (5.2), anterior width of carapace 4.5 (3.4), opisthosoma length 14.1 (12.5), opisthosoma width 8.3 (7.2). Eyes: AME 0.45 (0.39), ALE 0.55 (0.45), PME 0.54 (0.45), PLE 0.55 (0.46), AME–AME 0.28 (0.18), AME–ALE 0.08 (0.06), PME–PME 0.36 (0.32), PME–PLE 0.55 (0.51), AME–PME 0.88 (0.68), ALE–PLE 0.64 (0.52), clypeus height at AME 1.83 (1.20), clypeus height at ALE 1.78 (1.14).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243 (1423). Palp: 11.4 (9.6) [4.1 (3.4), 1.7 (1.3), 2.0 (1.8), 3.6 (3.1)]; Legs: I 55.8 (46.0) [15.3 (12.5), 4.2 (3.4), 15.9 (12.6), 14.1 (12.0), 6.3 (5.5)], II 44.6 (36.1) [13.0 (10.0), 4.0 (3.1), 11.7 (9.5), 11.0 (9.3), 4.9 (4.2)], III 30.9 (25.4) [9.2 (7.6), 2.9 (2.4), 7.6 (5.9), 7.7 (6.5), 3.5 (3.0)], IV 44.5 (36.4) [13.5 (10.5), 3.5 (2.8), 11.6 (9.4), 11.0 (9.4), 4.9 (4.4)].

Palpal claw with 14 teeth.

Spination. Palp: 131 (131), 110 (110), 1101{1201} (1101), 1014 (1014); legs: femur I 556 (546), II 556 (546), III 556 (545), IV 376{385} (544{554}); patella I–IV 000; tibia I–II 3038 (3038), III 3038{3036} (2026{2036}), IV 3037{2037} (3036{2036}); metatarsus I–IV 3035 (3035).

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Epigynal muscle sigilla included in epigynal field (EF), slit sense organs located outside EF (Figs 64a,d). Receptacula clearly smaller than bulbous sections of CD (Fig. 64b).

Colouration of female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace slightly serrated. Lateral bands absent (Fig. 82c). Light longitudinal line ventrally on opisthosoma strongly constricted subdistally and broad. If measured centrally on opisthosoma, its width is 0.7–1.3 the width of one half of the cribellum. Distal part (patch) broader than main section.

Variation of copulatory organs. Median septum in paratype SB 618 anteriorly (Fig. 64d) clearly narrower than in holotype. EF in SB 618 narrower than in holotype. Distance between bulbous sections of CD narrower in SB 618 (Fig. 64e). Spermathecal heads directed anterio-medially in holotype (Fig. 64b), medially in SB 618 (Fig. 64e).

Remarks: This species differs only slightly from *P. taiwanensis*. The alleged clear differences in epigynal shapes of the holotypes of *P. kenting* and *P. taiwanensis* have to be put into perspective as the paratype ♀ SB 618 (Fig. 64d, 89i) of *P. kenting* shows intermediate charatcer features of median septum. Vulva characters differ just marginally. It cannot be excluded that these differences fall into the range of intraspecific variation of one single species, which would mean that *P. kenting* should be synonymised with *P. taiwanensis*. However, according to the material available, there is no evidence for that. More material, also males, from (Southern) Taiwan is necessary to clarify this.

Distribution. Taiwan (Fig. 97).

Psechrus taiwanensis **Wang & Yin, 2001**

Figs 65a–c, 89j, 92j

Psechrus taiwanensis Wang and Yin 2001: 340, figs 29–30 (Description of ♀, illustration of ♀). [Holotype ♀ (SB 238) from TAIWAN (‘Formosa’); A.P. Holst leg. 1893–1894; NHM 1894·7·11·2, examined]. Ono 2009: 140, figs 2.2.24.1–3 (Non description & illustration of ♀, misidentified, see *P. clavis* **sp. nov.**). Yoshida 2009: 7, figs 1–7 (Non description & illustration of ♂ and ♀, misidentified, see *P. clavis* **sp. nov.**).

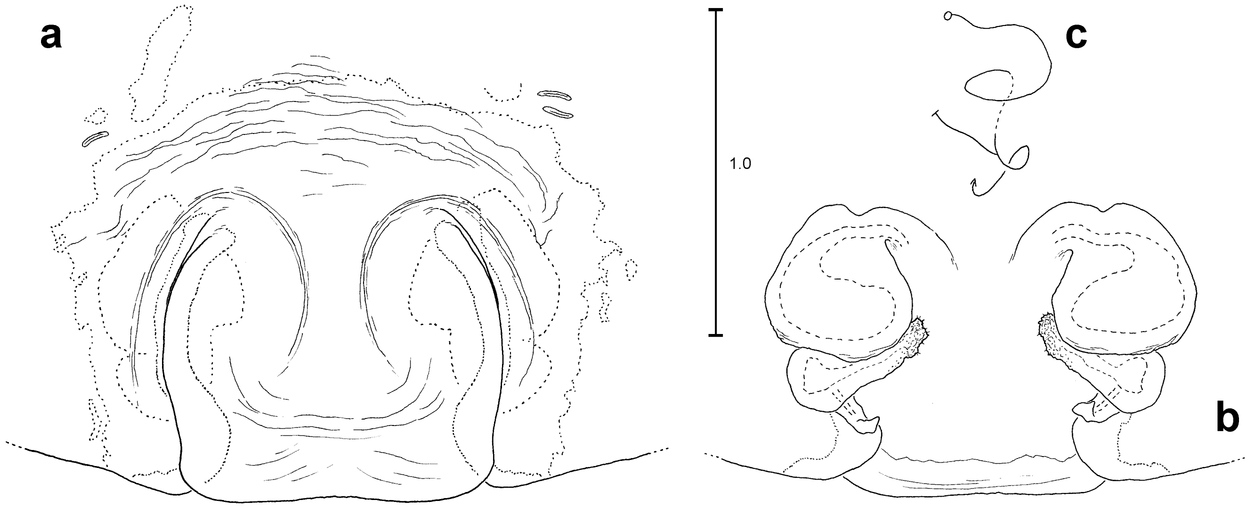
Note on holotype: In an ornithological publication La Touche (1895) stated that A.P. Holst —also an ornithologist— stayed mainly in the Southern part of Formosa (Taiwan) and about ten days in Kamana. This was a former station of English missionaries, presently Cishan in Tainan county. Possibly he had collected the female *Psechrus* specimen there.

Psechrus torvus — Lee 1966: 18, figs 3e–g (Description of ♂ and ♀, illustration of ♂ and ♀, misidentified). Hu 1984: 57, figs 51.1–3 (Description of ♂ and ♀, illustration of ♂ and ♀ after Lee 1966, misidentified).

Psechrus sinensis — Levi 1982: 123, figs 34–39, ad part, figs 36–39 misidentified (Description of ♀, figs 38–39: illustration of ♀).

Revised diagnosis (see also diagnosis for *sinensis*-group above)**.** Female very similar to *P. kenting* in having a relatively broad median septum (MS) (slightly broader than long) (Fig. 65a), narrow and curved initial sections of copulatory ducts (CD) and the bulbous sections of CD in contact with the receptacula (Fig. 65b). Distinguished by the posteriorly broader MS (Fig. 65a), the slightly longer bulbous sections of CD exhibiting a small bulge anteriorly and the spermathecal heads with longer stalks. Additionally, in *P. taiwanensis* receptacula partly covered by CD (Fig. 65b).

Description. Male: unknown.



FIGURES 65a–c. *Psechrus taiwanensis*, ♀ holotype SB 238 from Taiwan (Tainan County?). a Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system.

Female:

Body and eye measurements. Carapace length 9.6, carapace width 6.6, anterior width of carapace 3.9, opisthosoma length 12.5, opisthosoma width 6.1. Eyes: AME 0.48, ALE 0.51, PME 0.50, PLE 0.51, AME–AME 0.27, AME–ALE 0.08, PME–PME 0.35, PME–PLE 0.45, AME–PME 0.69, ALE–PLE 0.53, clypeus height at AME 1.37, clypeus height at ALE 1.30.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 11.0 [3.9, 1.6, 2.0, 3.5]; Legs: I 52.8 [13.9, 4.1, 14.6, 14.1, 6.1], II 42.2 [12.3, 3.7, 11.0, 10.7, 4.9], III 29.8 [9.1, 2.8, 6.9, 7.5, 3.5], IV 41.0 [12.1, 3.2, 10.2, 10.5, 5.0].

Palpal claw with 16 teeth.

Spination. Palp: 141, 110, 1101, 1014; legs: femur I 646, II 546, III 545, IV 544; patella I–IV 000; tibia I–II 3038, III 3036, IV 3037{30310}; metatarsus I–III 3035, IV 3037.

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Epigynal muscle sigilla and slit sense organs outside epigynal field (EF), but close by (Fig. 65a). As well as in *P. kenting* receptacula clearly smaller than bulbous sections of CD (Fig. 65b).

Colouration of female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace not serrated. Lateral bands very narrow (ca. 0.3 diameter of PME). Light longitudinal line ventrally on opisthosoma broken subdistally and medium-sized to broad. If measured centrally on opisthosoma, its width is ca. 0.7 the width of one half of the cribellum. Distal patch broader than main section.

Remarks: Lee (1966) reported *P. torvus* from Taiwan. According to his illustrations (Lee 1966, figs 3e–g) the specimens he had examined were definitely not *P. torvus* and might be *P. taiwanensis*. Unfortunately, there is no statement about deposition of the respective material. Since his illustrations are not really informative (too small, details of embolus and conductor of bulb not recognisable, vulva not illustrated) it cannot be clarified if he examined *P. taiwanensis*. According to his illustration of the epigyne (fig. 3.f) it is at least more likely that it was *P. taiwanensis* than *P. clavis* **sp. nov.** or *P. kenting*. The two latter species are also distributed throughout Taiwan.

Distribution. Taiwan (Fig. 97).

Psechrus clavis sp. nov.

Figs 66a–e, 67a–j, 86f, 89h, 92h

Psechrus torvus — Kayashima 1962: 9, figs 1–4 (Description of ♀, illustration of ♀, misidentified).

Psechrus sp. — Yoshida 1978: 24, fig. 2 (Illustration of ♂).

Psechrus sinensis — Chen 1996: 134 (Listed as fauna element of Taiwan, misidentified). Chen 1999: 426, 427, 431,

misidentified. Chen 2001: 243–244, figs integrated in the text (Photos of dorsal and ventral habitus of ♂, misidentified).
Psechrus taiwanensis — Ono 2009: 140, figs 2.2.24.1–3 (Description of ♀, illustration of ♀, misidentified). Yoshida 2009: 7, figs 1–7 (Description of ♂ and ♀, illustration of ♂ and ♀, misidentified).

Type material. Holotype ♀ (SB 1021), **TAIWAN: Taichung county:** Dong-Shi (Dongshih), N 24°15'04", E 120°51'03", ca. 450 m, secondary forest; R.C. Cheng leg. XI.2010; SMF. **Paratypes** (2 ♂♂, 7 ♀♀, 4 s.a. ♀♀)**: 1** ♀ (SB 276), **3 s.a.** ♀♀ (SB 1018, 1024, 1027), with same data as for holotype; SMF; **1 s.a.** ♀ (SB 276), **TAIWAN: Taichung county:** Wushihkeng, N 24°16'30", E 120°56'56", 950–1000 m, mixture of broadleaf forest and plantation forest, edge of a trail; R.C. Cheng leg. IX.2009; SMF; **1** ♀ (SB 614), **TAIWAN: Taoyuan county:** Ssuleng, N 24°37', E 121°23', ca. 1300 m, mountainous forest, bush on rocky surface (roadside); H. Ono leg. 030.X.2003; NSMT 8507; **1** ♂ (SB 616), **1** ♀ (SB 617), **TAIWAN: Nantou county:** Penpuchi, ca. N 24°00', E 121°05', ca. 800 m; H. Yoshida leg. 02.IV.1979; NSMT 8379; **1** ♂ (SB 1008), **1** ♀ (SB 1010), **TAIWAN: Nantou county:** Yuchih (Yu-Chi) township, Lian-Hua-Chih, N 23°55'07", E 120°53'02", ca. 700 m, secondary forest; R.C. Cheng leg. II.2011; SMF; **2** ♀♀ (SB 793, 879), **TAIWAN: Nantou county:** Chitou Forest Recreation Area, ca. N 23°42', E 120°48', ca. 1600 m; J. Haupt leg. 08.IV.2004; ZMB (SB793); H. Yoshida leg. 20.VII.1977; YPM (SB 879, at N 23°41'); **1** ♀ (SB 831), **TAIWAN: Chiayi county:** Alishan; H. Yoshida leg. 11.VII.1977; NSMT 8380.

Additional material examined (1 ♂, 4 ♀♀, 6 s.a. ♂♂, 1 p.s.a. ♂, 1 p.s.a. ♀, 2 juvs)**. TAIWAN: Taipei City:** Yangmingshan; H. Yoshida leg. 07.IV.1979; 2 ♀♀ (SB 877–878), YPM. **Miaoli county:** Kuan-Wu, N 24°24'20", E 120°58'32", ca. 1200 m, secondary forest; R.C. Cheng leg. XI.2009; 1 s.a. ♂ (SB 1011), 1 p.s.a. ♂ (SB 1012), SMF. **Taichung county:** Wushihkeng, N 24°16'30", E 120°56'56", 950–1000 m, mixture of broadleaf forest and plantation forest, edge of a trail; R.C. Cheng leg. IX.2009; 2 juvs (SB 277–278), SMF. Dong-Shi (Dongshih), N 24°15'04", E 120°51'03", ca. 450 m, secondary forest; R.C. Cheng leg. XI.2010; 4 s.a. ♂♂ (SB 1019, 1022–1023, 1026), 1 p.s.a. ♀ (SB 1020), SMF. **Nantou county:** Tsuifeng, ca. N 24°06', E 121°12', ca. 2200 m; H. Yoshida leg. 23.VII.1977; 1 ♂ (SB 876), YPM. Yuchih (Yu-Chi) township, Lian-Hua-Chih, N 23°55'07", E 120°53'02", ca. 700 m, secondary forest; R.C. Cheng leg. II.2011; 1 s.a. ♂ (SB 1009), SMF. Meichi; H. Yoshida leg. 30.III.1979; 1 ♀ (SB 619), NSMT 8377. **Chiayi county:** Alishan; H. Yoshida leg. 11.VII.1977; 1 ♀ (SB 880), YPM.

Etymology. The specific name refers to the similarity of the epigynal median septum of the female type specimens with a keyhole (Latin “clavis” means “key, lock, keyhole”); term (noun) in apposition.

Diagnosis (see also diagnosis for *sinensis*-group above)**.** Males with relatively simple embolus base (EB), without apophyses or special structures, except a few ridges (Fig. 66c). Tegulum (T) protruding baso-retrolaterally (Fig. 66b). Palpal femur only with very indistinct ventral modification (Fig. 66d), almost not recognisable as such. Epigyne of females similar to *P. senoculatus* in having elongated median septum (MS) broadest in anterior half. Distinguished by the shorter MS (at most 1.5x longer than broad) (Fig.67a). Vulva with initial section of copulatory duct (CD) already included in kidney-shaped bulbous section (Fig. 67b). The latter clearly longer than broad and not in direct contact with the spermathecae.

Description. Male:

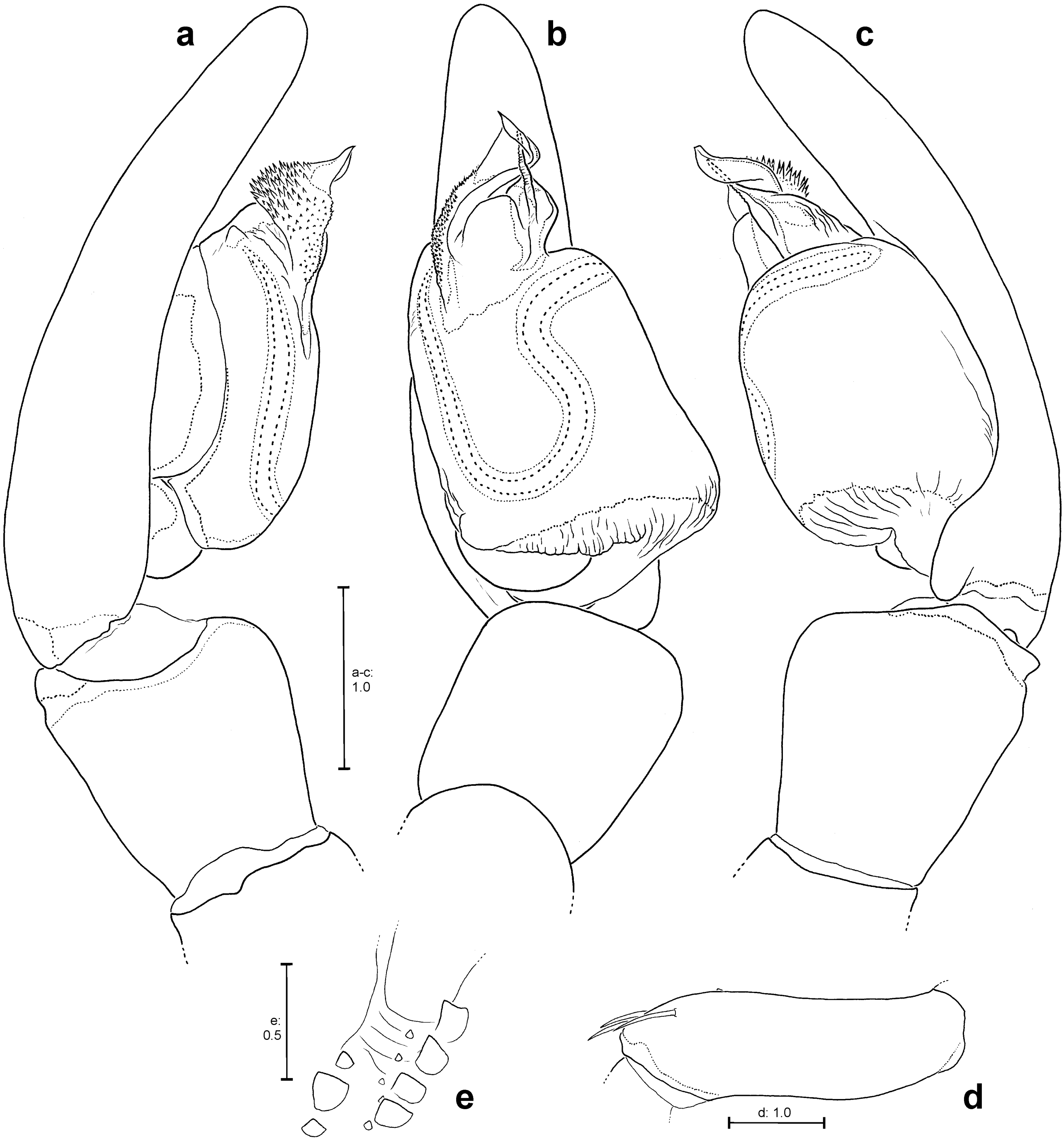
Body and eye measurements. Carapace length 6.3–10.2, carapace width 4.3–7.0, anterior width of carapace 2.7–3.9, opisthosoma length 7.7–11.6, opisthosoma width 4.6–6.1. Eyes: AME 0.31–0.41, ALE 0.38–0.49, PME 0.39–0.51, PLE 0.38–0.51, AME–AME 0.18–0.27, AME–ALE 0.08–0.11, PME–PME 0.28–0.37, PME–PLE 0.39–0.44, AME–PME 0.60–0.76, ALE–PLE 0.43–0.57, clypeus height at AME 0.87–1.20, clypeus height at ALE 0.79–1.15.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 7.4–11.5 [2.7–3.9, 1.2–1.9, 1.1–1.8, 2.4–3.9]; Legs: I 49.2–70.0 [12.7–17.8, 3.0–4.7, 14.1–19.3, 13.5–19.9, 5.9–8.3], II 38.9–52.8 [10.6–14.6, 2.7–4.2, 10.4–13.5, 10.4–14.5, 4.8–6.0], III 27.7–37.6 [8.0–10.7, 2.2–3.3, 6.8–9.4, 7.2–9.8, 3.5–4.4], IV 38.8–52.6 [10.4–14.7, 2.4–3.6, 10.0–13.8, 11.0–14.3, 5.0–6.2].

Spination. Palp: 131 (121), 110(prolateral one small), 1101(all spines small); legs: femur I 546 (546,525), II 546 (546,526) III 545 (545,525,565), IV 544 (544,524); patella I–IV 000; tibia I–II 3038, III 2034 (2034,3034), IV 3036 (3036,3034); metatarsus I–III 3035, IV 3035 (3035,3036).

Copulatory organ (see also diagnosis and general description for *sinensis*-group). Embolus slightly serrated ventrally (Fig. 66b). Conductor apically with folding and dorsally with small spines (Figs 66a–b). Sperm duct with transversal section in retrolateral half of T and with distinct loop in prolateral half. Palpal tibia short (Figs 66a–c).



FIGURES 66a–e. *Psechrus clavis* **sp. nov.** a–d ♂ paratype SB 616 from Taiwan, Nantou County. e s.a. ♂ SB 1026 from Taiwan, Taichung County. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e Left cheliceral furrow, orthogonal view.

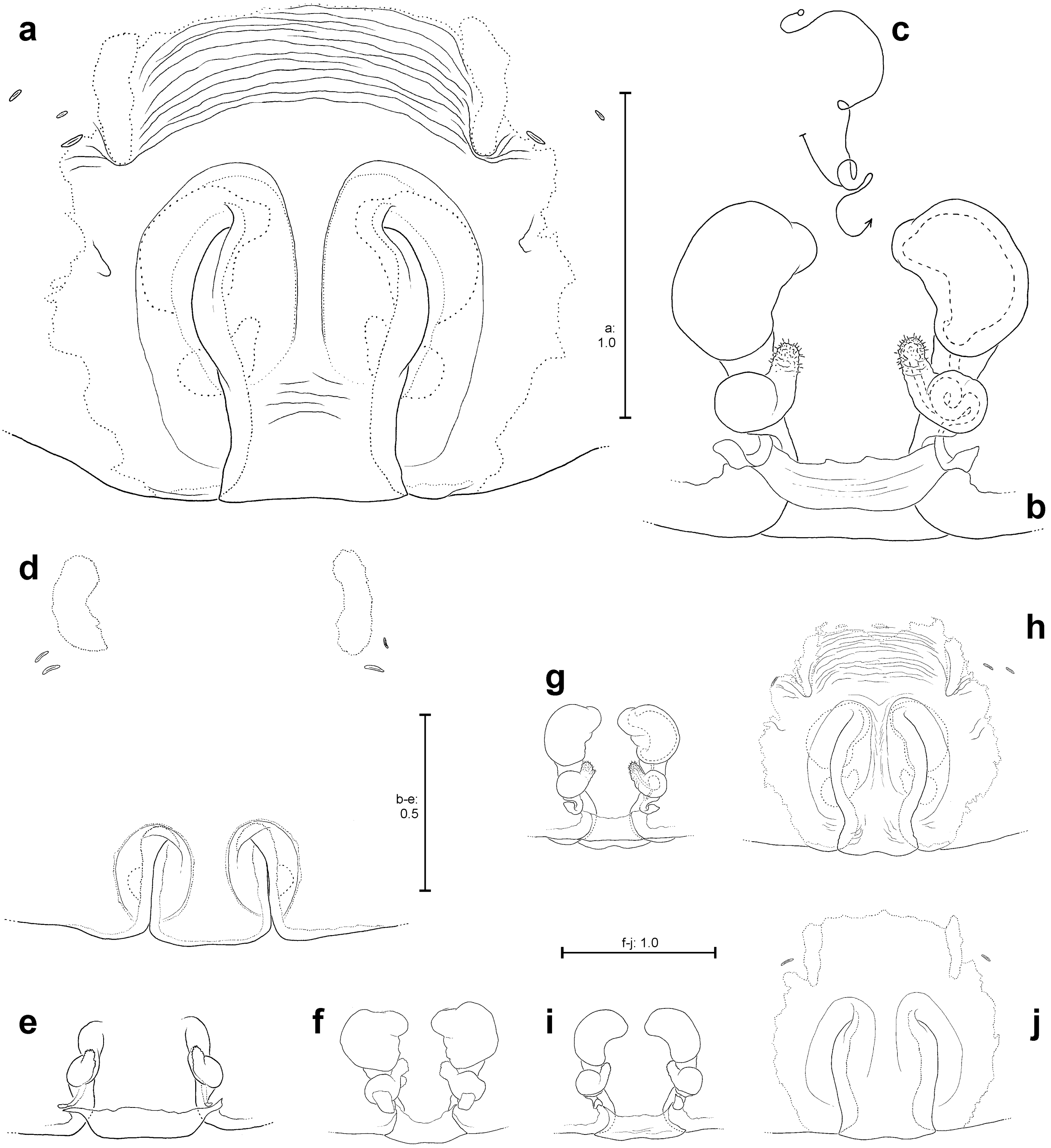
Female (Measurements of holotype first, those of paratype females as range in parentheses).

Body and eye measurements. Carapace length 8.2 (7.2–8.5), carapace width 5.7 (4.7–6.0), anterior width of carapace 3.8 (3.3–3.9), opisthosoma length 9.7 (7.3–11.6), opisthosoma width 3.9 (3.6–6.8). Eyes: AME 0.41 (0.37–0.44), ALE 0.50 (0.46–0.51), PME 0.51 (0.47–0.51), PLE 0.49 (0.46–0.50), AME–AME 0.22 (0.17–0.24), AME–ALE 0.06 (0.05–0.06), PME–PME 0.31 (0.29–0.36), PME–PLE 0.43 (0.40–0.48), AME–PME 0.66 (0.63–0.73), ALE–PLE 0.48 (0.51–0.61), clypeus height at AME 1.03 (0.91–1.05), clypeus height at ALE 1.03 (0.85–1.03).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243 (1243,1423). Palp: 9.4 (9.0–10.2) [3.3 (3.1–3.3), 1.3 (1.2–1.6), 1.7 (1.7–1.9), 3.1 (3.0–3.4)]; Legs: I 48.3 (42.9–48.7) [13.2 (11.7–13.2), 3.6 (3.0–3.6), 13.8 (11.9–13.7), 12.3 (11.1–12.7), 5.4 (5.2–5.7)], II 38.7 (32.6–39.0) [11.3 (9.4–10.8), 3.3 (2.7–3.3), 10.3 (9.2–10.5), 9.4 (8.2–9.8), 4.4 (3.1–4.6)], III 27.2 (24.3–28.1) [8.3 (7.3–8.3), 2.4 (2.2–2.6), 6.6 (6.0–6.9), 6.7 (5.9–7.1), 3.2 (2.9–3.2)], IV 38.3 (34.3–38.9) [11.4 (9.9–11.2), 2.8 (2.3–2.9), 10.1 (9.1–10.2), 9.5 (8.6–9.9), 4.5 (4.3–4.7)].

Palpal claw with 15 (13–15) teeth.



FIGURES 67a–j. *Psechrus clavis* **sp. nov.**, ♀ adult and primordial copulatory organ. a–c ♀ holotype SB 1021, d–e s.a. ♀ paratype SB276, both from Taiwan, Taichung County. g–h ♀ paratype SB 793, i–j ♀ SB 619, both from Taiwan, Nantou County. f ♀ SB 877 from Taiwan, Taipei County. a, h, j Epigyne, ventral view. b, f–g, i Vulva, dorsal view. c Schematic course of internal duct system. d Pre-epigyne, ventral view. e Pre-vulva, dorsal view.

Spination. Palp: 131 (131), 110 (110), 1101 (1101), 1014 (1014); legs (—except for patella— variable, only most common states noted): femur I 546 (536,526), II 546 (546,436,636) III 545 (555,536,445), IV 544 (554,544,434); patella I–II, IV 000 (000), III 000{100} (000); tibia I 3038 (3038), II 3038 (3038,3037), III 2036{2024} (2036,2035,2026), IV 2036 (3036,2036,3027); metatarsus I 3035 (3035), II 3035 (3035,3037), III 3035 (3035), IV 3035 (3035,3025,3036).

Copulatory organ (see also diagnosis and general description of *sinensis*-group). Margins of MS at least slightly S-shaped. Slit sense organs outside and epigynal muscle sigilla within epigynal field (Fig. 67a). Bulbous parts of CD (Figs 67b,i) laterally convex, medially concav, separated from receptacula by a gap.

Primordial copulatory organ. Pre-epigyne: Similar to *P. senoculatus* in shape of pre-MS. The latter (at least slightly) longer than broad and with (almost) parallel margins (Fig. 67d). Distinguished by the shorter pre-MS whose margins anteriorly bordered by transversal edges (Fig. 67d).

Pre-vulva: Similar to *P. senoculatus*. Distinguished by the shorter pre-CD (Fig. 67e).

Colouration of male and female (see also description for *sinensis*-group and *Psechrus*). Median bands on carapace slightly serrated. Lateral bands very narrow (at most 0.7 diameter of PME) and not serrated. Light longitudinal line ventrally on opisthosoma may be broken subdistally or strongly constricted subdistally and broad. If measured centrally on opisthosoma, its width is ca. 0.7–1.2 times the width of one half of the cribellum. Distal part (patch) mostly broader than main section.

Variation of copulatory organs. In males T may be a bit shorter and the spines on C may be more indistinct (not illustrated) than in SB 616 (Figs 66a–c). In females MS may be slightly narrower (Fig. 67h) or broader (Fig. 67j, 89h) than in holotype. Posterior part of MS straight in holotype (Fig. 67a) and very slightly concave medially in SB 793 from Chitou, Nantou County (Fig. 67h). In vulvae the shapes of bulbous section of CD may be broader (Fig. 67f) or narrower (Fig. 67i) than in holotype (Fig. 67b) or in SB 793 from Chitou (Fig. 67g). Spermathecal head in some specimens with additional, small outgrowth (Fig. 67g).

Remarks: Ono (2009) and Yoshida (2009) regarded this species as *P. taiwanensis*. However, a comparison of the females of this new species examined in the present study with the female *P. taiwanensis* holotype, showed that their copulatory organs are clearly different.

Distribution. Taiwan (Fig. 97).

Specimen from *sinensis*-group with doubtful identification

Figs 68a–d

Material examined: TAIWAN: Taipei county: Wulai, N 24°51'51", E 121°33'15", ca. 150 m, secondary forest near bridge across stream; J. Haupt leg. 16.IV.1980; 1 ♂ (SB 792), ZMB 35304.

Description. Male:

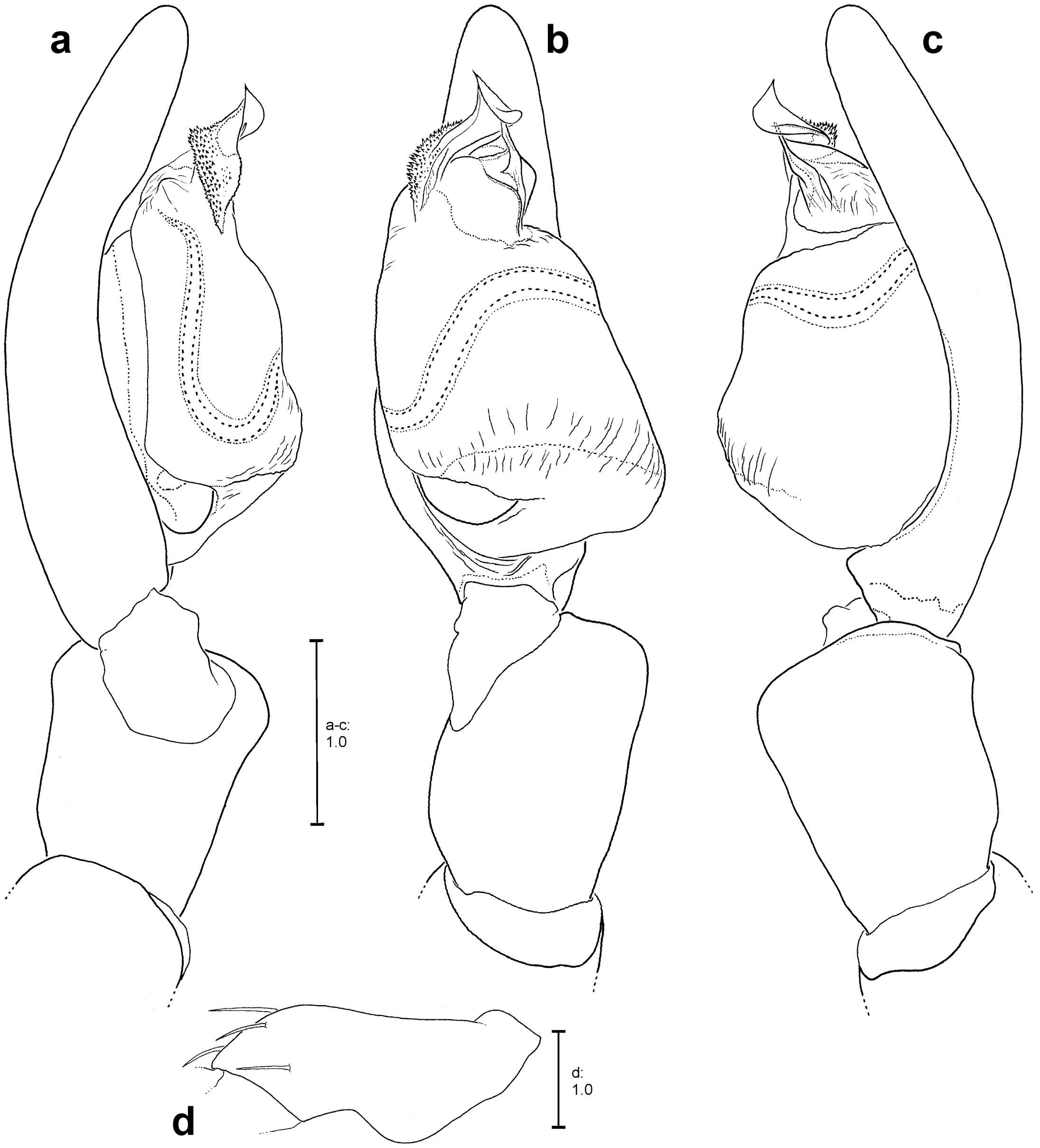
Body and eye measurements. Carapace length 8.3, carapace width 5.5, anterior width of carapace 3.6, opisthosoma length ca. 9.5, opisthosoma width ca. 5.0. Eyes: AME 0.42, ALE 0.48, PME 0.50, PLE 0.49, AME–AME 0.24, AME–ALE 0.06, PME–PME 0.35, PME–PLE 0.42, AME–PME 0.72, ALE–PLE 0.56, clypeus height at AME 0.91, clypeus height at ALE 0.90.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243. Palp: 10.0 [3.4, 1.8, 1.4, 3.4]; Legs: I 59.2 [14.7, 3.9, 15.8, 17.6, 7.2], II 46.3 [12.0, 3.5, 12.1, 13.1, 5.5], III 31.1 [9.0, 2.7, 7.2, 8.5, 3.7], IV 44.5 [11.9, 2.9, 11.4, 12.6, 5.7].
Spination. Palp: 132, 110 (all spines very small), 0000; legs: femur I 536, II 536{535}, III 545, IV 544; patella I–IV 000; tibia I–II 3038, III 2023, IV 2035; metatarsus I–IV 3035.

Palpal femur modified with strongly protruding rounded ventral bulge (Fig. 68d), similar to the one in *P. tingpingensis*.

Remark: According to the male palp structures (Fig. 68a–c) this specimen is similar to *P. clavis* **sp. nov.** Differences are: Palpal femur with distinct modification (Fig. 68d); embolus slightly shorter; prolateral 'loop' of sperm duct less distinct; tegulum with basal protrusion (Figs 68a,c); Conductor apically with slightly different folding (Figs 68a–c). Thus, this specimen either belongs to a new species or it may be conspecific with one of the two other *Psechrus* species appearing in Taiwan, *P. taiwanensis* or *P. kenting*, which are known only from females. Due to the lack of material of *P. taiwanensis* and *P. kenting* this question cannot be solved at the moment.



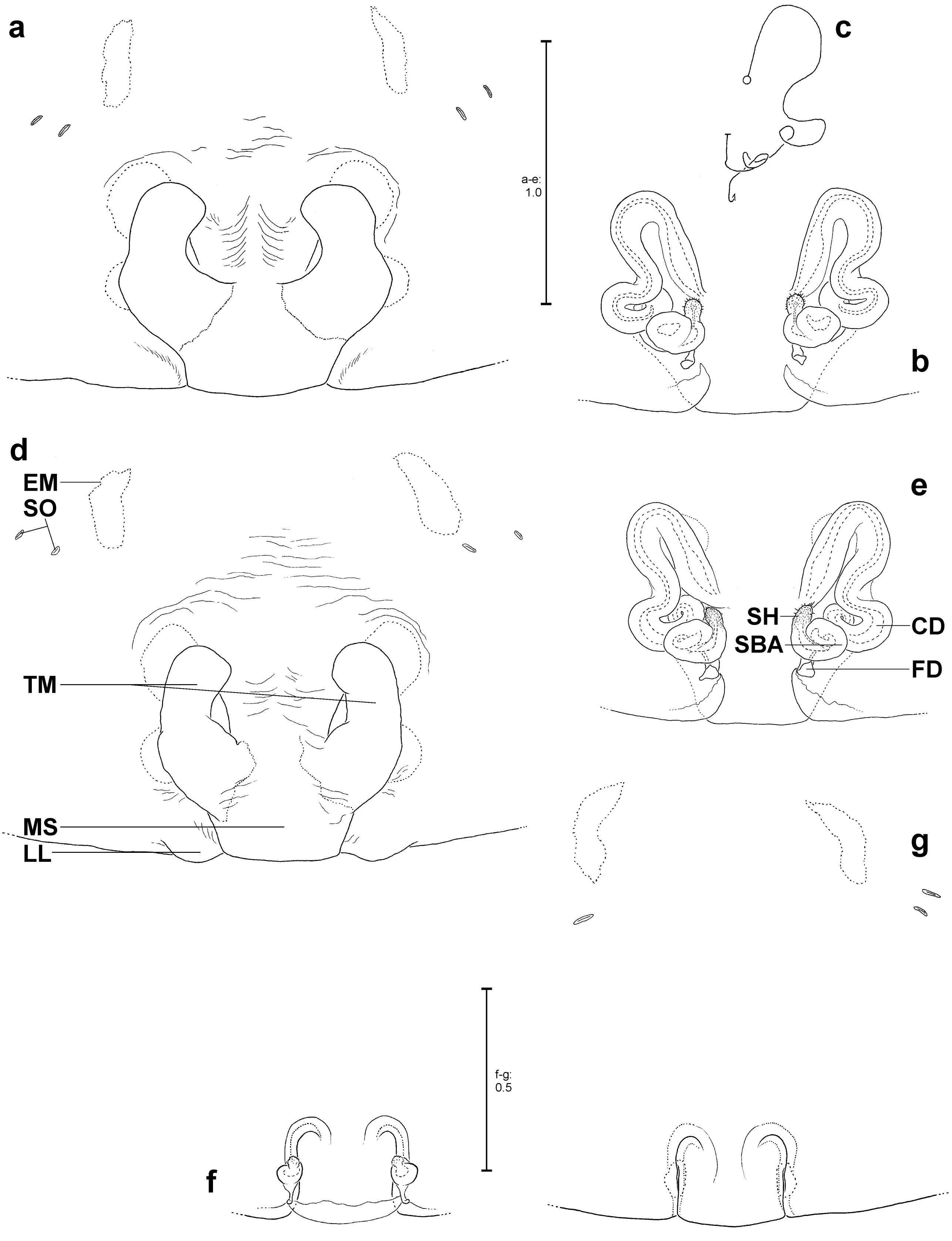
FIGURES 68a–d. *Psechrus* ♂ SB 792 [out of *sinensis*-group] with doubtful identification from Taiwan, Taipei County. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

torvus-group

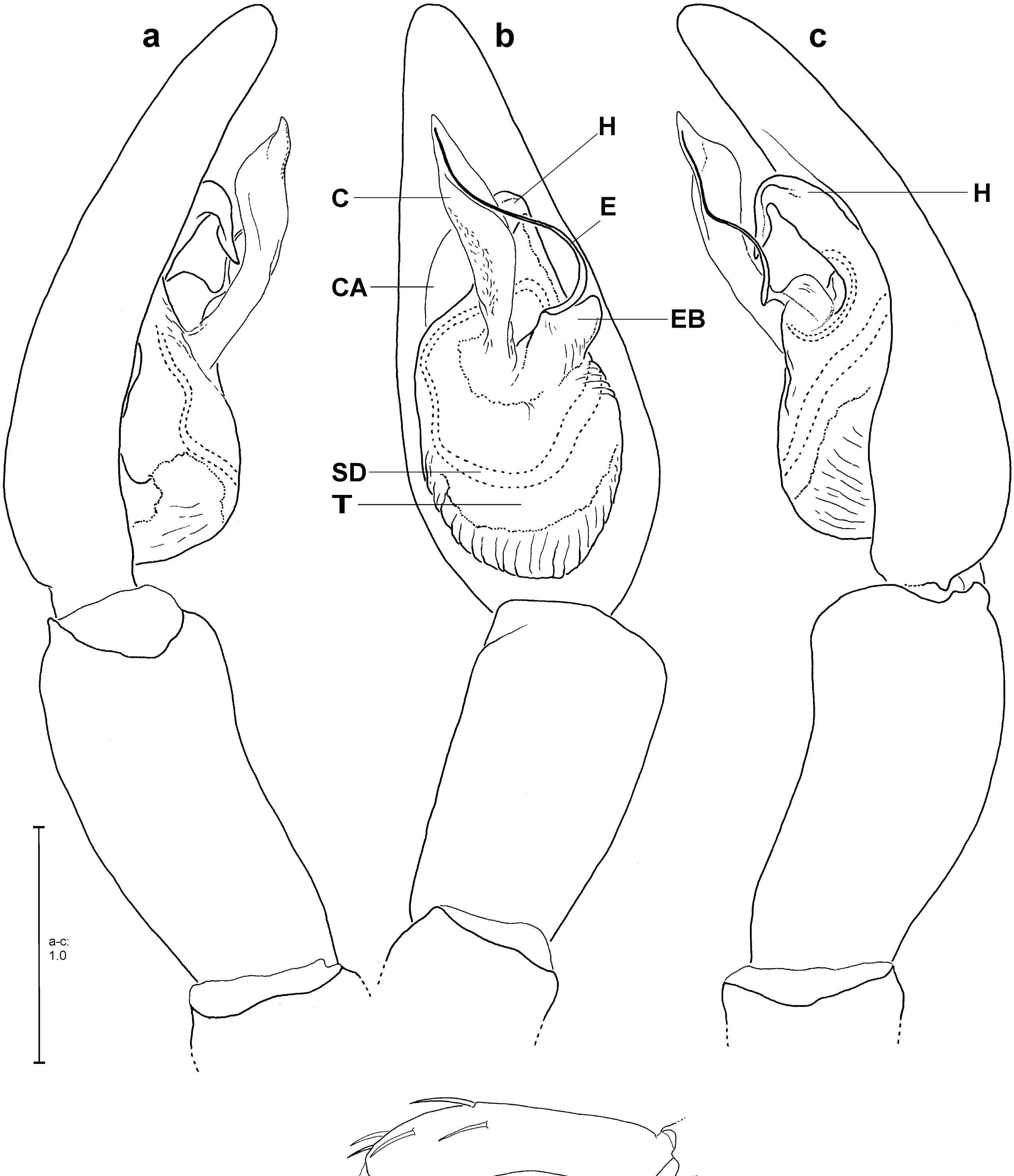
Diagnosis. Males with harpago (Figs 70a–c, 72a–c, 74a–c); Embolus (E) helically curved and with distinct base (EB). In females median septum (MS) exhibiting two strongly scleortised anterio-lateral foldings/extensions (tegimentum, TM) covering the copulatory opening (CO) at least partly (Figs 69a, 89m); copulatory ducts (CD) very long, consisting of three to five loops (Figs 69b, 71b).

Description. Sternum mostly unicoloured yellowish brown to red-brown (Fig. 82j). May be brown to red-brown with yellowish-white median line running end-to-end (Fig. 82k). Median bands on carapace serrated (Fig. 82g). Lateral bands broad (2–3x diameter of PME) and serrated (Fig. 82g). Dorsal spines on tibia III and IV present. Legs medium-sized in relation to other species-groups: FEM-I+MTT-I/CL : Males: ca. 5–5.5; Females: 3.0–3.8.

Sperm duct in males diagonal U-shaped (Fig. 72b). Cymbium dorsally with very dense scopula (Fig. 83f). Palpal femur may be with modification or without. Macrosetae ventrally on coxae of leg I (MC-I) may be absent or two large apical ones (Fig. 82p), those of trochanter of leg I (MT-I) may be indistinct or missing.



FIGURES 69a–g. *Psechrus torvus*, from Sri Lanka, Central Prov., ♀ adult and primordial copulatory organ. a–c ♀ lectotype SB 93, d–e ♀ SB 260, f–g s.a. ♀ SB 941. a, d Epigyne, ventral view. b, e Vulva, dorsal view. c Schematic course of internal duct system. f Pre-vulva, dorsal view. g Pre-epigyne, ventral view.



FIGURES 70a–d. *Psechrus torvus*, ♂ paralectotype SB 264 from Sri Lanka, Central Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. C: Conductor. CA: Cymbium alveolus. E: Embolus. EB: Embolus base. H: Harpago. SD: Sperm duct. T: Tegulum.

Males mostly with podium-like EB (Fig. 70b). Conductor long and fleshy. Palpal tibia in comparison to other *Psechrus* species quite long (Figs 70a–c, 72a–c).

Many wrinkles and ridges in front of epigyne, within MS and sometimes also lateral to MS (Fig. 73a). In females spermathecal heads always associated with spermathecae (Fig. 69a, 75b). The latter located posterior to CD.

Psechrus torvus (O. Pickard-Cambridge, 1869)

Figs 69a–g, 70a–d, 86g, 89m, 92m

Tegenaria torva O. Pickard-Cambridge 1869: 376, pl. 11, figs 10–20 (Description of ♂ and ♀, illustration of ♂). [Lectotype: 1 ♀ (SB 93), here designated, from SRI LANKA (‘Ceylon’): Central Province: Ramboda (‘Rambodde’), ca. N 07°02', E 80°42', 1000–1700 m; J. Nietner leg. ca. 1855; OUMNH; Paralectotypes: 3 ♂♂ (SB 264, 268–269), 7 ♀♀ (SB 263, 265–267, 270–271, 275), 1 s.a. ♂ (SB 274), 2 s.a. ♀♀ (SB 272–273), with same data as for lectotype; OUMNH, all type material examined].

Notes on type material: During his stay in Ceylon (Sri Lanka) between 1852 and 1874, John Nietner spent most of his time in the area of ‘Rambodde’ (presently Ramboda) as plantation owner (Kraatz 1857), where he collected plenty of insect material (Nietner 1855). It is likely that he collected the type specimens of *Tegenaria torva* at the same locality.

The type series contains one specimen (♀ SB 275) belonging to another species (see material list in the species description of *P. hartmanni* **sp. nov.**).

Lancaria torva — Karsch 1879: 557 (Transfer from *Tegenaria*).

Psechrus torvus — Simon 1887: 194 (Syn. of *Lancaria* with *Psechrus*; Formal transfer from *Lancaria*). Karsch 1891: 275 (Syn. with *P. argentatus*). Simon 1892: 225 (Removed from Syn. with *P. argentatus*), 224, figs 173, 175 (Non description & illustration of ♂, misidentified, see *P. hartmanni* **sp. nov.**). Pocock 1900: 211. Simon 1906: 287 (Non record of ♀ from Singapore, misidentified, see *P. singaporensis*). Kulczyński 1908: 567. Berland and Berland 1914: 133. Sherriffs 1919: 222. Fage 1929: 359. Reimoser 1934: 467 (Non record of ♀ from Pumbarai, India, misidentified, see *P. crepido* **sp. nov.**). Kayashima 1962: 9, figs 1–4 (Non illustration of ♀, misidentified, see *P. clavis* **sp. nov.**). Lee 1966: 18, figs 3e–g (Non illustration of ♂ and ♀, misidentified, see *P. taiwanensis*). Lehtinen 1967: 260, fig. 476 (Non illustration of ♀, misidentified, see *P. decollatus* **sp. nov.**). Tikader 1977: 209. Levi 1982: 120, figs 16–28, ad part, figs 23–28 misidentified (Description of ♂ and ♀, figs 16–22: illustration of ♂, s.a. ♀ and ♀). Hu 1984: 57, figs 51.1–3 (Non illustration of ♂ and ♀, misidentified, see *P. taiwanensis*). Yin *et al.* 1985: 19. Song *et al.* 1999: 398. Song *et al.* 2002: 373 (Erroneously listed as fauna element of Singapore [according to Simon 1906]. However, to date this species has been recorded only from Sri Lanka and India). Sebastian and Peter 2009: 279, 528.

Psechrus alticeps Pocock 1899: 751 (Description of s.a. ♀). [Syntypes: 1 s.a. ♀ (SB 234), 1 ♂ (SB 235), 1 juv. (SB 1047), all from INDIA: Kerala Province (‘Travancore’): Ponmudi, ca. N 08°45', E 77°07', 700–800 m; H. Ferguson leg. III.1896; NHM 1899·1·17·54–55, all type material examined]. Pocock 1900: 211. Simon 1906: 286. Kulczyński 1908: 567. Berland and Berland 1914: 132. Sherriffs 1919: 223. Chamberlin 1924: 2. Fage 1929: 360. Lehtinen 1967: 261 (Syn.).

Note on type material: Pocock (1899) did not mention how many type specimens he had designated and of which sex they were. He only described the (subadult) female, so one would guess that there are no males among type material, but there is one male that is missing both pedipalps. The femur, patella and tibia from the right pedipalp are still present. Maybe the two palpal organs were already lost, when Pocock examined this male, otherwise he should have recognised it as such.

Additional material examined (2 ♀♀, 3 s.a. ♀♀, 1 s.a. ♂)**. INDIA: Tamil Nadu Province:** Anaimalai Sanctuary (20 km SW of Pollachi), Top Slip, ca. N 10°27'30", E 76°53', 1300–1400 m; W. Eberhard leg. XII.1983; 1 s.a. ♀ (SB 622), 1 s.a. ♂ (SB 623), MCZ 82514; 1 s.a. ♀ (SB 168), MCZ 82519. **SRI LANKA: Central Province:** Pundaluoya, ca. N 07°00'30", E 80°40', ca. 1100 m; E. E. Green leg. before 1898; 1 ♀ (SB 260), NHM 1899·12·13·19. Labugolla, Mackwoods Tea Centre, N 07°01'24.5", E 80°43'07.4", ca. 1500 m, tea plantation, under large rock; V. Hartmann leg. 10.I.2011; 1 ♀ (SB 941, raised from juvenile, pre-epigyne of cuticle of subadult instar was kept), SMF.

Revised diagnosis (see also diagnosis for *torvus*-group above)**.** Males with long conductor (C) (longer than width of tegulum [T], Figs 70a–c). Embolus (E) with two helical windings (Fig. 70c), tip of harpago (H) pointing proximally (Figs 70a,c). Females with distally rounded branches of tegimentum (TM) pointing anterio-medially (Figs 69a,d, 89m). First loop of copulatory duct (CD) directed anteriorly, larger than second loop (Fig. 69b).

Description. Male:

Body and eye measurements. Carapace length 5.3–7.2, carapace width 3.8–4.8, anterior width of carapace 2.3–2.8, opisthosoma length 5.5–8.2, opisthosoma width 2.3–5.0. Eyes: AME 0.26–0.34, ALE 0.36–0.39, PME 0.33–0.36, PLE 0.36–0.42, AME–AME 0.14–0.24, AME–ALE 0.03–0.04, PME–PME 0.18–0.22, PME–PLE 0.26–0.31, AME–PME 0.44–0.54, ALE–PLE 0.34–0.43, clypeus height at AME 0.51–1.11, clypeus height at ALE 0.43–0.93.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.7–9.5 [2.8–3.4, 1.2–1.6, 1.5–1.7, 2.2–2.8]; Legs: I 45.0–53.3 [10.9–13.8, 2.5–3.4, 12.3–14.4, 12.6–14.3, 6.7–7.4], II 33.6–41.0 [8.8–11.3, 2.3–3.0, 8.6–10.9, 8.9–10.4, 5.0–5.4], III 22.2–26.3 [6.5–7.7, 1.8–2.2, 5.3–6.2, 5.4–6.4, 3.2–3.8], IV 35.4–41.7 [9.0–11.3, 2.0–2.7, 8.5–10.0, 10.0–11.1, 5.9–6.6].

Spination. Palp: 132, 000, 0000; legs: femur I 546, II 546 (556), III 545, IV 544 (545); patella I–IV 000; tibia I–II 3038, III 2134 (2124), IV 3136 (3126); metatarsus I 3037, II 3037 (3035), III 3035, IV 3036 (3046).

Palpal femur without modification (Fig. 70d). MC-I–II and MT-I: absent.

Copulatory organ (see also diagnosis and general description for *torvus*-group). Harpago arising at 12:30 o' clock position on tegulum. Conductor with almost pointed tip, embolus base protruding retrolaterally (Fig. 70b). Sperm duct with flat curve anterio-prolaterally (Fig. 70b). Cymbium dorsally with very dense scopula, covering 2/3 of cymbium. Palpal tibia relatively long (Figs 70a–c), its distal retrolateral bulge not very distinct (Fig. 70b).

Female (Measurements of lectotype first, those of other females as range in parentheses)**:**

Body and eye measurements. Carapace length 8.0 (7.9–9.0), carapace width 5.5 (5.2–6.2), anterior width of carapace 3.7 (3.6–4.0), opisthosoma length 10.8 (10.1–12.6), opisthosoma width 6.0 (5.5–9.2). Eyes: AME 0.38 (0.36–0.38), ALE 0.47 (0.41–0.47), PME 0.45 (0.41–0.48), PLE 0.48 (0.47–0.48), AME–AME 0.24 (0.23–0.27), AME–ALE 0.06 (0.06–0.08), PME–PME 0.34 (0.26–0.34), PME–PLE 0.42 (0.36–0.42), AME–PME 0.63 (0.61–0.65), ALE–PLE 0.53 (0.49–0.54), clypeus height at AME 1.44 (1.21–1.55), clypeus height at ALE 1.16 (1.09–1.38).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 10.4 (9.9–11.4) [3.5 (3.4–4.2), 1.5 (1.4–1.6), 2.0 (1.9–2.1), 3.4 (3.2–3.5)]; Legs: I 48.7 (43.6–48.0) [12.4 (11.0–13.0), 3.6 (3.3–3.7), 13.2 (12.1–12.8), 12.8 (11.5–12.2), 6.7 (5.7–6.3)], II 37.6 (34.6–38.8) [10.3 (9.8–11.1), 3.0 (3.0–3.5), 9.9 (9.1–9.8), 9.6 (8.4–9.5), 4.8 (4.3–4.9)], III 25.6 (23.4–26.1) [7.6 (7.2–8.1), 2.4 (2.3–2.5), 6.0 (5.4–6.4), 6.3 (5.7–6.5), 3.3 (2.8–3.4)], IV 38.7 (35.1–39.0) [10.5 (9.7–11.2), 2.9 (2.6–3.0), 9.4 (8.4–9.6), 10.2 (9.3–10.0), 5.7 (5.1–5.5)].

Palpal claw with 15 (13–15) teeth.

Spination. Palp: 131{141} (131,141), 110{120} (110,110), 1101 (1101), 1014 (1014); legs (—except for patella— variable, only most common states noted): femur I 546 (546,556), II 546 (546,555) III 545 (545,555), IV 553 (554,454); patella I–IV 000; tibia I–II 3038 (3038), III 2124 (2124,3124), IV 3136 (3136); metatarsus I–II 3037 (3037), III 3035 (3035,3037), IV 3046 (3046,3036,3047).

Copulatory organ (see also diagnosis and general description of *torvus*-group). Epigyne without (distinct) epigynal field (EF) (Figs 69a,d, 89m). Copulatory ducts distinctly larger than receptacula. Spermathecal heads arising anterio-medial on receptacula (Fig. 69b).

Primordial copulatory organ. Pre-epigyne: Pre-MS just slightly broader than long, with parallel lateral margins, curves of anterior margins narrow (Fig. 69g). Distance between the two endings of anterior margins longer than half the length of pre-MS.

Pre-vulva: Pre-CD long, narrow and anteriorly with narrow curve (Fig. 69f).

Colouration of male and female (see also description for *torvus*-group and *Psechrus*). Sternum unicoloured yellowish brown. Median bands on carapace serrated. Lateral bands broad (ca. 2x diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma mostly continuous, but sometimes broken subdistally and narrow to very narrow. If measured centrally on opisthosoma, its width is 0.1–0.3 times the width of one half of the cribellum.

Variation of copulatory organs. Males only with marginal intraspecific variation in the structures of bulb. Females: Lateral margins of tegimentum (TM) may be with slight curves (Fig. 69a) or without (Fig. 69d). Vulvae without significant variation (Figs 69b,e, 92m).

Remarks: *Psechrus alticeps* Pocock, 1899 was synonymised with *P. torvus* by Lehtinen (1967). Though Lehtinen gave no reason for this synonymy, he most likely was right. Firstly, the pre-epigynes of the subadult female syntype of *P. alticeps* matches the pre-epigyne of a *P. torvus* specimen from Labugolla, which is very close to type locality. The respective specimen (SB 941) had been raised from juvenile for the present study. After the final moult its exuviae was kept and the pre-epigyne was dissected and examined. Secondly, the pre-epigynes of the s.a. ♀ syntypes of *P. torvus* match those of *P. alticeps*, which Levi (1982) had already recognised. Thirdly and finally, the palpal femur of the male syntype of *P. alticeps* does not show the slightest modification and its palpal tibia is quite long and has a rather indistinct retrolateral bulge distally, like in the male paralectotypes of *P. torvus* and unlike in similar species related with *P. torvus* (see below).

Sherriffs (1919) stated that he has observed the webs of *P. torvus* in the field. Notice that at least a part of the material collected by Sherriffs in Sri Lanka (it is possible that additional material is deposited in other museums or were lost) had been checked in the present study and had proved to belong to other, closely related species.

Jose and Sebastian (2001) reported *P. alticeps* from Kerala Province, India, which is correct, as the type locality Ponmundi belongs to the present Kerala Province. However, they reproduced the illustrations of the copulatory organs of *Fecenia protensa* Thorell, 1891 after Tikader (1977, sub *Psechrus nicobarensis*) (on this in detail see Bayer 2011, p. 31).

Distribution. Sri Lanka, India (Fig. 94).

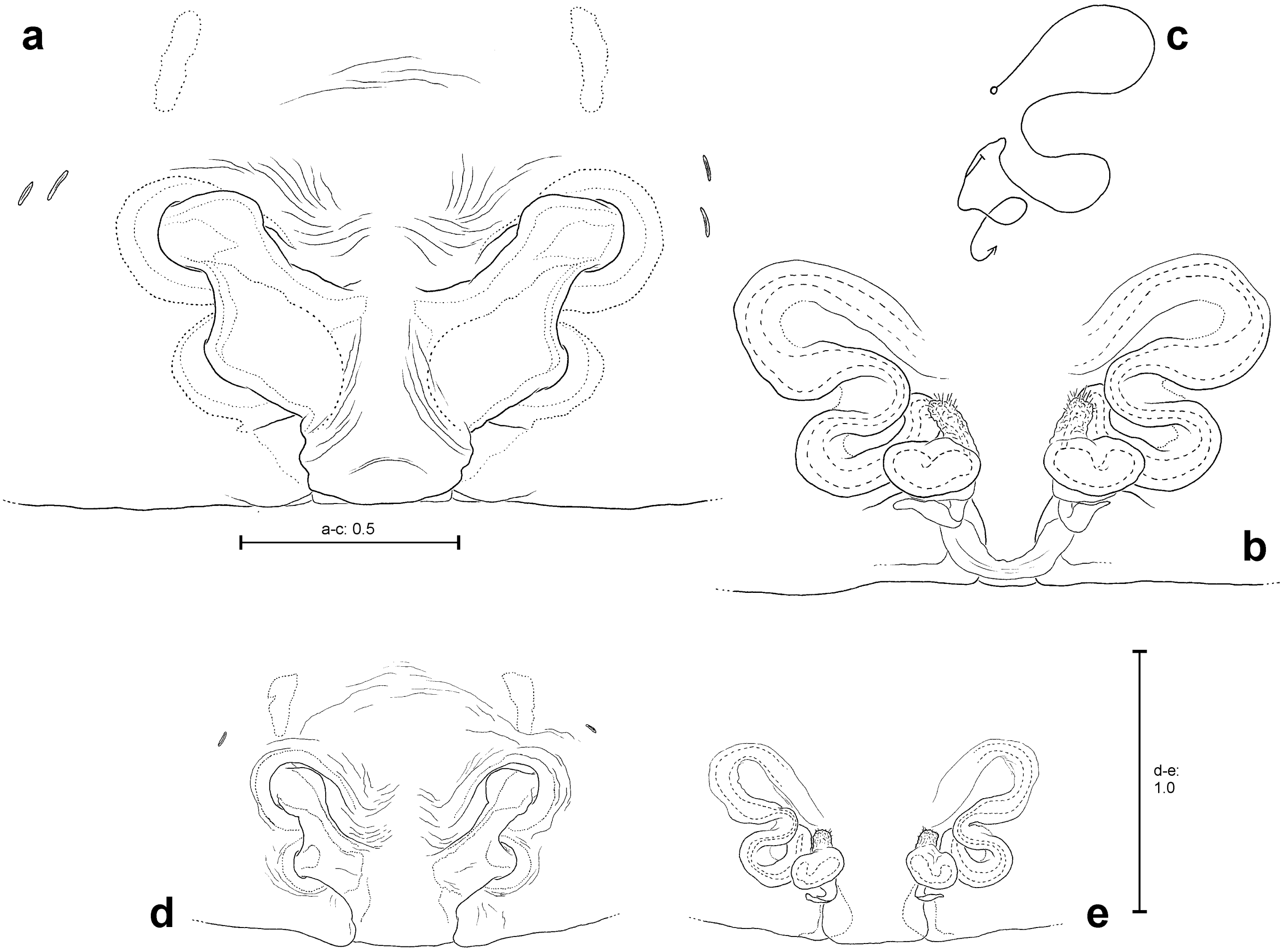
Psechrus hartmanni sp. nov.

Figs 71a–e, 72a–d, 81b, 82j,p, 83f, 86h, 89n, 92n

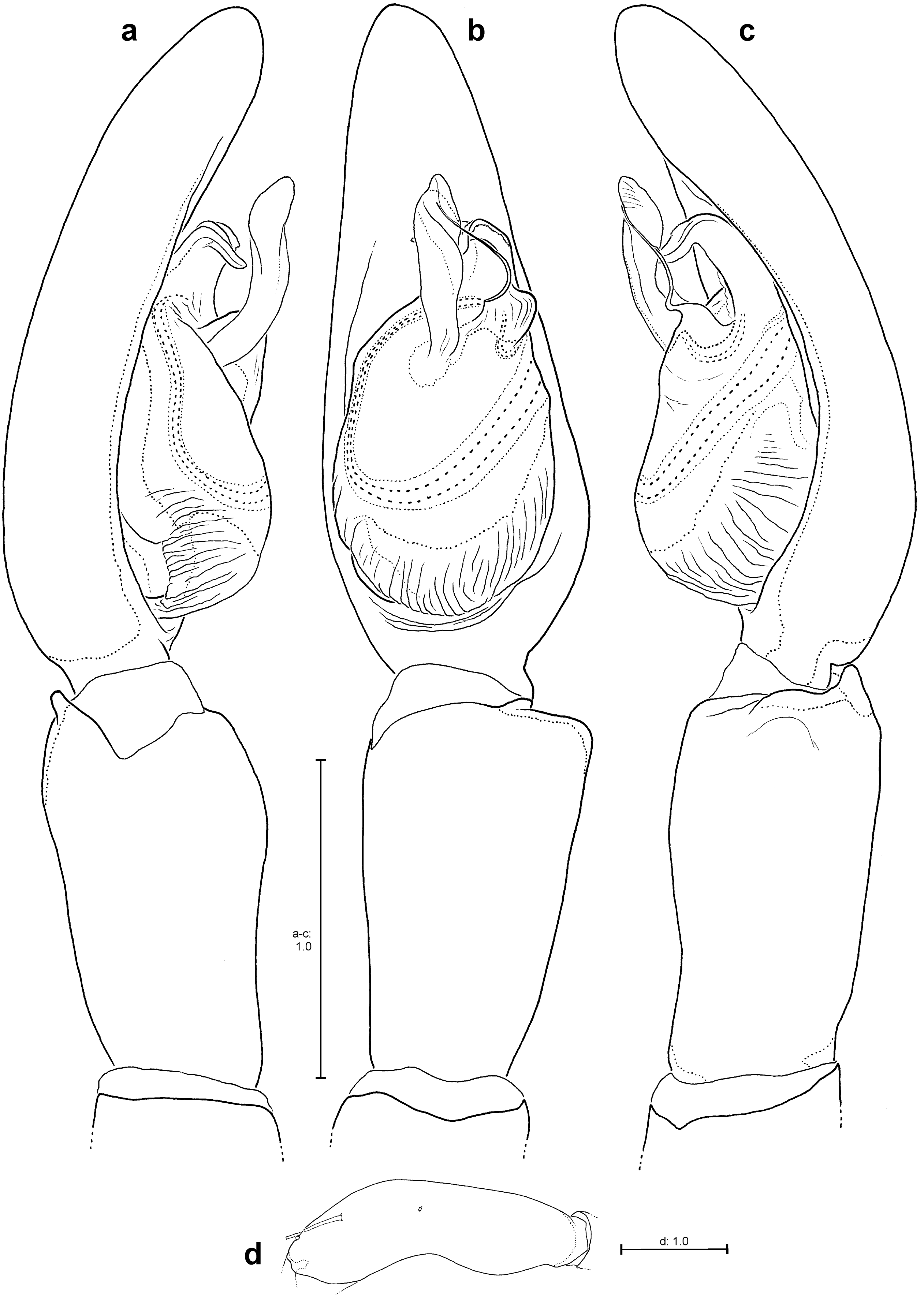
Psechrus torvus — Simon 1892: 225, figs 173, 175 (Description & illustration of ♂, misidentified). Levi 1982: 122, figs 16–28, ad part, figs 23–28 misidentified (figs 23–24: illustration of ♀).

Type material. Holotype ♀ (SB 1007), **SRI LANKA: Central Province:** Pattipola, Horton Plains National Park, N 06°50'34.5", E 80°48'51.3", ca. 2100 m, moutainous rainforest, fern-rich road bank; V. Hartmann leg. 10.I.2011; SMF; **Paratype** ♀ (SB 845), **SRI LANKA: Central Province:** Nuwara Eliya, N 06°58'30", E 80°47'30", ca. 2000 m, tea plantation; G. Schmidt leg. XII.1981; SMF 34520.

Type material of *Tegenaria torva*. Paralectotype ♀ (SB 275, designated here), **SRI LANKA** (‘Ceylon’); J. Nietner leg. ca. 1855; OUMNH.



FIGURES 71a–e. *Psechrus hartmanni* **sp. nov.**, from Sri Lanka, Central Prov. a–c ♀ holotype SB 1007. d–e ♀ SB 275 (paralectotype of *Tegenaria torva*). a, d Epigyne, ventral view. b, e Vulva, dorsal view. c Schematic course of internal duct system.



FIGURES 72a–d. *Psechrus hartmanni* **sp. nov.**, ♂ SB 624 from Sri Lanka. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

Additional material examined (6 ♀♀, 1 ♂, 1 p.s.a. ♀, 2 juvs)**. SRI LANKA** (‘Ceylan’); E. Simon leg. before 1892; Simon det. *P. torvus;* Simon-Coll. No. 499; 1 ♂ (SB 624), 2 ♀♀ (SB 628–629), MNHN AR170/1; 2 ♀♀ (SB 625–626), 1 juv. (SB 627), MNHN AR170/2; 2 ♀♀ (SB 630, 632), MNHN AR170/3. **SRI LANKA: Central Province:** Nuwara Eliya, N 06°58'30", E 80°47'30", ca. 2000 m, tea plantation; G. Schmidt leg. XII.1981; 1 p.s.a. ♂ (SB 874), 1 juv. (SB 875), SMF 34496.

Additional doubtful material examined. SRI LANKA, with no further details; G. Schmidt leg. XII.1981; 1 juv. (SB 844), SMF 34495.

Etymology. The specific name is a patronym in honour of the collector of the holotype, Volker Hartmann; noun (name) in genitive case.

Diagnosis (see also diagnosis for *torvus*-group above)**.** In males embolus (E) with one helical winding (Fig. 72c) and tip of harpago (H) pointing ventrally (Figs 72a,c). H dorsally with three ridges and shorter than in *P. torvus*. Females with branches of tegimentum (TM) pointing anterio-laterally (Fig. 71a). First loop of copulatory duct (CD) directed laterad, larger than second loop (Fig. 71b). Distal section of CD located lateral to SH, not medial.

Description. Male:

Body and eye measurements. Carapace length 5.6, carapace width 4.2, anterior width of carapace 2.2, opisthosoma length 9.5, opisthosoma width 2.8. Eyes: AME 0.35, ALE 0.36, PME 0.37, PLE 0.36, AME–AME 0.18, AME–ALE 0.03, PME–PME 0.21, PME–PLE 0.29, AME–PME 0.46, ALE–PLE 0.42, clypeus height at AME 0.78, clypeus height at ALE 0.65.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.8 [3.0, 1.2, 1.3, 2.3]; Legs: I 59.9 [15.9, 2.9, 15.9, 17.5, 7.7], II 43.0 [12.0, 2.4, 10.7, 12.1, 5.8], III 28.3 [8.4, 2.0, 6.8, 7.4, 3.7], IV 48.2 [12.7, 2.3, 11.2, 14.9, 7.1]. Spination. Palp: 122, 000, 0000; legs: femur I 666, II 646, III 546, IV 656{645}; patella I–IV 000; tibia I 3038, II 3038{3138}, III 3134, IV 3136; metatarsus I–II 3037, III 3035, IV 3036.

Palpal femur ventrally modified with flat bulge (Fig. 72d). MC-I present in form of two large apical ones (Fig. 82p; Simon 1892: fig. 173), MT-I rather narrow, indistinct and as apical row. MC-II absent.

Copulatory organ (see also diagnosis and general description for *torvus*-group). Harpago arising at 1:00 o’ clock position on tegulum. Embolus base protruding retrolaterally (Fig. 72b). Sperm duct diagonal U-shaped (Fig. 72b). Cymbium dorsally with very dense scopula, covering 6/7 of cymbium (Fig. 83f). Palpal tibia medium sized to long (Figs 72a–c), its distal retrolateral bulge corner-shaped (Fig. 72b).

Female (Measurements of holotype first, those of other females as range in parentheses)**:**

Body and eye measurements. Carapace length 6.9 (5.5–8.2), carapace width 4.6 (4.0–5.3), anterior width of carapace 3.2 (2.6–3.7), opisthosoma length 9.8 (7.1–10.5), opisthosoma width 7.4 (4.4–7.5). Eyes: AME 0.41 (0.32–0.42), ALE 0.44 (0.40–0.47), PME 0.47 (0.41–0.46), PLE 0.45 (0.41–0.46), AME–AME 0.27 (0.18–0.28), AME–ALE 0.06 (0.03–0.07), PME–PME 0.29 (0.20–0.27), PME–PLE 0.37 (0.30–0.38), AME–PME 0.57 (0.53–0.62), ALE–PLE 0.48 (0.41–0.52), clypeus height at AME 1.01 (0.78–1.22), clypeus height at ALE 0.93 (0.73–1.08).

Cheliceral furrow in holotype with three promarginal and four (left) and five (right) retromarginal teeth. Other females with three promarginal and four retromarginal, one with three promarginal and five retromarginal teeth.

Measurements of palp and legs. Leg formula: 1243 (holotype), 1423 (other females). Palp: 9.3 (7.9–11.2) [3.2 (2.7–4.0), 1.2 (1.1–1.6), 1.8 (1.6–2.1), 3.1 (2.5–3.5)]; Legs: I 38.6 (32.0–44.4) [10.2 (8.4–11.4), 2.6 (2.4–3.4), 10.9 (9.0–12.7), 10.0 (7.9–11.5), 4.9 (4.3–5.4)], II 31.5 (25.0–35.6) [8.7 (7.2–9.8), 2.4 (2.2–3.2), 8.5 (6.7–9.5), 7.6 (5.9–8.9), 3.7 (3.0–4.2)], III 21.0 (17.4–24.4) [6.2 (5.4–7.2), 1.9 (1.5–2.4), 5.1 (4.3–5.8), 5.1 (4.0–6.0), 2.7 (2.2–3.0)], IV 30.9 (25.3–35.5) [8.7 (7.2–9.8), 2.2 (1.8–2.7), 7.9 (6.3–8.9), 7.8 (6.3–9.3), 4.3 (3.7–4.8)].

Palpal claw with 14 (13–15) teeth.

Spination. Palp: 131 (131,152), 110 (110), 1101 (1101), 1014 (1014); legs (—except for patella— variable, only most common states noted): femur I 555 (546,556), II 556 (556,546) III 545 (545,556), IV 553 (544,543); patella I 000 (000), II 000{100} (000), III–IV 000 (000); tibia I 40210 (3038), II 3038 (3038), III 2124 (2124), IV 3137 (3138,3037,3025); metatarsus I 3037 (3037,3036), II 3037 (3037), III 3035 (3035), IV 3046 (3046,3035).

Copulatory organ (see also diagnosis and general description of *torvus*-group). Epigyne without (distinct) epigynal field (EF) (Fig. 71a,d, 89n). Copulatory ducts distinctly larger than receptacula. Spermathecal heads arising anterio-medial on receptacula (Fig. 71b).

Colouration of male and female (see also description for *torvus*-group and *Psechrus*). Sternum unicoloured yellowish brown (Fig. 82j). Median bands on carapace serrated. Lateral bands broad to very broad (2–3x diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma mostly continuous, may be broken subdistally and narrow. If measured centrally on opisthosoma, its width is 0.2–0.4 times the width of one half of the cribellum.

Variation of copulatory organs. Females: Branches of tegimentum (TM) may be narrower (Fig. 71d) than generally. Spermathecal heads may differ slightly in direction (Figs 71a, 71e, 92n).

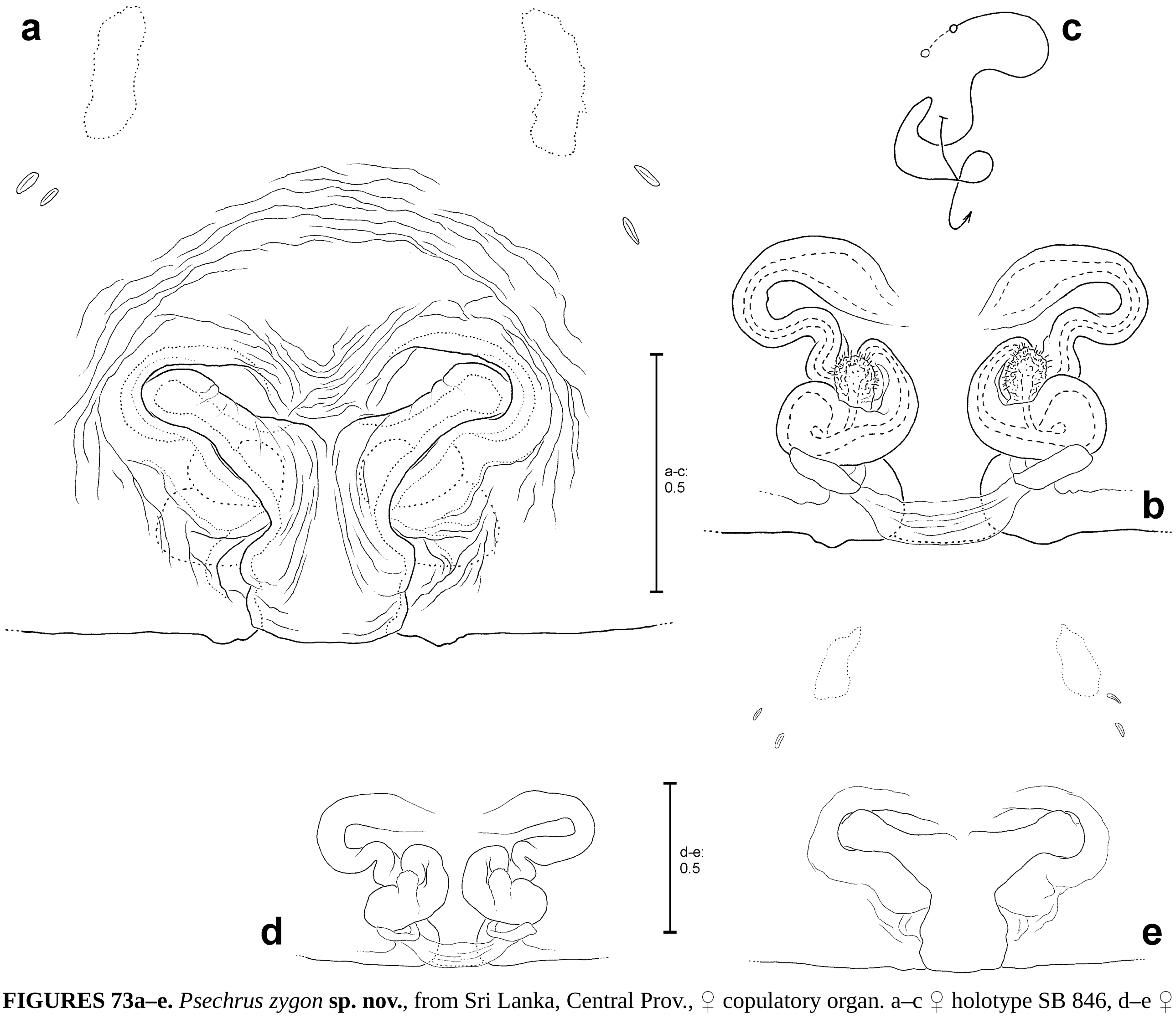
Distribution. Sri Lanka (Fig. 94).

Psechrus zygon sp. nov.

Figs 73a–e, 89o, 92o

Psechrus torvus — Levi 1982: 122, figs 16–28, ad part, figs 23–28 misidentified (figs 27–28: illustration of ♀).

Type material. Holotype ♀ (SB 846), **SRI LANKA (‘Ceylon’): Central Province:** Nawalapitiya, ca. N 07°02', E 80°32', 915 m, road-banks; W.R. Sherriffs leg. 1914–1918, collected between February and May; W.R. Sherriffs det. *P. torvus* 1919; Tilg. 20-11-1960, ZMUC 5719; **Paratype** ♀ (SB 847), with same data as for holotype; ZMUC 5719.



FIGURES 73a–e. *Psechrus zygon* **sp. nov.**, from Sri Lanka, Central Prov., ♀ copulatory organ. a–c ♀ holotype SB 846, d–e ♀ SB 631. a, e Epigyne, ventral view. b, d Vulva, dorsal view. c Schematic course of internal duct system.

Note on type material: W.R. Sherriffs collected *Psechrus* in the highlands of central Ceylon (Sherriffs 1919). He observed the webs of what he thought to be *P. torvus* in the area of Nawalapitiya (Sherriffs 1919). It is not clear if he had collected more material than what is deposited in ZMUC. It is also not clear if all the specimens were collected in the area of Nawalapitiya, but at least he did not mention any other localities in his publication (Sherriffs 1919).

Additional material examined. SRI LANKA ('Ceylan'); E. Simon leg. before 1892; Simon det. *P. torvus*; Simon-Coll. No. 499; 1 ♀ (SB 631), MNHN AR170/6.

Identification of the following, additional material examined not absolutely certain.

SRI LANKA ('Ceylon'): Central Province: Nawalapitiya, ca. N 07°02', E 80°32', 915 m, road-banks; W.R. Sherriffs leg. 1914–1918, collected between February and May; W.R. Sherriffs det. *P. torvus* 1919; Tilg. 20-11-1960; 1 ♂ (SB 848, see also remark below), ZMUC 5716.

Etymology. The specific name refers to the shape of the epigynal median septum of the female type specimens resembling a beam balance (Ancient Greek "zygon" means "beam of a balance"); term (noun) in apposition.

Diagnosis (see also diagnosis for *torvus*-group above)**.** Females with posterior part of median septum (MS) longer than broad and narrow branches of tegimentum (TM) pointing almost laterally (Figs 73a, e). Distal section of copulatory duct (CD) located medial to spermathecal heads (SH) (Fig. 73b). Male (not absolutely certain if conspecific with *P. zygon* **sp. nov.**, see remarks below) with short, stout and complex harpago (H), whose tip is pointing ventrally (Figs 74a,c). Conductor (C) entirely located in retrolateral half of tegulum (T) and broadest in most distal fourth (Fig. 74b).

Description. Male (not absolutely certain if conspecific with *P. zygon* **sp. nov.**)**:**

Body and eye measurements. Carapace length 5.4, carapace width 4.1, anterior width of carapace 2.2, opisthosoma length 6.4, opisthosoma width 1.9. Eyes: AME 0.26, ALE 0.34, PME 0.35, PLE 0.35, AME–AME 0.13, AME–ALE 0.07, PME–PME 0.19, PME–PLE 0.22, AME–PME 0.41, ALE–PLE 0.35, clypeus height at AME 0.69, clypeus height at ALE 0.51.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.0 [2.8, 1.1, 1.2, 1.9]; Legs: I 52.7 [14.1, 2.5, 14.4, 14.9, 6.8], II 38.7 [10.6, 2.2, 10.3, 10.6, 5.0], III 26.9 [7.9, 1.6, 6.0, 7.5, 3.9], IV 42.3 [11.7, 1.9, 9.6, 12.6, 6.5].
Spination. Palp: 132, 110, 1101 (all spines very small); legs: femur I–II 546, III 545, IV 554; patella I–IV 000; tibia I 3038, II 3138, III 3124, IV 3136; metatarsus I–II 3037, III 3035, IV 4047.

Palpal femur ventrally modified with flat bulge and clearly curved dorsally (Fig. 74d). MC-I present in form of two large apical ones, MT-I as one large apical one. MC-II absent.

Copulatory organ (see also diagnosis and general description for *torvus*-group). Harpago arising at almost 2:00 o' clock position on tegulum. Embolus base relatively small (Figs 74b–c). Tegulum quite broad and sperm duct diagonal U-shaped (Fig. 74b). Cymbium dorsally with very dense scopula, covering 4/5 of cymbium. Palpal tibia medium sized to long (Figs 74a–c), its distal retrolateral bulge extending further (Fig. 74b) than in *P. hartmanni* **sp. nov.**

Female (Measurements of holotype first, those of other females as range in parentheses)**:**

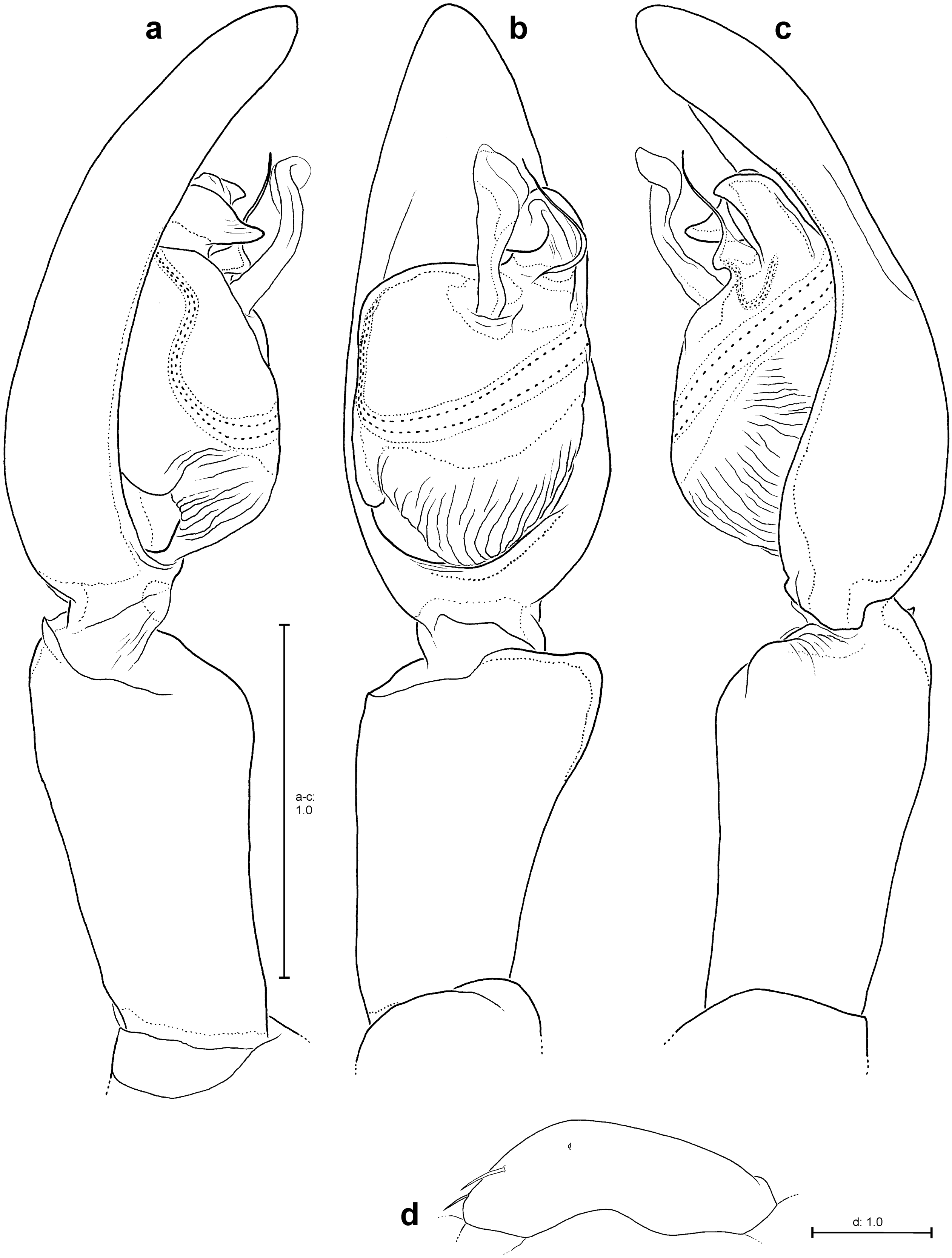
Body and eye measurements. Carapace length 7.4 (6.7–8.6), carapace width 5.1 (4.5–5.8), anterior width of carapace 3.1 (2.8–3.7), opisthosoma length 11.8 (10.1–12.5), opisthosoma width 6.0 (3.8–6.1). Eyes: AME 0.32 (0.29–0.38), ALE 0.42 (0.40–0.46), PME 0.43 (0.40–0.46), PLE 0.43 (0.40–0.44), AME–AME 0.25 (0.21–0.28), AME–ALE 0.11 (0.09, both), PME–PME 0.28 (0.27–0.36), PME–PLE 0.36 (0.35–0.43), AME–PME 0.68 (0.60–0.76), ALE–PLE 0.56 (0.51–0.61), clypeus height at AME 1.12 (1.02–1.66), clypeus height at ALE 0.88 (0.85–1.26).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.0 (8.1–9.7) [3.1 (2.8–3.4), 1.3 (1.1–1.4), 1.7 (1.6–1.8), 2.9 (2.6–3.1)]; Legs: I 48.3 (46.4–53.5) [12.8 (12.5–14.5), 3.2 (3.0–3.8), 13.4 (13.1–14.7), 12.9 (12.2–14.2), 6.0 (5.6–6.3)], II 37.2 (35.2–41.2) [10.2 (9.8–11.7), 2.8 (2.6–3.2), 9.9 (9.7–11.0), 9.7 (9.3–10.5), 4.6 (4.1–4.8)], III 26.1 (24.8–29.2) [7.9 (7.5–9.0), 2.2 (2.0–2.5), 6.1 (6.0–6.9), 6.6 (6.2–7.2), 3.3 (3.1–3.6)], IV 39.1 (38.3–42.4) [10.8 (11.2–11.7), 2.5 (2.3–2.9), 9.6 (9.7–10.5), 10.6 (10.3–11.7), 5.6 (4.8–5.6)].

Palpal claw with 14 (14–15) teeth.

Spination. Palp: 131 (131), 110 (110), 1101 (1101), 1014 (1014); legs: femur I 656 (666), II 646 (656) III 545 (545), IV 554 (555,554); patella I–IV 000 (000); tibia I–II 3038 (3038), III 2124 (2124), IV 3136 (3136); metatarsus I–II 3037 (3037), III 3035 (3035), IV 3036 (3037).



FIGURES 74a–d. *Psechrus zygon* **sp. nov.** (doubtful identification), ♂ SB 848 from Sri Lanka, Central Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

Copulatory organ (see also diagnosis and general description of *torvus*-group). Epigyne with many wrinkles and ridges surrounding MS and without (distinct) epigynal field (EF) (Fig. 73a). Copulatory ducts (CD) larger than receptacula. First loop of CD directed laterally. Spermathecal heads arising anteriorly on receptacula, where there is a fluent transition between distal section of CD and receptaculum (Fig. 73b).

Colouration of male and female (see also description for *torvus*-group and *Psechrus*). Sternum unicoloured yellowish brown. Median bands on carapace serrated. Lateral bands broad to very broad (2–2.5x diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma continuous and narrow. If measured centrally on opisthosoma, its width is 0.4–0.5 times the width of one half of the cribellum.

Variation of copulatory organs. Females: Branches of tegimentum (TM) may even more transversally orientated (Fig. 73e), which means they are pointing laterally. Second loop of CD may be smaller and narrower (Fig. 73d).

Remark: The label within the vial of the male (SB 848) comprises the same dates as the one within the vial of the two females. As this male has its own collection number it is not absolutely certain if it had been collected at exactly the same site as the females. Consequently, it is not absolutely certain if it really belongs to *P. zygon* **sp. nov.**

Distribution. Sri Lanka (Fig. 94).

Psechrus tauricornis sp. nov.

Figs 75a–g, 81j, 82g,k, 89p, 92p

Psechrus torvus — Simon 1905b: 167 (material from Kandy, misidentified). Levi 1982: 122, figs 16–28, ad part, figs 23–28 misidentified (figs 25–26: illustration of ♀).

Type material. Holotype ♀ (SB 129), **SRI LANKA: Central Province:** Kandy, near waterworks, ca. N 07°17', E 80°38', ca. 600 m, forest, along vertical walls of stream; C.L. Deeleman & P.R. Deeleman leg. 11.VIII.1981; Deeleman Coll. in RMNH; **Paratypes: 1** ♀ (SB 849), **1 s.a.** ♀ (SB 850), **SRI LANKA: Central Province:** Nawalapitiya, ca. N 07°02', E 80°32', 915 m, road-banks; W.R. Sherriffs leg. 1914–1918, collected between February and May; W.R. Sherriffs det. *P. torvus* 1919; Tilg. 20-11-1960; ZMUC 12814.

Additional material examined (3 ♀♀, 1 s.a. ♀, 6 juvs)**. SRI LANKA** (‘Ceylan’)**:** Possibly Kandy; E. Simon leg. before 1892; Simon det. *P. torvus*; Simon-Coll. No. 499; 1♀ (SB 633), MNHN AR170/5; 1 ♀ (SB 634), MNHN AR170/4. **SRI LANKA: Central Province:** Kandy, near waterworks, ca. N 07°17', E 80°38', ca. 600 m, forest, along vertical walls of stream; C.L. Deeleman & P.R. Deeleman leg. 11.VIII.1981; 6 juvs (SB 851–856), Deeleman Coll. in RMNH. **SRI LANKA: Central Province:** Vakarawatte (near Kandy); Pagel leg. 1973; ‘Eingang’ (acquisition): 15.I.1974, 1 s.a. ♀ (SB 515), NHMW. **SRI LANKA: Southern Province:** Hiniduma, Kanneliya Forest Reserve (‘Kaneliya’), ca. N 06°17', E 80°20', ca. 150 m; R.R. Jackson leg. 09.I.1982, Zoo. Dept. Univ. Cant. NZ; |SL 25|; D.P. Wijesinghe det. *P. torvus* 1983; 1 ♀ (SB 261), NHM.

Additional doubtful material examined. SRI LANKA: Sabaragamuwa Province: Sinharaja Nature Reserve, near Pitadeniya, N 6°21'40.19", E 80°29'03.61", ca. 300 m, primary rainforest, slope at pathside; V. Hartmann leg. 16.I.2011; 1 juv. (SB 885), SMF.

Etymology. The specific name refers to the shape of the epigynal median septum of the female type specimens resembling a bull head in frontal view (Ancient Greek “tauros” means “bull, buffalo”; latin “cornu” means “horn”); adjective.

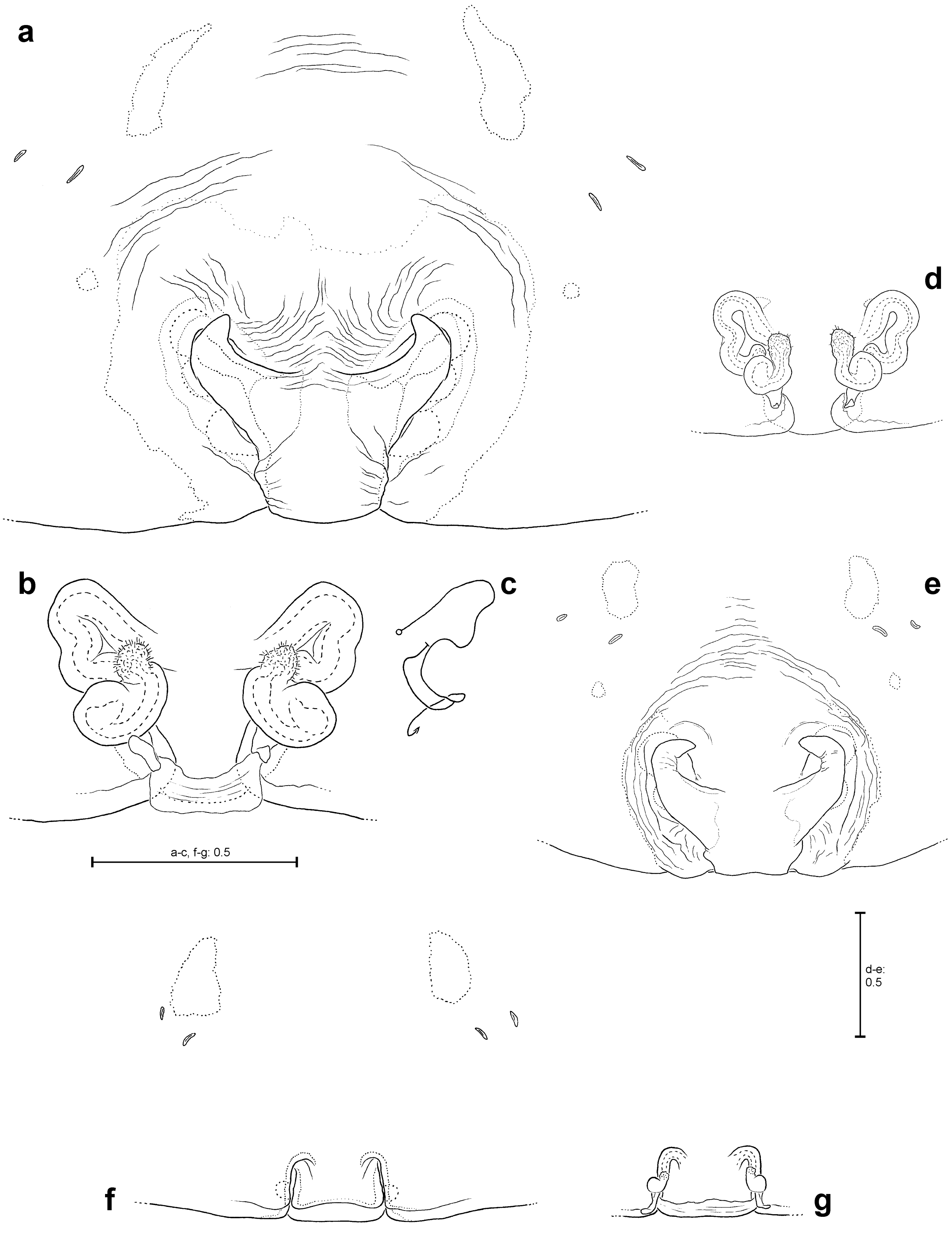
Diagnosis (see also diagnosis for *torvus*-group above)**.** Females with branches of tegimentum (TM) distally pointed and resembling the horns of a bull (Figs 75a,e, 89p). Copulatory duct (CD) with small loops being more or less equal in size (Figs 75b,d, 92p).

Description. Male: unknown.

Female (Measurements of holotype first, those of other females as range in parentheses)**:**

Body and eye measurements. Carapace length 7.8 (6.1–8.8), carapace width 5.1 (4.3–5.5), anterior width of carapace 3.5 (2.8–4.0), opisthosoma length 10.4 (9.1–10.3), opisthosoma width 6.2 (4.9–3.9). Eyes: AME 0.39 (0.32–0.40), ALE 0.42 (0.38–0.51), PME 0.43 (0.39–0.44), PLE 0.44 (0.39–0.45), AME–AME 0.24 (0.19–0.28), AME–ALE 0.08 (0.03–0.15), PME–PME 0.28 (0.25–0.28), PME–PLE 0.37 (0.33–0.43), AME–PME 0.62 (0.57–0.68), ALE–PLE 0.52 (0.46–0.53), clypeus height at AME 1.14 (1.03–1.53), clypeus height at ALE 0.98 (0.87–1.23).

Cheliceral furrow with three promarginal and four retromarginal teeth.



FIGURES 75a–g. *Psechrus tauricornis* **sp. nov.**, ♀ adult and primordial copulatory organ. a–c ♀ holotype SB 129, f–g s.a. ♀ paratype SB 850, both from Sri Lanka, Central Prov. d–e ♀ SB 261 from Sri Lanka, Southern Prov. a, e Epigyne, ventral view. b, d Vulva, dorsal view. c Schematic course of internal duct system. f Pre-epigyne, ventral view. g Pre-vulva, dorsal view.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.6 (8.2–11.0) [3.2 (2.7–4.0), 1.4 (1.2–1.6), 2.0 (1.7–2.1), 3.0 (2.6–3.3)]; Legs: I 46.0 (41.3–56.1) [12.4 (11.0–14.9), 3.3 (2.6–3.8), 12.7 (11.2–15.4), 11.8 (11.1–15.5), 5.8 (5.4–6.5)], II 37.3 (33.3–43.3) [10.3 (9.2–12.2), 3.0 (2.4–3.4), 9.7 (8.8–10.8), 9.6 (8.6–11.6), 4.7 (4.3–5.3)], III 26.9 (23.2–28.7) [8.1 (6.8–8.7), 2.3 (1.9–2.5), 6.5 (5.5–6.6), 6.6 (5.9–7.4), 3.4 (3.1–3.5)], IV 38.5 (34.8–44.0) [10.8 (9.8–12.5), 2.7 (2.1–2.8), 9.7 (8.8–10.8), 10.0 (9.2–12.1), 5.3 (4.9–5.8)].

Palpal claw with 14 (13–15) teeth.

Spination. Palp: 121{141} (131,141,142), 110 (110), 1101 (1101), 1014 (1014); legs: femur I 556 (566,676,757), II 556 (546,657,855) III 545 (545,546), IV 554 (555,654,554); patella I–IV 000 (000); tibia I–II 3038 (3038,30310), III 2124 (2124,2134,3134), IV 3134 (3136); metatarsus I 3037 (3037,3038,3047), II 3037 (3037), III 3035 (3035), IV 3036 (3037,3035,3036).

Copulatory organ (see also diagnosis and general description of *torvus*-group). Distal endings of the branches of TM pointing anterio-medially (Fig. 75a). Epigyne with many wrinkles and ridges surrounding MS and mostly without (distinct) epigynal field (EF). Copulatory ducts (CD) just a bit larger than receptacula. Spermathecal heads arising anterio-medial on receptacula (Fig. 75b).

Primordial copulatory organ. Pre-epigyne: Pre-septum (pre-MS) with one posterior transversal edge. Anterior margins of pre-MS visible as two small longitudinal edges (Fig. 75f) below anterior margins of pre-lateral lobes. Distance between the two endings of the former longer than half the length of pre-MS.

Pre-vulva: Pre-CD shorter than in *P. torvus*, narrow and anteriorly with narrow curve (Fig. 75g).

Colouration of female (see also description for *torvus*-group and *Psechrus*). Sternum brown to red-brown with yellowish-white median line running end-to-end (Fig. 82k). Median bands on carapace clearly serrated. Lateral bands very broad (2.5–3.5x diameter of PME) and clearly serrated. Light longitudinal line ventrally on opisthosoma continuous and (very) narrow. If measured centrally on opisthosoma, its width is 0.2–0.3 times the width of one half of the cribellum.

Variation in colouration pattern: Interestingly in this species a second morph colour pattern exists: The female from Southern Province (SB 261) and one female from ‘Ceylan’ (Simon-Collection, SB 633) belong to that morph. It is characterised by the absence of the light longitudinal line ventrally on opisthosoma (Fig. 81j) and by the unicoloured yellowish-brown sternum.

Variation of copulatory organs. Females: Distal tips of the branches of tegimentum (TM) may be directed further medially (Fig. 75e). Posterior section of MS may be shorter (Fig. 75e). Direction of SH may differ slightly (Fig. 75d).

Distribution. Sri Lanka (Fig. 94).

The following species could not be assigned to any of the species groups established above:

Psechrus crepido sp. nov.

Figs 76a–d, 77a–h, 83g, 86j, 89k, 92k

Psechrus torvus — Reimoser 1934: 467, misidentified (record of ♀ from Pumbarai, India).
Psechrus ghecuanus — Levi 1982: 122, figs 29–33, ad part, figs 32–33 misidentified (figs 32–33: illustration of ♀).

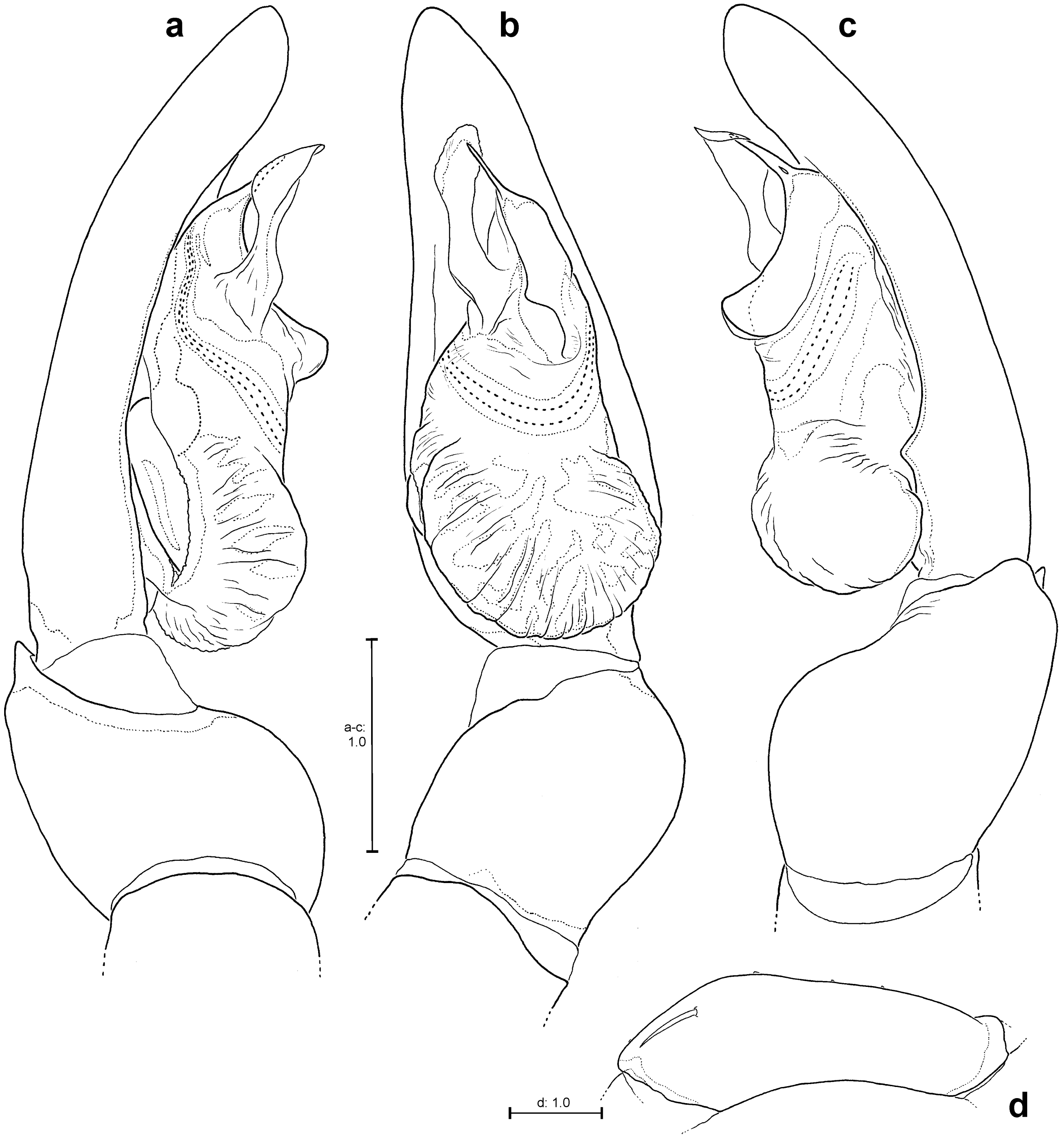
Type material. Holotype ♂ (SB 644), **INDIA: Tamil Nadu Province:** Thiruchirappalli (‘Trichinopoly’), ca. N 10°49', E 78°42', ca. 70 m; Noualhier (?) leg. 1895 (?); MNHN AR176; **Paratypes** (1 ♂, 10 ♀♀, 6 s.a. ♀♀)**: 1** ♂ (SB 645), **5** ♀♀ (SB 646, 649, 650–652), **1 s.a.** ♀ (SB 647), with same data as for holotype; MNHN AR176; **3** ♀♀ (SB 635–636, 641), **3 s.a.** ♀♀ (SB 637, 640, 642), **INDIA: Tamil Nadu Province:** Kodaikanal, ca. N 10°14', E 77°29', ca. 2100 m; Noualhier (?) leg. 1895 (?); MNHN AR175; **2** ♀♀ (SB 984–985), **INDIA: Tamil Nadu Province:** Kodaikanal, ca. N 10°14', E 77°29', 2130 m; V. Roth & B. Roth leg. 30.XII.1989; CAS 9032229; **2 s.a.** ♀♀ (SB 980–981), **INDIA: Tamil Nadu Province:** Kodaikanal, Silver Cascade roadside forest below Kodaikanal, N 10°15', E 77°31', ca. 1700 m; V. Roth & B. Roth leg. 31.XII.1989; CAS 9032228.

Additional material examined (3 s.a. ♂♂, 1 p.s.a. ♀, 2 juvs)**. INDIA: Tamil Nadu Province:** Kodaikanal, ca. N 10°14', E 77°29', ca. 2100 m; Noualhier (?) leg. 1895 (?); 1 p.s.a. ♀ (SB 643), 1 s.a. ♂ (SB 638), 1 juv. (SB 639), MNHN AR175. Kodaikanal, ca. N 10°14', E 77°29', 2130 m; V. Roth & B. Roth leg. 30.XII.1989; 1 juv. (SB

983), CAS 9032229. Thiruchirappali (‘Trichinopoly’), ca. N 10°49', E 78°42', ca. 70 m; Noualhier (?) leg. 1895 (?); 2 s.a. ♂♂ (SB 648, 653), MNHN AR176.

Etymology. The specific name refers to the ventral protrusion at the embolus base of the male type specimens (Latin “crepido” means “protrusion, pedestal”; term (noun) in apposition.

Diagnosis. Males with an elongated embolus base (EB) possessing a distinct ventral protrusion basally (Figs 76a–c). Tegulum (T) basally with rounded section possessing numerous wrinkles and ridges (Figs 76a–c). Females with median septum (MS) continously diverging anteriorly and with a flat large-area bulge in front of MS (Figs 77a,e, 89k). Spermatheca with small, corner-like structure dorso-anterio-laterally and fused with distal winding of copulatory duct (CD) (Figs 77b,d,f, 92k).



FIGURES 76a–d. *Psechrus crepido* **sp. nov.**, ♂ holotype SB 644 from India, Tamil Nadu Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

Description. Male (Measurements of holotype first, those of partatype in parentheses behind; paratype male misses both legs IV)**:**

Body and eye measurements. Carapace length 9.4 (7.0), carapace width 6.9 (4.8), anterior width of carapace 3.6 (2.8), opisthosoma length 11.4 (8.2), opisthosoma width 5.5 (3.8). Eyes: AME 0.43 (0.34), ALE 0.49 (0.44), PME 0.50 (0.44), PLE 0.48 (0.42), AME–AME 0.29 (0.14), AME–ALE 0.07 (0.06), PME–PME 0.34 (0.17), PME–PLE 0.46 (0.30), AME–PME 0.75 (0.53), ALE–PLE 0.67 (0.46), clypeus height at AME 1.28 (0.69), clypeus height at ALE 1.08 (0.65).

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 11.3 (8.6) [4.3 (3.3), 1.9 (1.5), 1.8 (1.2), 3.3 (2.6)]; Legs: I 61.5 (47.4) [17.2 (12.7), 4.4 (3.1), 17.5 (13.0), 16.9 (12.4), 7.5 (6.2)], II 48.5 (36.0) [14.1 (10.1), 3.9 (2.9), 12.8 (9.3), 12.3 (9.1), 5.4 (4.6)], III 34.7 (25.8) [10.3 (7.8), 3.2 (2.3), 8.3 (6.1), 8.9 (6.5), 4.0 (3.1)], IV 51.0 [14.4, 3.6, 12.9, 14.1, 6.0]. Thus, legs in males, in relation to other *Psechrus* species, short: FEM-I+MTT-I/CL : ca. 3.6.

Spination. Palp: 151{141} (141), 110 (110), 1101 (1101); legs: femur I 556 (547), II 655{555} (556), III 555{545} (555), IV 554; patella I–IV 000; tibia I–II 3036 (3038), III 3036 (3036), IV 3036{3037}; metatarsus I–III 3035 (3035), IV 3037.

Palpal femur without modification and broadest distally (Fig. 76d). MC-I–II & MT-I absent.

Copulatory organ. Embolus (E) thin, not filiform, but somewhat compressed and conductor (C) thin, fleshy, membranous most distally and slightly curved proximally (Figs 76a–b). Subtegulum barely visible in ventral view. Sperm duct broad U-shaped (Fig. 76b). Cymbium dorsally with very dense scopula, covering 1/2 of cymbium (Fig. 83g). Palpal tibia short and strangely shaped (Figs 76a–c).

Female:

Body and eye measurements. Carapace length 8.5–11.2, carapace width 6.1–8.0, anterior width of carapace 3.6–4.6, opisthosoma length 11.9–14.2, opisthosoma width 6.1–6.9. Eyes: AME 0.38–0.49, ALE 0.47–0.54, PME 0.47–0.51, PLE 0.49–0.52, AME–AME 0.23–0.33, AME–ALE 0.06–0.11, PME–PME 0.31–0.45, PME–PLE 0.43–0.58, AME–PME 0.76–0.84, ALE–PLE 0.57–0.80, clypeus height at AME 1.29–1.68, clypeus height at ALE 1.06–1.49.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 9.7–13.6 [3.3–4.8, 1.4–2.0, 1.9–2.4, 3.1–4.4]; Legs: I 46.2–63.9 [12.8–17.4, 3.6–5.1, 12.9–17.5, 11.5–16.8, 5.4–7.1], II 36.3–51.1 [10.5–14.8, 3.3–4.6, 9.6–13.1, 8.6–13.0, 4.3–5.6], III 26.4–36.2 [8.1–10.9, 2.6–3.5, 6.2–8.6, 6.3–9.1, 3.2–4.1], IV 37.3–51.9 [10.6–15.0, 2.9–4.1, 9.8–13.2, 9.4–13.7, 4.6–5.9]. Thus, legs in females, in comparison to other *Psechrus* species, rather short: FEM-I+MTT-I/CL : 2.8–3.1.

Palpal claw with 14–16 teeth.

Spination. Palp: 141, 110, 1201 (1301), 1014; legs: femur I 556 (546), II 556 (556,546,657), III 555 (555,545), IV 554 (554,555); patella I–IV 000; tibia I 3036, II 3036 (3036,3037), III 3036 (3036,3034), IV 3036 (3036,3037); metatarsus I 3035 (3035), II 3035 (3037), III 3035 (3035), IV 3035 (3037).

Copulatory organ. Epigynal field (EF) somewhat indistinct but large (Fig. 77a). Epigynal muscle sigilla associated with EF, slit sense organs may be outside or within EF. Spermathecal heads bulbous, arising anterio-medial on receptacula-CD-complex (Fig. 77b).

Primordial copulatory organ. Pre-epigyne: Pre-septum (pre-MS) slightly broader than long, distal endings of its lateral margins not or just slightly extending medially (Fig. 77h). Pre-epigynal field small but continous.

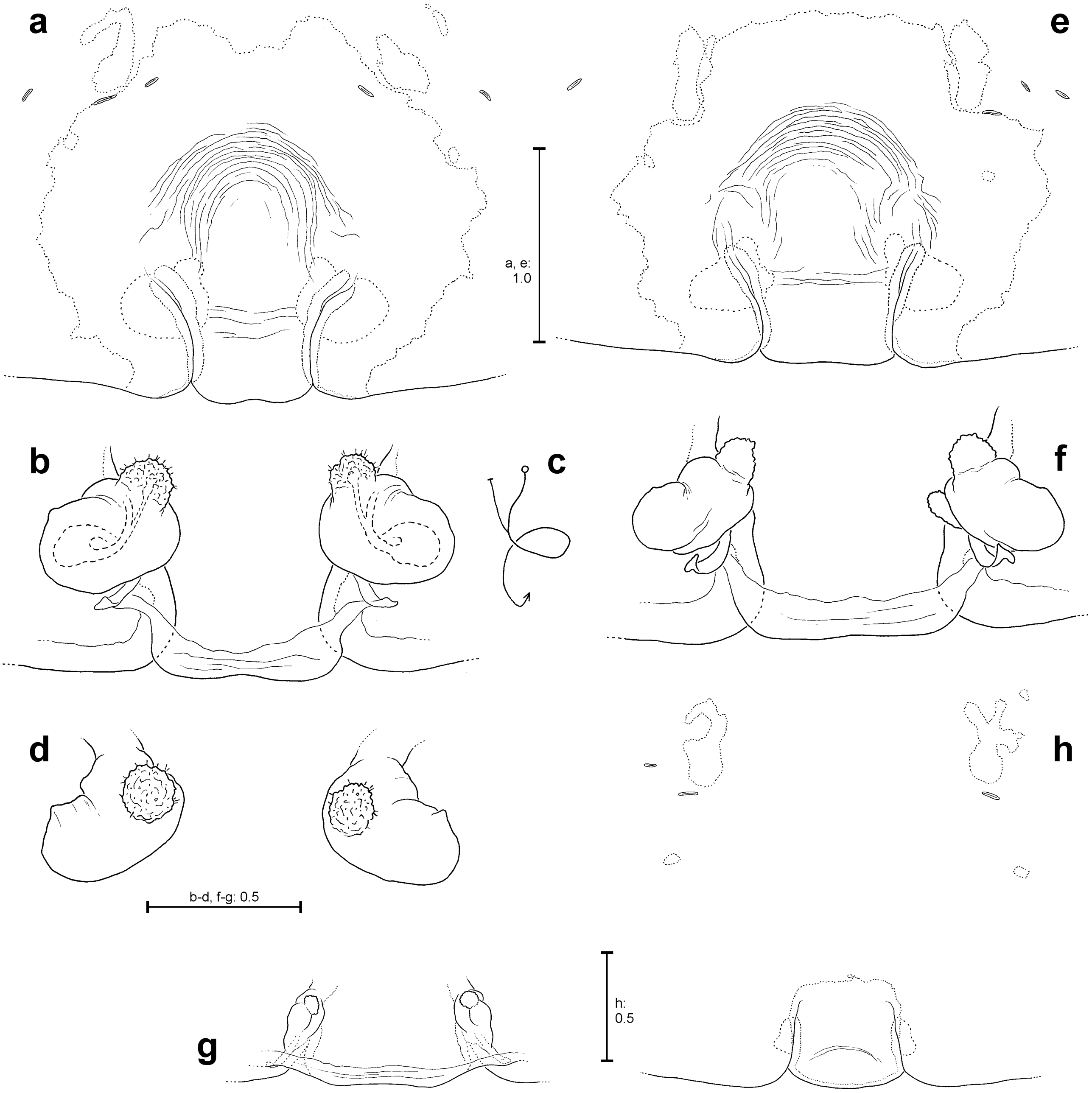
Pre-vulva: Distal part of pre-CD larger than pre-receptacula (Fig. 77g).

Colouration of male and female (see also description for *Psechrus*). Sternum light yellowish brown at lateral margins and with light brown to red-brown, tapered patch centrally. Median bands on carapace slightly serrated. Lateral bands broad to very broad (2–3x diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma continuous, meduim-sized in width. If measured centrally on opisthosoma, its width is 0.4–0.8 times the width of one half of the cribellum.

Variation of copulatory organs. The two males examined showed no significant variation. Females: Lateral margins of MS may be less diverging anteriorly (Fig. 77e). In one specimen they are just slightly diverging (Fig. 89k). Receptaculum-CD-complex may be narrower and/or basally with additional, smaller spermathecal head (Figs 77f, 92k).

Distribution. India (Fig. 94).

Remarks: This species was already examined by Reimoser (1934), who obtained a ♀ from Pumbarai (presently Poombarai, Tamil Nadu Province, India), collected by J. Carl and K. Escher, XI.1926–IV.1927, subsequently deposited in MHNG. He identified the specimen as *P. torvus* without providing an illustration. The respective female was not available for the present study (all material of Psechridae deposited in the arachnid collection of MHNG was provided by the curator, P. Schwendinger; there was no female from Pumbarai, India among the material; this specimen may have been mislaid or lost.). Nevertheless, according to his material list, Levi (1982) had examined and illustrated this specimen and identified it as *P. ghecuanus*. However, Levi denoted this female as "doubtful specimen". His accurate illustrations (Levi 1982, figs 32–33) of the copulatory organ unambiguously show that it is conspecific with *P. crepido* **sp. nov.** Moreover, Poombarai is only nine km West of Kodaikanal, where some of the paratypes of *P. crepido* **sp. nov.** designated herein, had been recorded.



FIGURES 77a–h. *Psechrus crepido* **sp. nov.**, from India, Tamil Nadu Prov., ♀ adult and primordial copulatory organ. a–d ♀ paratype SB 646, e–f ♀ paratype SB 635, g–h s.a. ♀ paratype SB 647. a, e Epigyne, ventral view. b, f Vulva, dorsal view. c Schematic course of internal duct system. d Vulva, frontal view. g Pre-vulva, dorsal view. h Pre-epigyne, ventral view.

***Psechrus schwendingeri* sp. nov.**

Figs 78a–f, 86k

Type material. Holotype ♂ (SB 143), **PHILIPPINES: Luzon: Mountain Province:** Banaue, ca. N 16°55', E 121°03', ca. 1100 m, forest relict; P. Schwendinger leg. II.1981; MHNG; **Paratypes: 1 s.a.**♀ (SB 144), with same data as for holotype (originally in same series); MHNG; **1 s.a.** ♂ (SB 870, very close to adult moult, opisthosoma lost), **PHILIPPINES: Luzon: Mountain Province:** Mt. Datá, ca. N 16°52', E 120°52', ca. 2200 m; O. Koch leg. 1883–1894; F. Karsch det. *Lancaria* sp.; ZMB 3842.

Note on type material: The subadult male SB 870 must have been very close to the final moult when it was collected. The specific bulb structures are already visible through the old cuticula. According to the label it was collected by Otto Koch in Luzon. Mt. Datá is most likely the exact locality. The publication Beolens *et al.* (2009) states that Otto Koch had collected most of his material from the Philippines in expeditions with Alexander Schadenberg. Schadenberg had collected a lot of material in Northern Luzon. In the first description of a bark rat named after Schadenberg (Meyer 1895) the author stated that Schadenberg stayed a longer period of time at Mount Datá, where he collected this rat and also lots of other animals.

Additional material examined. PHILIPPINES: Luzon: Mountain Province: Mt. Datá, ca. N 16°52', E 120°52', ca. 2200 m; Otto Koch leg. 1883–1894; F. Karsch det. *Lancaria* sp.; 1 s.a. ♀ (SB 871, opisthosoma lost), ZMB 3842.

Additional doubtful material examined. PHILIPPINES: Luzon: Mountain Province: most likely: Bontoc, ca. N 17°05', E 120°58', ca. 900 m; C.G. Semper leg. VIII.1860; No. 235; 1 p.s.a. ♀ (SB 872), 1 juv. (SB 873), ZMH.

Etymology. The specific name is a patronym in honour of the collector of the holotype, Peter Schwendinger; noun (name) in genitive case.

Diagnosis. Males with distally hook-shaped embolus (E) with its tip resting in the cymbium alveolus (CA). Conductor partly reduced and covered with a great many very small tubercles (Figs 78a–c).

Description. Male:

Body and eye measurements. Carapace length 7.3, carapace width 5.4, anterior width of carapace 2.9, opisthosoma length 9.4, opisthosoma width 3.1. Eyes: AME 0.39, ALE 0.38, PME 0.39, PLE 0.39, AME–AME 0.27, AME–ALE 0.09, PME–PME 0.30, PME–PLE 0.37, AME–PME 0.51, ALE–PLE 0.48, clypeus height at AME 1.02, clypeus height at ALE 0.88.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.7 [2.8, 1.1, 1.2, 2.6]; Legs: I 61.2 [17.0, 3.4, 16.3, 17.8, 6.7], II 44.9 [12.9, 3.0, 11.3, 12.7, 5.0], III 30.1 [8.9, 2.3, 7.1, 8.3, 3.5], IV 45.7 [12.7, 2.6, 11.4, 13.5, 5.5].

Spination. Palp: 131, 000, 1201{1101}; legs: femur I 556{656}, II 556, III 434{546}, IV 545; patella I–IV 000; tibia I–II 3036, III 2026, IV 2036; metatarsus I–III 3035, IV 3036.

Palpal femur with extremely flat ventral bulge proximally (Fig. 78d), actually not worth mentioning as modification. MC-I–II & MT-I absent.

Copulatory organ. Embolus (E) with membranous structure leading from tip to proximal section. Conductor (C), which has in fact lost its function, distally with very narrow, membranous section. Tegulum elongated and sperm duct U-shaped (Fig. 78b). Cymbium dorsally with very dense scopula covering 2/3 of cymbium. Palpal tibia rather short and broadest distally (Figs 78a–c).

Female: unknown (only subadult female known, a few measurements of the subadult female are given anyway).

Body measurements. Carapace length 5.9, carapace width 4.0, opisthosoma length 9.5, opisthosoma width 4.8.

Cheliceral furrow with three promarginal and four retromarginal teeth.

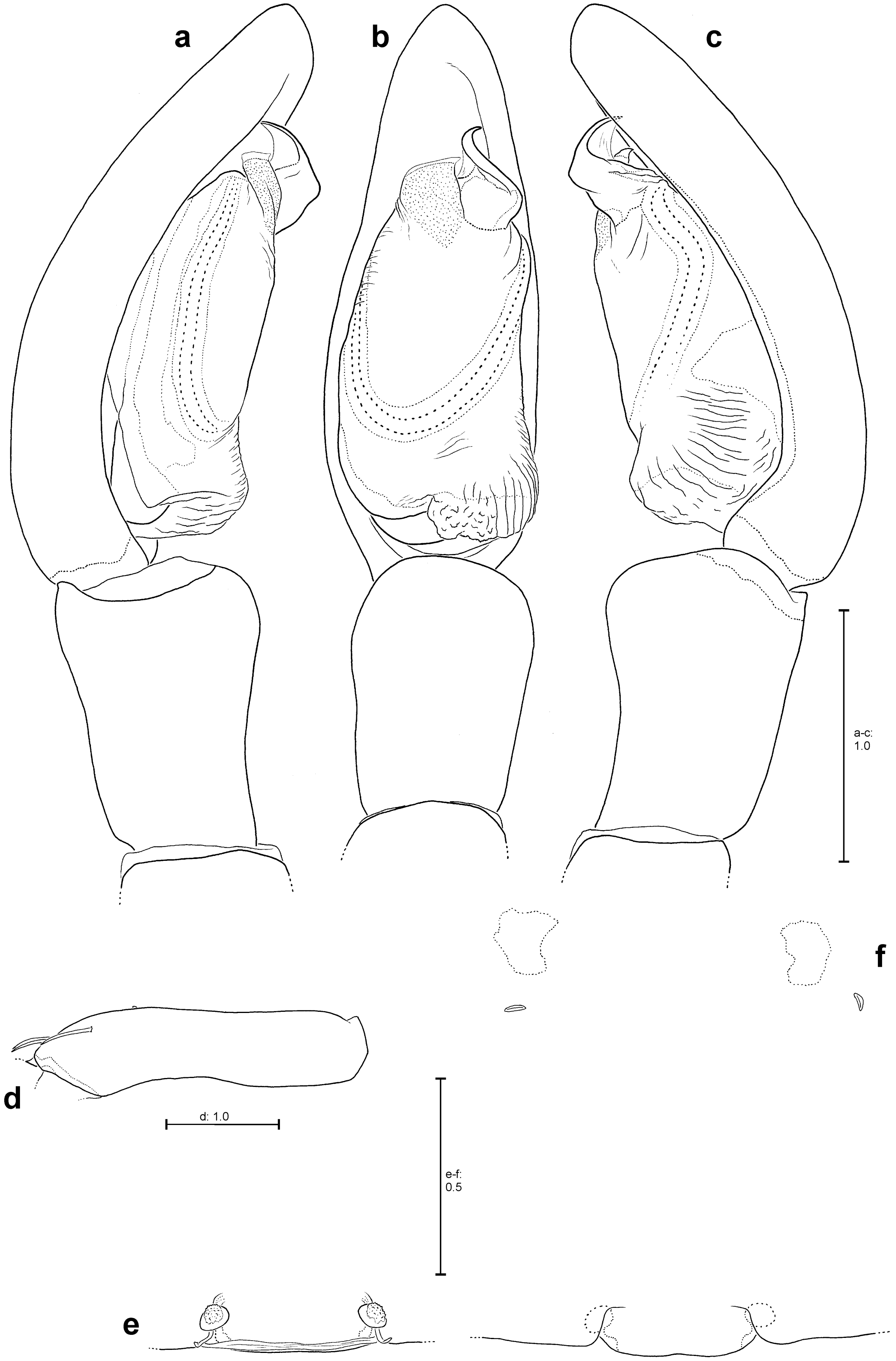
Leg formula: 1423. Measurements of metatarsi of legs. I 9.2, II 6.6, III 4.6, IV 7.0.

Palpal claw with 14 teeth.

Spination. Palp: 131, 110, 1101, 1014; legs: femur I 647, II–III 545, IV 544; patella I–IV 000; tibia I–II 3036, III 3034, IV 3033; metatarsus I–IV 3035.

Primordial copulatory organ. Pre-epigyne: Pre-MS three times broader than long. Distal endings of the lateral margins of pre-lateral lobes curved medially (Fig. 78f). Pre-epigynal field absent.

Pre-vulva: Pre-spermathecal heads very flat, located dorsally upon cross-oval pre-receptacula (Fig. 78e). Pre-copulatory ducts short and narrow.



FIGURES 78a–f. *Psechrus schwendingeri* **sp. nov.**, from Philippines, Luzon, Mountain Prov. a–d ♂ holotype SB 143. e–f s.a. ♀ paratype SB 144. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view. e Pre-vulva, dorsal view. f Pre-epigyne, ventral view.

Colouration of male and subadult female (see also description for *Psechrus*). Sternum light yellowish brown at lateral margins and with broad, light brown to red-brown, tapered patch centrally. Median bands on carapace barely serrated. Lateral bands rather broad (ca. 1.5x diameter of PME) and hardly or slightly serrated. Light longitudinal line ventrally on opisthosoma continuous and very narrow. If measured centrally on opisthosoma, its width is 0.1–0.3 times the width of one half of the cribellum.

Distribution. Philippines (Fig. 102).

Psechrus cebu **Murphy, 1986**

Figs 79a–d, 80a–f, 86l, 89l, 92l

Psechrus cebu Murphy 1986: 66, figs 3–6 (Description of ♂ and ♀, illustration of ♂ and ♀). [Holotype ♂ (SB 149) from PHILIPPINES: Cebu: Cebu Province: White Cave, camp 7; Fr. Schoenig (accompanied by Tumilap + company) leg. 17.I.1984; MCZ; Paratypes: 2 ♀♀ (SB 150 [epigyne dissected and lost], 151), with same data as for holotype; MCZ; 1 ♀ (SB 177), PHILIPPINES: Cebu: Cebu Province: near Cebu City, Cave 7, camp 7, cave, near entrance; G. Alberti leg. III.1983; MCZ, all type material examined].

Additional material examined. PHILIPPINES: Cebu: Cebu Province: White Cave, camp 7; Fr. Schoenig (accompanied by Tumilap + company) leg. 17.I.1984; 1 s.a. ♀ (SB 152), MCZ.

Revised diagnosis. Males with margins of tegulum (T) continuously converging from proximal to distal section. Embolus (E) dorsally with characteristic, small, pointed apophysis (Figs 79a–c). Conductor (C) membranous, simple and in prolateral view S-shaped and wound around E (Figs 79a,c). Females with trapezoid median septum (MS). Anterior margins of lateral lobes strongly diverging (Figs 80a,f, 89l). Copulatory ducts (CD) short, broad and with distinctly rough surface (Figs 80b, 92l).

Description. Male:

Body and eye measurements. Carapace length 6.3, carapace width 4.3, anterior width of carapace 2.4, opisthosoma length 9.0, opisthosoma width 2.8. Eyes: AME 0.35, ALE 0.40, PME 0.45, PLE 0.40, AME–AME 0.23, AME–ALE 0.06, PME–PME 0.27, PME–PLE 0.36, AME–PME 0.47, ALE–PLE 0.46, clypeus height at AME 0.74, clypeus height at ALE 0.64.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.5 [2.7, 1.2, 1.2, 2.4]; Legs: I 73.4 [20.0, 3.0, 19.8, 21.9, 8.7], II 52.3 [14.7, 2.5, 12.6, 16.4, 7.1], III 36.0 [10.6, 2.0, 8.6, 10.2, 4.6], IV 57.4 [15.5, 2.4, 14.0, 17.7, 7.8]. Spination. Palp: 141, 010, 0100; legs: femur I 657{656}, II 656, III 646, IV 756{646}; patella I–IV 000; tibia I–II 3038, III 3138, IV 3235{3138}; metatarsus I–III 3036, IV 3035.

Palpal femur modified with ventral bulge (Fig. 79d). MC-I–II & MT-I absent.

Copulatory organ. Embolus- (E) length and width medium-sized, conductor (C) thin, rounded apically (Fig. 79b). Sperm duct U-shaped (Fig. 79b). Cymbium dorsally with very dense scopula, covering 1/2 of cymbium. Palpal tibia medium-sized and broadest distally (Figs 79a–c).

Female:

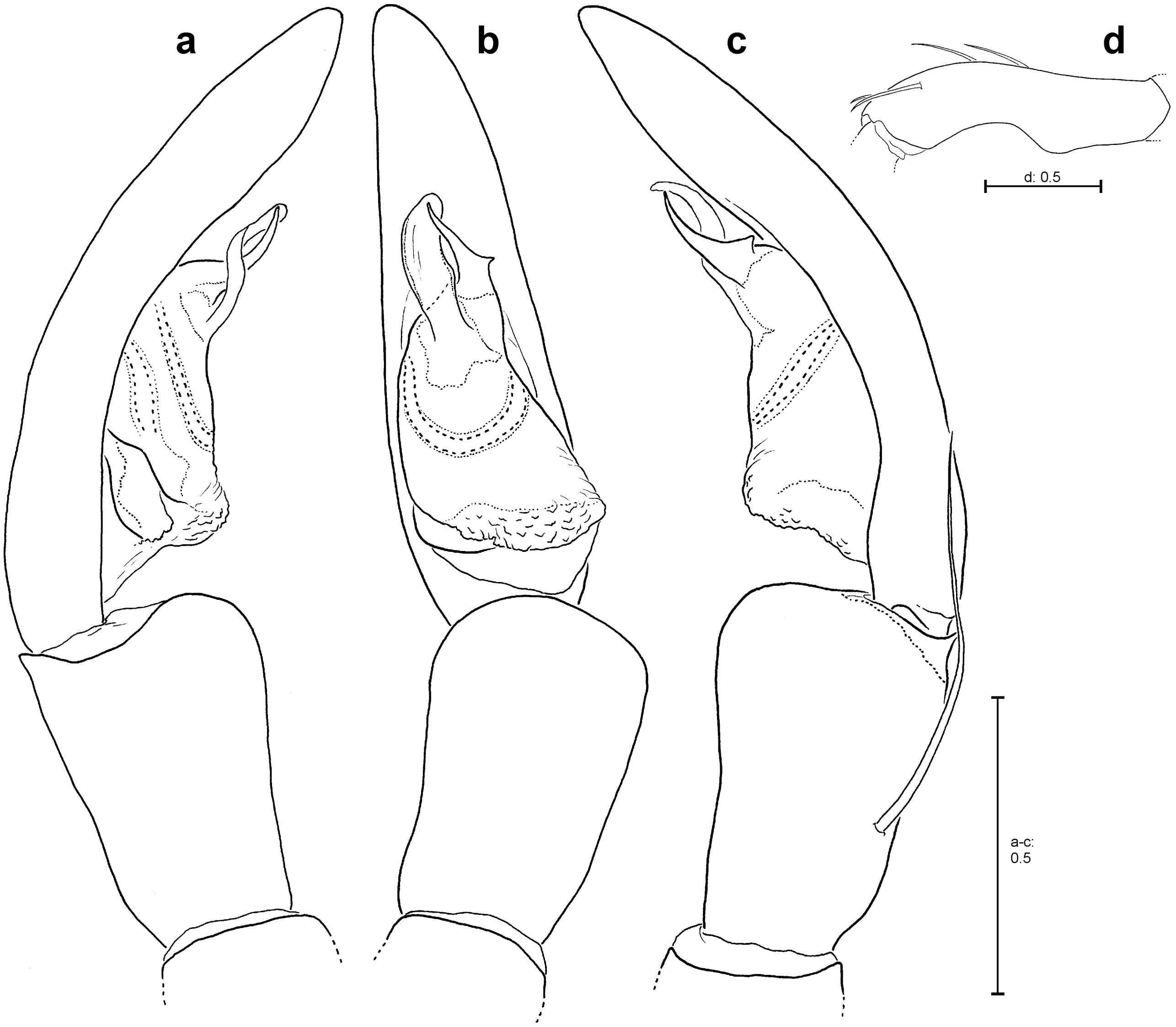
Body and eye measurements. Carapace length 6.1–7.1, carapace width 4.2–4.6, anterior width of carapace 2.7–3.0, opisthosoma length 10.0–10.8, opisthosoma width 3.4–3.8. Eyes: AME 0.37–0.43, ALE 0.44–0.48, PME 0.46–0.47, PLE 0.46–0.48, AME–AME 0.21–0.24, AME–ALE 0.06–0.08, PME–PME 0.23–0.28, PME–PLE 0.34–0.39, AME–PME 0.47–0.52, ALE–PLE 0.42–0.46, clypeus height at AME 0.84–0.93, clypeus height at ALE 0.64–0.78.

Cheliceral furrow with three promarginal and four retromarginal teeth.

Measurements of palp and legs. Leg formula: 1423. Palp: 7.8–8.6 [2.7–3.0, 1.1–1.2, 1.5–1.6, 2.5–2.8]; Legs: I 50.0–55.7 [14.2–15.6, 2.6–3.1, 13.8–15.4, 13.5–15.1, 5.9–6.5], II 37.6–42.4 [10.8–12.2, 2.3–2.7, 9.9–11.2, 10.1–11.3, 4.5–5.0], III 25.6–28.8 [7.9–8.9, 1.8–2.1, 6.1–6.9, 6.6–7.4, 3.2–3.5], IV 39.5–44.4 [11.4–12.8, 2.2–2.5, 10.2–11.5, 10.6–12.0, 5.1–5.6]. Thus, legs in females, in relation to other *Psechrus* species, rather long: FEM-I+MTT-I/CL : ca. 4.5.

Palpal claw with 13–14 teeth.

Spination. Palp: 131, 110, 1101, 1014 (1015); legs: femur I 667 (766), II 666 (656,667,665), III 656 (646,666), IV 655 (545,665); patella I–IV 000; tibia I 3036 (3038), II 3038 (3038), III 3136 (313,3135), IV 3137 (3137,3138); metatarsus I–II 3037, III 3035 (3035,3036), IV 3034.



FIGURES 79a–d. *Psechrus cebu*, ♂ holotype SB 149 from Philippines, Cebu Prov. a–c ♂ palp (a prolateral, b ventral, c retrolateral view). d ♂ left palpal femur, retrolateral view.

Copulatory organ. Epigynal field (EF) relatively high (Fig. 80a). Epigynal muscle sigilla and slit sense organs outside EF. Spermathecal heads relatively small, arising anterio-medial on receptacula (Fig. 80b).

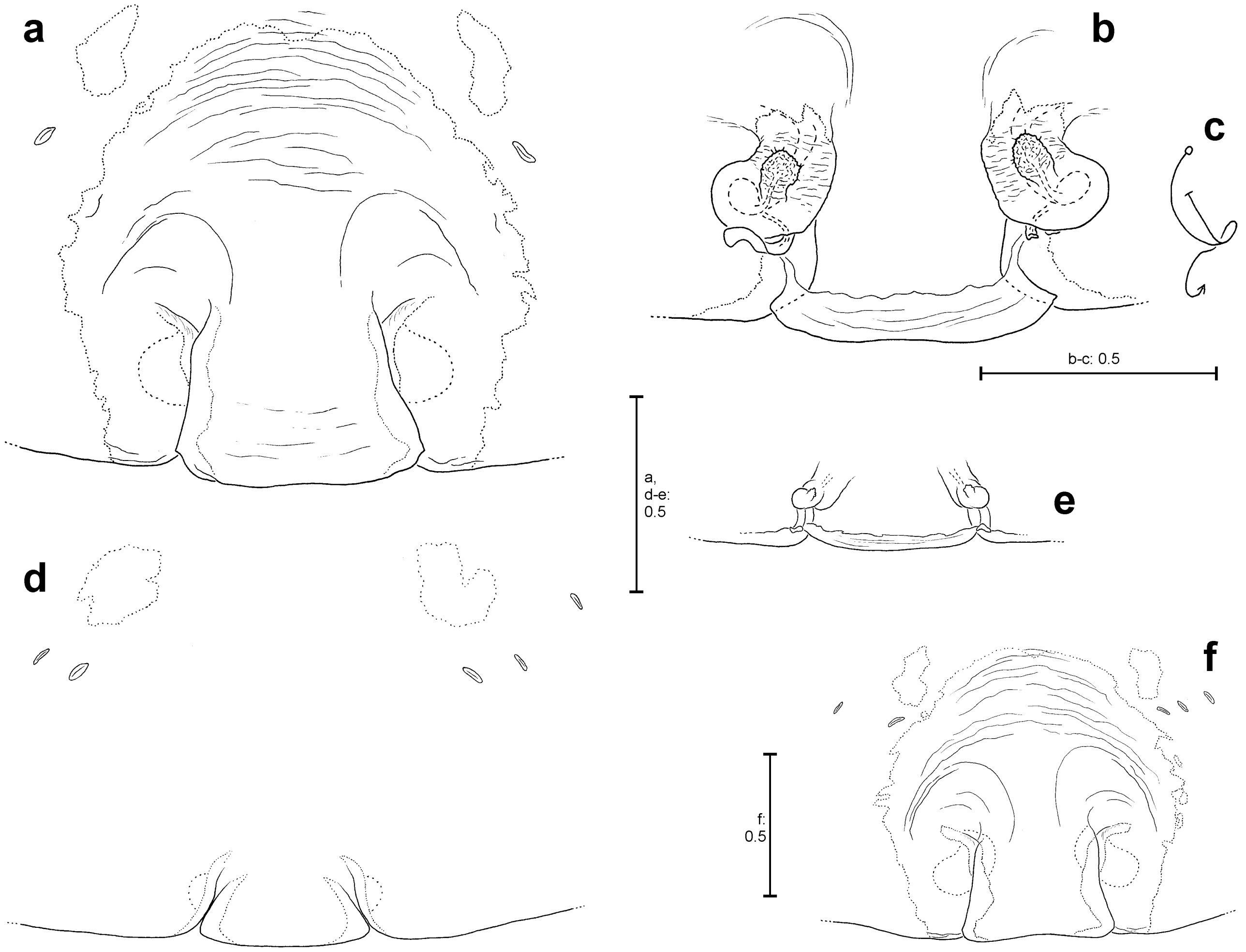
Primordial copulatory organ. Pre-epigyne: Pre-septum broader than long, the distal endings of its lateral margins as well as the ones of the lateral lobes just slightly extending medially. Pre-copulatory openings broad (Fig. 80d). Pre-EF absent.

Pre-vulva: Pre-CD broader than pre-receptacula (Fig. 80e).

Colouration of male and female (see also description for *Psechrus*). Sternum light yellowish brown at lateral margins and with brown, tapered patch centrally. Median bands on carapace serrated. Lateral bands (very) broad (1.5–2.5x diameter of PME) and serrated. Light longitudinal line ventrally on opisthosoma continuous and rather narrow. If measured centrally on opisthosoma, its width is 0.3–0.5 times the width of one half of the cribellum.

Variation of copulatory organs. Females: In one specimen posterior margin of MS slightly concave (Fig. 80f). Vulvae without significant variation.

Distribution. Philippines (Fig. 102).



FIGURES 80a–f. *Psechrus cebu*, from Philippines, Cebu Prov., ♀ adult and primordial copulatory organ. a–c ♀ paratype SB 151, d–e s.a. ♀ SB 152, f ♀ paratype SB 177. a, f Epigyne, ventral view. b Vulva, dorsal view. c Schematic course of internal duct system. d Pre-epigyne, ventral view. e Pre-vulva, dorsal view.

Nomen dubium:

Psechrus mimus Chamberlin, 1924

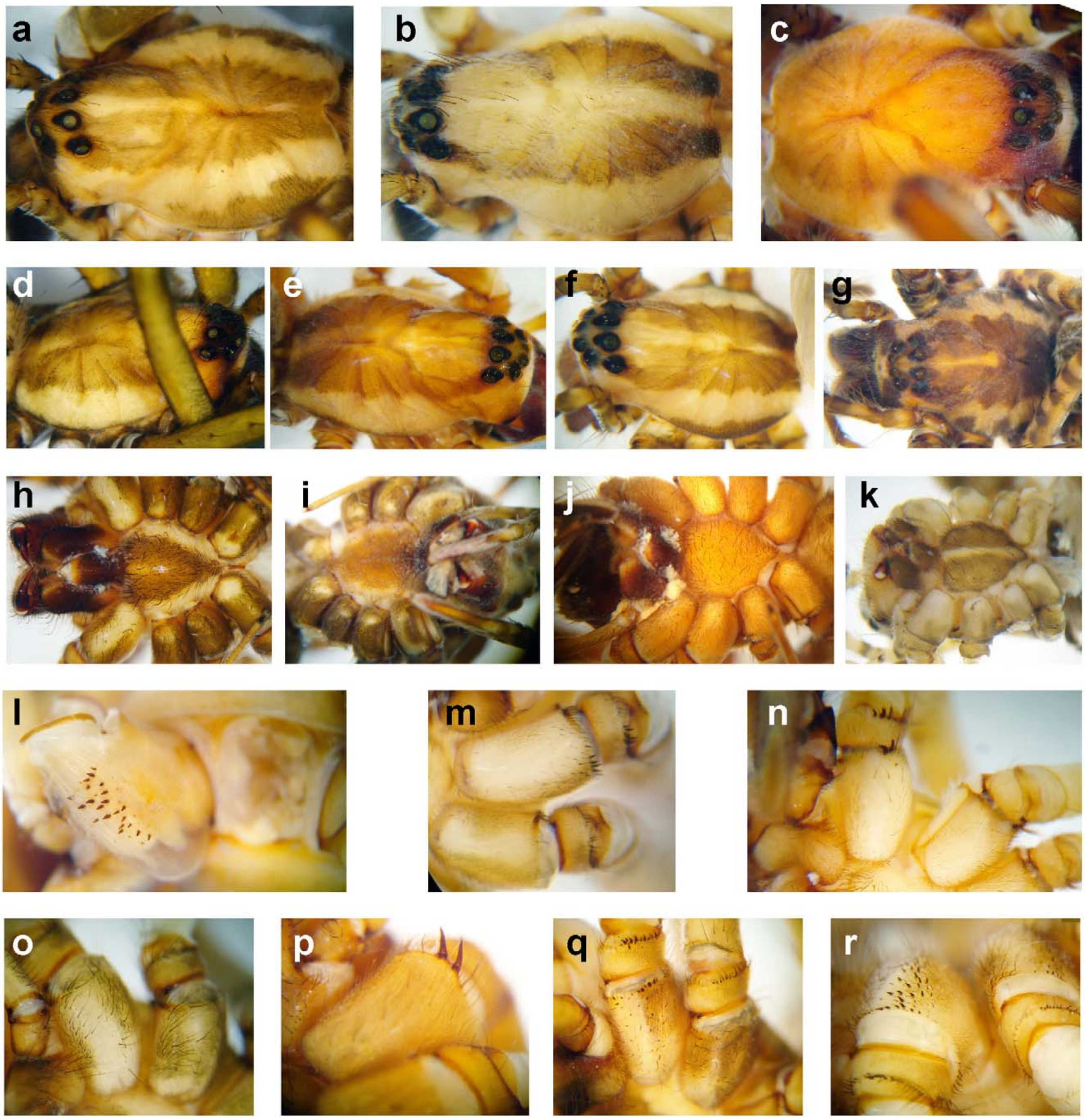
Figs 63h–i

Psechrus mimus Chamberlin 1924: 2 (Description of p.s.a. ♀). [Holotype p.s.a. ♀ (SB 191, label marked with 'TYPE') from CHINA: Jiangsu Province: Suzhou ('Suchan'); N. Gist Gee leg.; Type No. 863; |A31|; USNM 1054; Paratypes: 1 p.s.a. ♀ (SB 603), 1 juv. (SB 723), with same data as for holotype; USNM (p.s.a. ♀), MCZ 1025 (juv.), all type material examined]. Lehtinen 1967: 261 (Syn. with *P. torvus*, rejected by subsequent authors). Levi 1982: 123 (Syn. with *P. sinensis*). Xu and Wang 1983: 35, figs 1–7 (Illustration of ♂ and ♀). Song 1987: 68, fig. 34 (Illustration of ♂ and ♀). Song 1988: 133. Song *et al.* 1999: 397, figs 232E–F, Q–R (Illustration of ♂ and ♀). Wang and Yin 2001: 337 (Removed from syn. with *P. sinensis*, considered as nomen dubium).

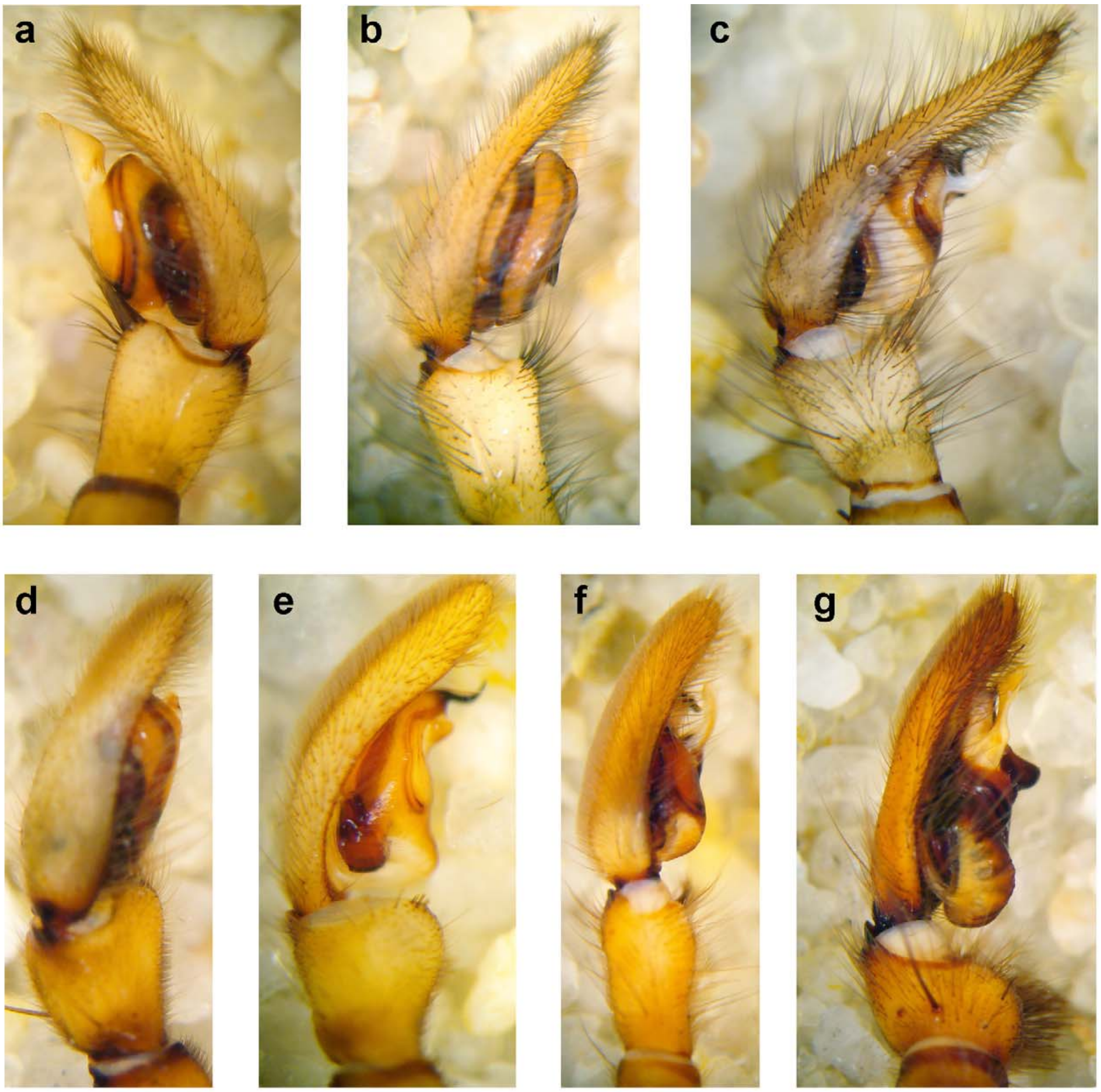
Psechrus sinensis — Levi 1982: 123, figs 34–39, ad part, figs 36–39 misidentified (figs 36–37: illustration of p.s.a. ♀).

Remark: Wang and Yin (2001) considered *P. mimus* as nomen dubium giving the reason that "Chamberlin described *P. mimus* from an unidentifiable female juvenile...". The holotype (Figs 63h–i) as well as one paratype (SB 603) are herein considered pre-subadult females. Therefore, it is indeed very complicated, if not impossible, to assign these specimens to a particular species. In *Psechrus* females the pre-epigynes mostly show already species-specific characters, but the pre-pre-epigynes (of antepenultimate instar females) are hard to characterise. Hence, for now I agree with Wang and Yin (2001) in regarding *P. mimus* as nomen dubium. Nevertheless, it cannot be excluded, that *P. senoculatus*, which is regarded as valid species in the present study, is a synonym of *P. mimus* as proposed by Song (1988); however, there is no clear evidence for that. With additional material (including p.s.a. ♀♀, s.a. ♀♀ and adults) from the type locality, Suzhou, this problem may be solved.

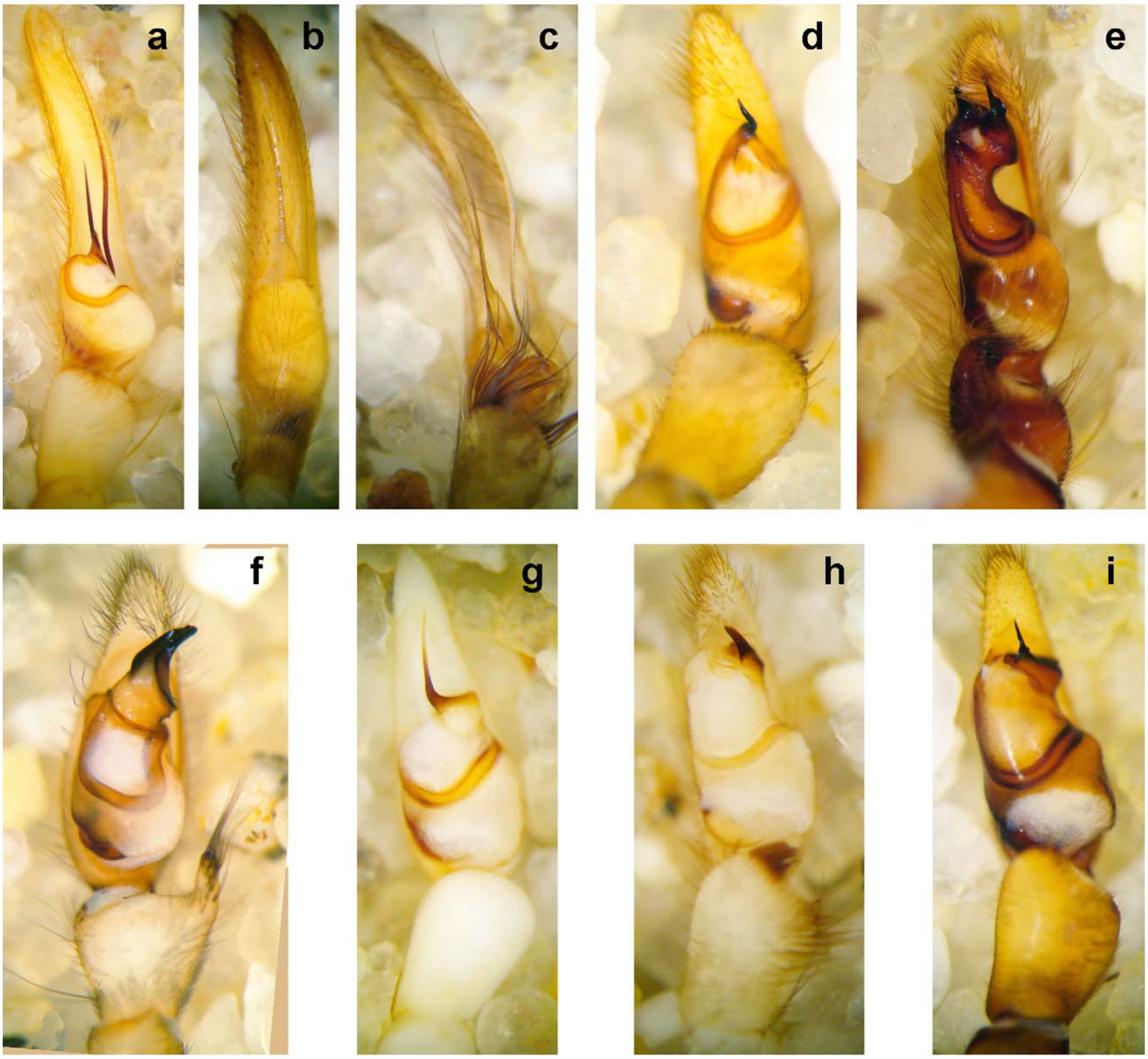
FIGURES 81a–j. *Psechrus* spp., photos of dorsal habitus (a–d) and ventral view of opisthosoma (e–j). a *P. ancoralis*. b *P. hartmanni* **sp. nov.** c *P.* sp. out of *mulu*-group. d *P. luangprabang*. e *P. singaporensis*. f *P. annulatus*. g *P. jaegeri* **sp. nov.** h *P. marsyandi*. i *P. kunmingensis*. j *P. tauricornis* **sp. nov.** a ♀ SB 75 from Laos, Luang Prabang Prov. b ♀ holotype SB 1007 from Sri Lanka, Central Prov. c ♂ from Malaysia, Borneo, Sarawak Prov. d ♀ SB 508 from Laos, Luang Nam Tha Prov. e s.a. ♀ SB 559 from Indonesia, Sumatera Utara Prov. f ♀ paralectotype SB 830 from Indonesia, Jawa Barat Prov. g ♀ holotype SB 530 from Laos, Champasak Prov. h s.a. ♀ SB 748 from Nepal, Dhawalagiri Prov. i ♀ SB 953 from China, Yunnan Prov. j ♀ SB 633 from Sri Lanka. Photos 81a by Helmut Steiner, Hanau, 81c by Peter Koomen, Leeuwarden (copyright owner).



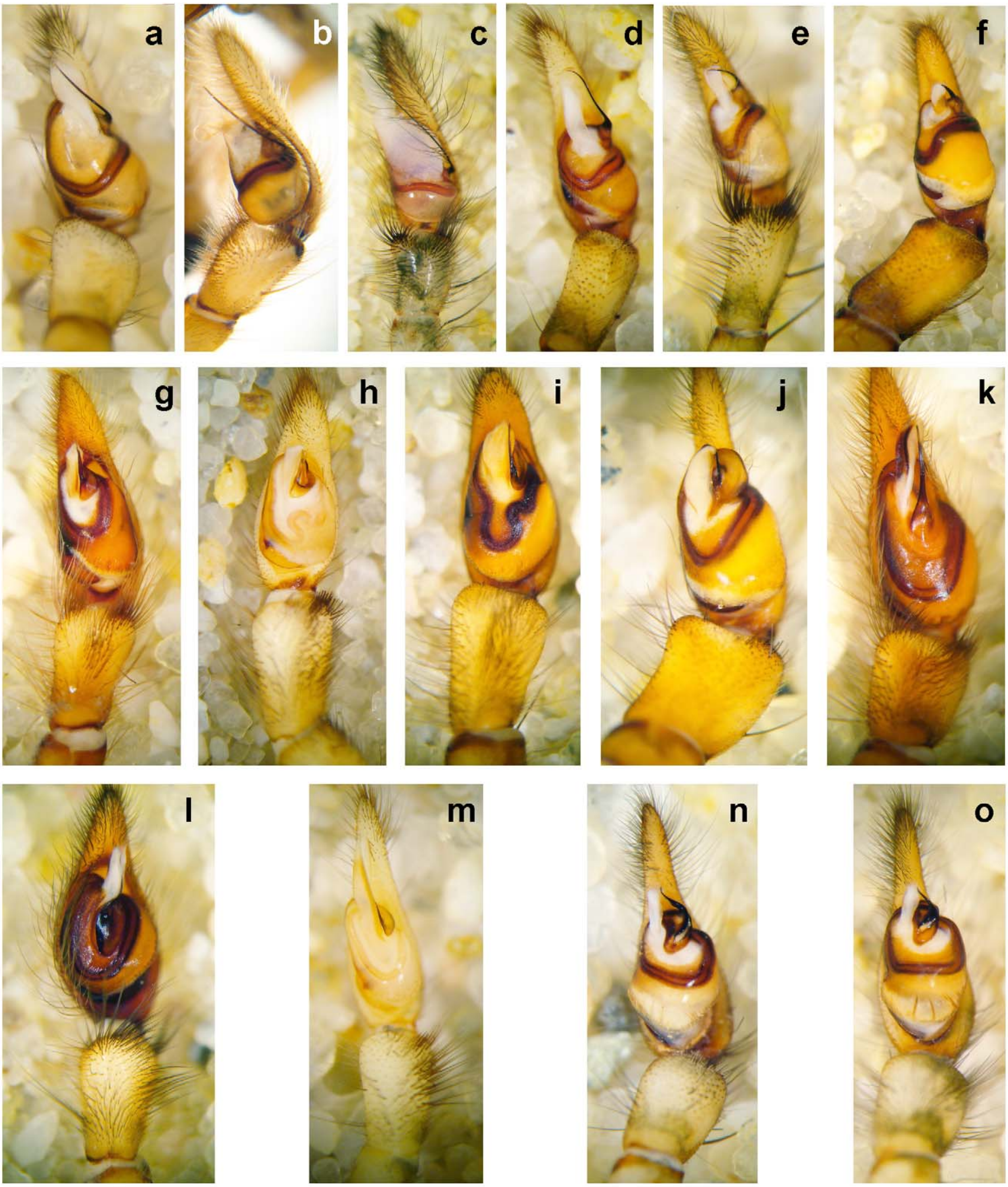
FIGURES 82a–r. *Psechrus* spp., photos of carapace (a–g), sternum (h–k) and ventral view of coxae of legs I–II (l-r). a *P. libelti*. b *P. khammouan*. c *P. kenting*. d *P. fuscai* **sp. nov.** e *P. ghecuanus*. f *P. elachys* **sp. nov.** g, k *P. tauricornis* **sp. nov.** h, o *P. antraeus*. i *P. annulatus*. j, p *P. hartmanni* **sp. nov.**, l *P. himalayanus*, m *P. ancoralis*, n *P. mulu*, q *P. senoculatus*, r *P. marsyandi*. a ♀ SB 969 from Brunei Darussalam. b ♀ SB 382 from Laos, Khammouan Prov. c ♀ holotype SB 615 from Taiwan, Pingtung County. d ♀ holotype SB 954 from China, Yunnan Prov. e s.a. ♀ syntype SB 222 from Myanmar, Kayin Prov. f ♀ holotype SB 861 from Thailand, Satun Prov. g ♀ paratype SB 849, k juv. SB 851, both from Sri Lanka, Central Prov. h ♀ holotype SB 8 from Laos, Vientiane Prov. i ♀ paralectotype SB 830 from Indonesia, Jawa Barat Prov. j ♀ SB 630 from Sri Lanka. l ♂ lectotype SB 14 from India, Uttarakhand Prov. m ♂ paratype SB 26 from Laos, Luang Nam Tha Prov. n ♂ paratype SB 241 from Malaysia, Borneo, Sarawak Prov. o ♂ paratype SB 7 from Laos, Vientiane Prov. p ♂ SB 624 from Sri Lanka. q ♂ paratype SB 537 from China, Hunan Prov. r ♂ holotype from Nepal, Gandaki Prov.



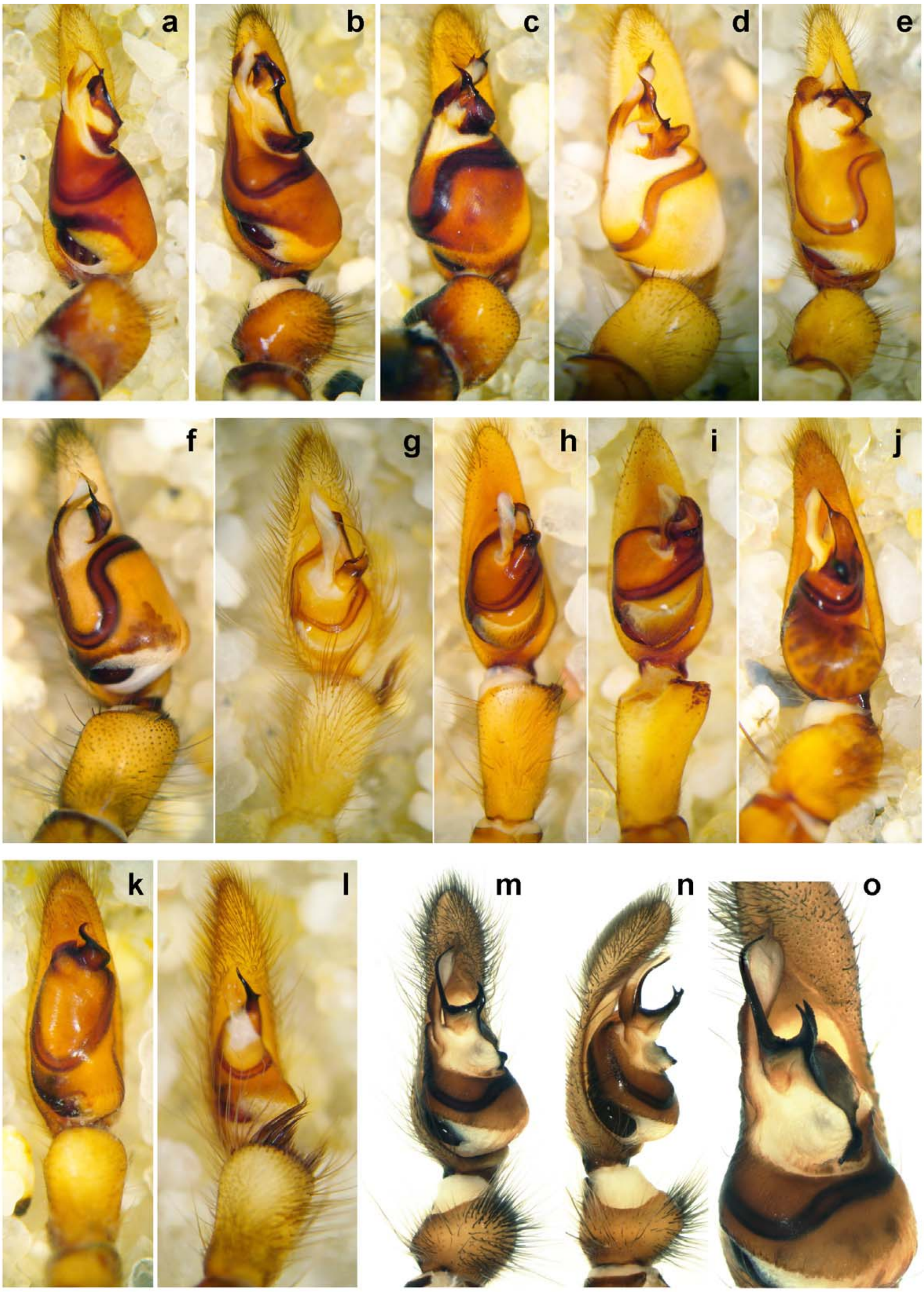
FIGURES 83a–g. *Psechrus* spp., photos of left (b–g) and right (a) ♂ palp, prolateral view. a *P. ancoralis*. b *P. luangprabang*. c *P. jaegeri* **sp. nov.** d *P. elachys* **sp. nov.** e *P. kinabalu*. f *P. hartmanni* **sp. nov.** g *P. crepido* **sp. nov.** a ♂ paratype SB 24 from Laos, Luang Nam Tha Prov. b ♂ holotype SB 1030 from Laos, Luang Prabang Prov. c ♂ paratype SB 302 from Laos, Champasak Prov. d ♂ paratype SB 862 from Thailand, Satun Prov. e ♂ holotype SB 237 from Malaysia, Borneo, Sabah Prov. f ♂ SB 624 from Sri Lanka. g ♂ holotype SB 644 from India, Tamil Nadu Prov. Remark: cymbium dorsally with moderate dense- (a–b), very dense-scopula (d–g) or without any scopula (c).



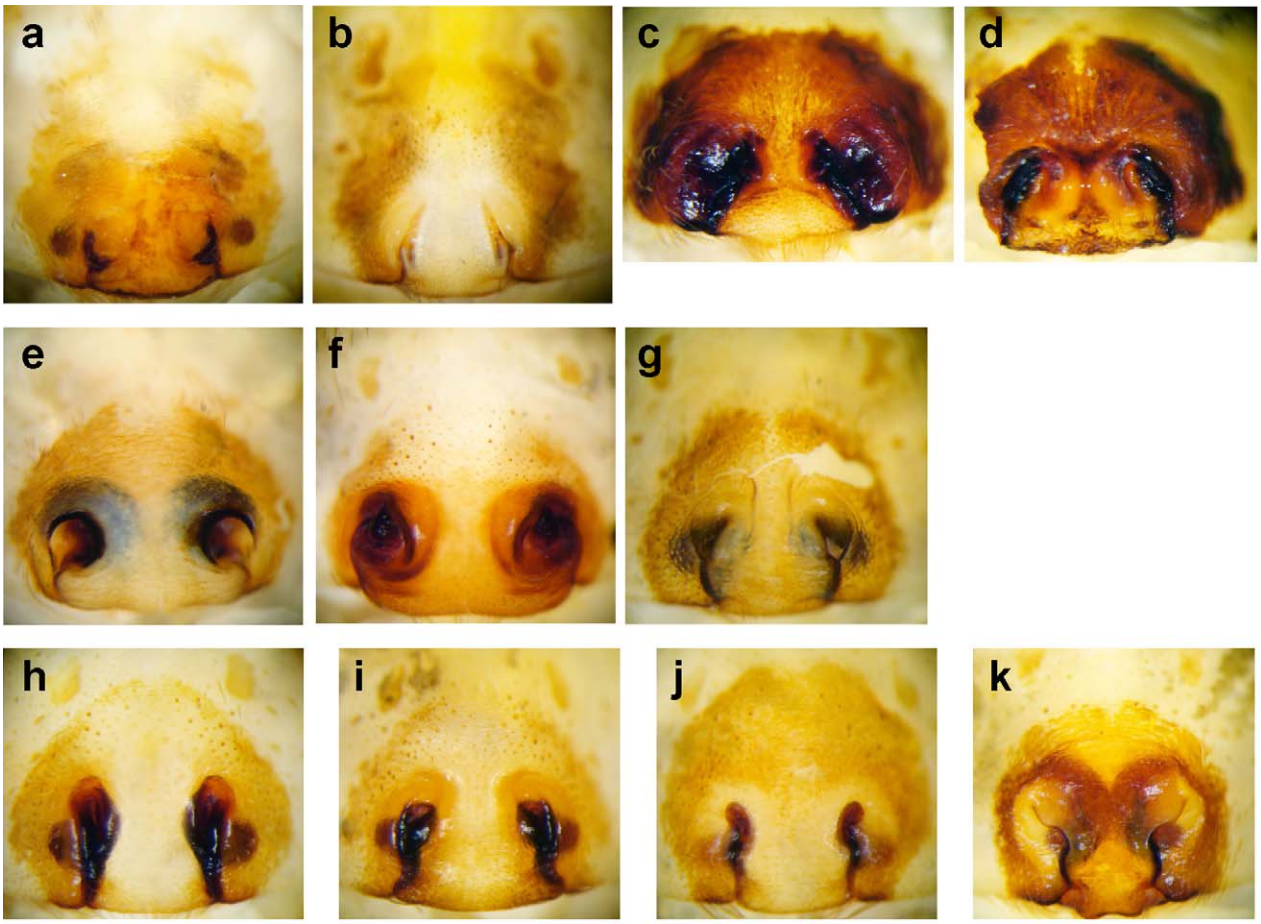
FIGURES 84a–i. *Psechrus* spp., photos of left ♂ palp, ventral view. a *P. argentatus*. b–c *P. libelti*. d *P. kinabalu*. e *P. mulu*. f *P. ulcus* **sp. nov.** g *P. decollatus* **sp. nov.** h *P. singaporensis*. i *P. elachys* **sp. nov.** a ♂ SB 1107 from Papua New Guinea. b s.a. ♂ syntype SB 339 from Indonesia, Sumatera Selatan Prov. c ♂ SB 203 from Thailand, Song Khla Prov. d ♂ holotype SB 237 from Malaysia, Borneo, Sabah Prov. e ♂ holotype SB 242 from Malaysia, Borneo, Sarawak Prov. f ♂ holotype SB 141 from Indonesia, Kalimantan Selatan Prov. g ♂ paratype SB 857 from Indonesia, Jawa Timur Prov. h ♂ SB 507 (syntype of *P. curvipalpis*) from Malaysia, Selangor Prov. i ♂ paratype SB 862 from Thailand, Satun Prov.



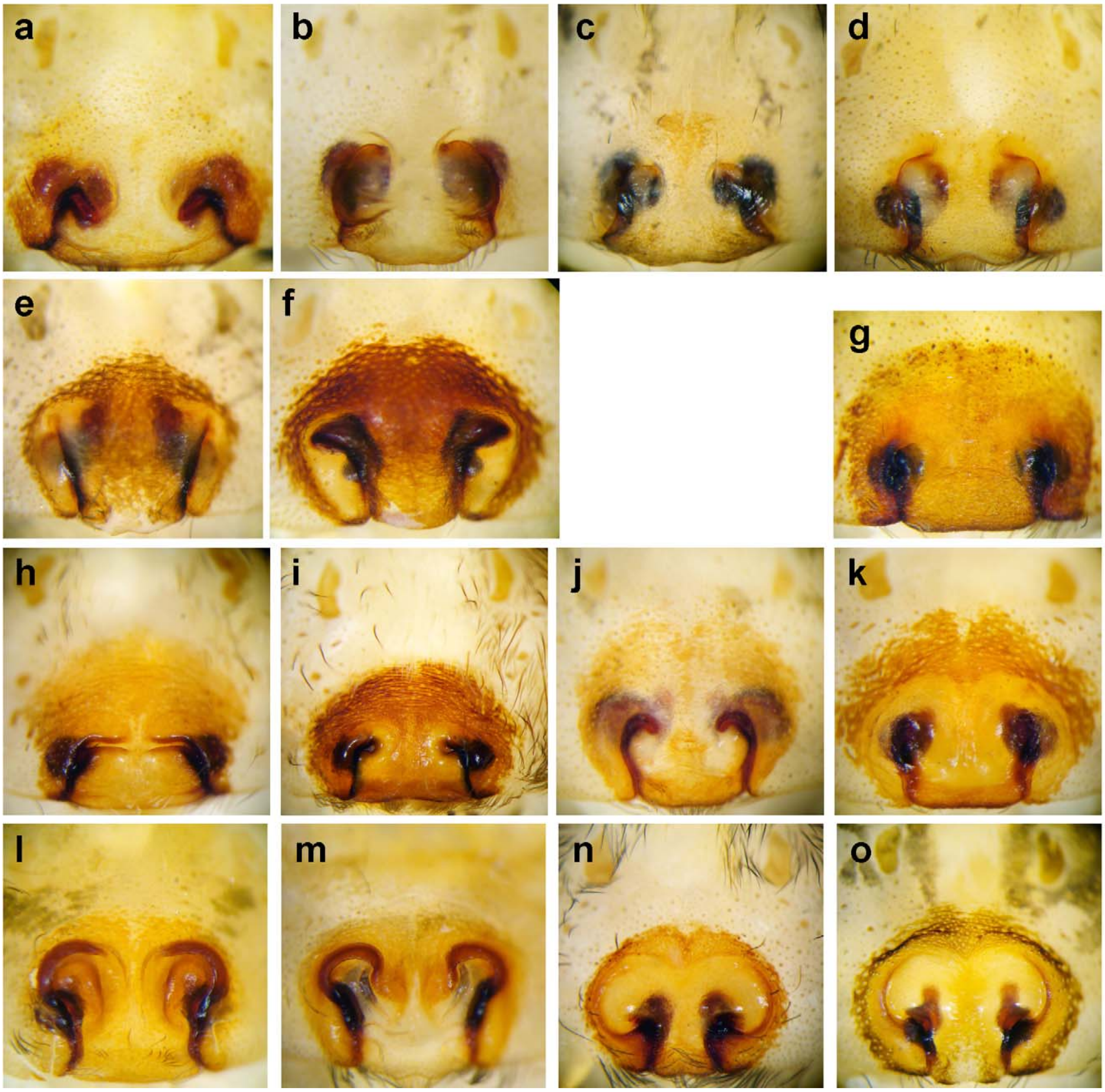
FIGURES 85a–o. *Psechrus* spp., photos of left ♂ palp, ventral view (a, c–o) and retrolatero-ventral view (b). a *P. ancoralis*. b *P. rani*. c *P. laos* **sp. nov.** d *P. antraeus*. e *P. khammouan*. f *P. steineri*. g *P. himalayanus*. h *P. marsyandi*. i *P. inflatus* **sp. nov.** j *P. ghecuanus*. k *P. pakawini* **sp. nov.** l *P. luangprabang*. m *P. demiror* **sp. nov.**? n *P. jaegeri* **sp. nov.** o *P. vivax* **sp. nov.** a ♂ SB 321 from Laos, Luang Prabang Prov. b ♂ SB 122 from Vietnam, Lang Son Prov. c ♂ holotype SB 367 from Laos, Bolikhamsay Prov. d ♂ paratype SB 7 from Laos, Vientiane Prov. e ♂ SB 381 from Laos, Khammouan Prov. f ♂ paratype SB 64 from Laos, Khammouan Prov., Xe Bangfai cave system. g ♂ SB 17 from Nepal, Rapti Prov. h ♂ holotype SB 79 from Nepal, Gandaki Prov. i ♂ holotype SB 952 from China, Yunnan Prov. j ♂ SB 36 from Laos, Luang Nam Tha Prov. k ♂ paratype SB 142 from Thailand, Chiang Mai Prov. l ♂ SB 459 from Laos, Luang Nam Tha Prov. m ♂ SB 329 from “Indochina”. n ♂ paratype SB 302 from Laos, Champasak Prov. o ♂ holotype SB 367 from Thailand, Trat Prov., Koh Chang.



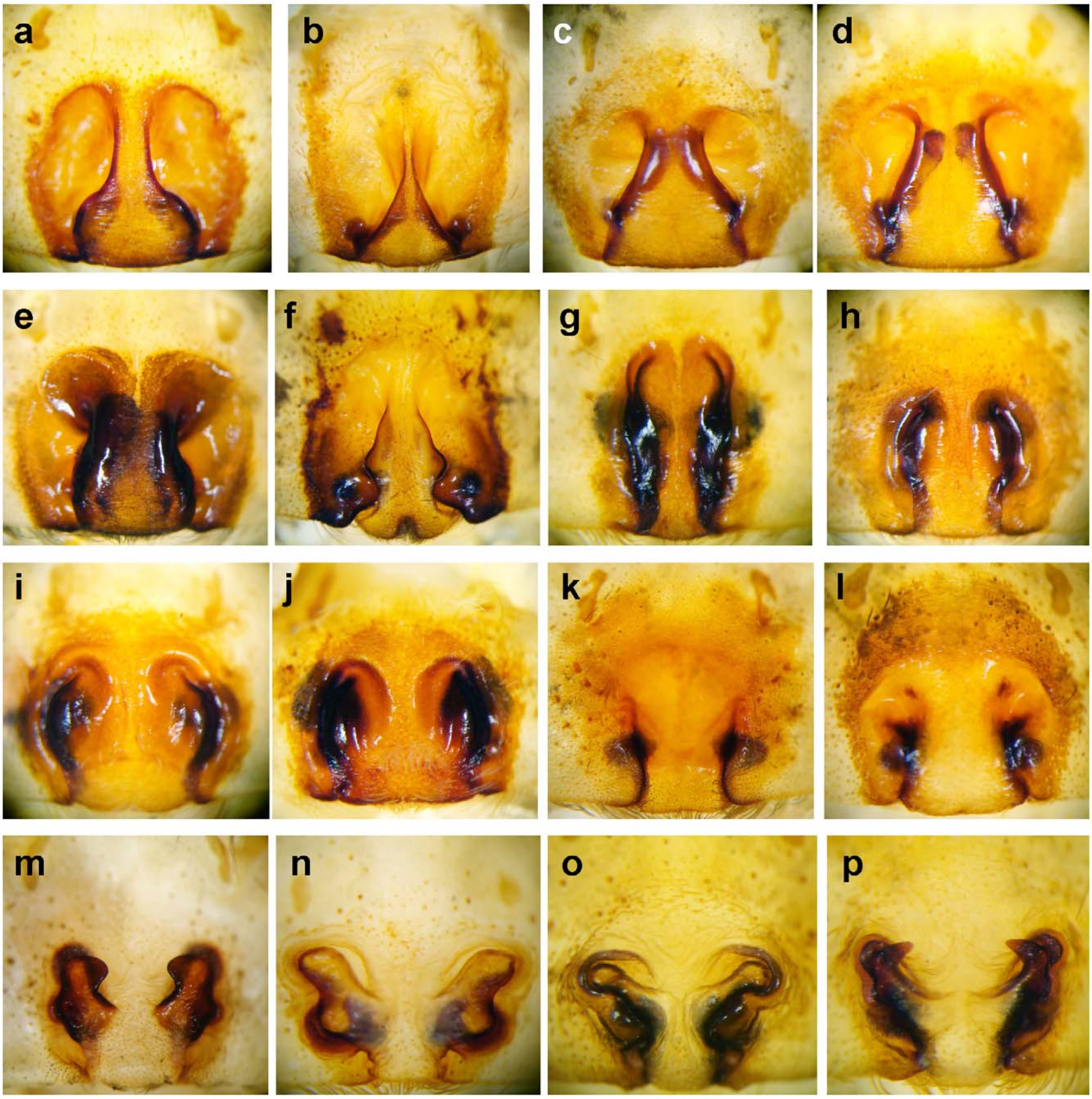
FIGURES 86a–o. *Psechrus* spp., photos of left ♂ palp. a *P. sinensis*. b *P. triangulus*. c *P. tingpingensis*. d *P. obtectus* **sp. nov.** e *P. senoculatus*. f *P. clavis* **sp. nov.** g *P. torvus*. h *P. hartmanni* **sp. nov.** i *P. zygon* **sp. nov.?** j *P. crepido* **sp. nov.** k *P. schwendingeri* **sp. nov.** l *P.cebu*. m–o *P. kunmingensis*. a ♂ syntype SB 521 from China, Guizhou Prov. b ♂ paratype SB 882 from China, Yunnan Prov. c ♂ SB 529 from China, Hunan Prov. d ♂ paratype SB 1150 from Vietnam, Bac Thai Prov. e ♂ paratype SB 537 from China, Hunan Prov. f ♂ paratype SB 1008 from Taiwan, Nantou County. g ♂ paralectotype SB 264 from Sri Lanka, Central Prov. h ♂ SB 624 from Sri Lanka. i ♂ SB 848 from Sri Lanka, Central Prov. j ♂ holotype SB 644 from India, Tamil Nadu Prov. k ♂ holotype SB 143 from Philippines, Luzon, Mountain Prov. l ♂ holotype SB 149 from Philippines, Cebu Prov. m–o ♂ from China, Yunnan Prov., Kunming. a–m, o ventral, n prolateral view.
m–o: Photos by Ping Feng, Dali, China.



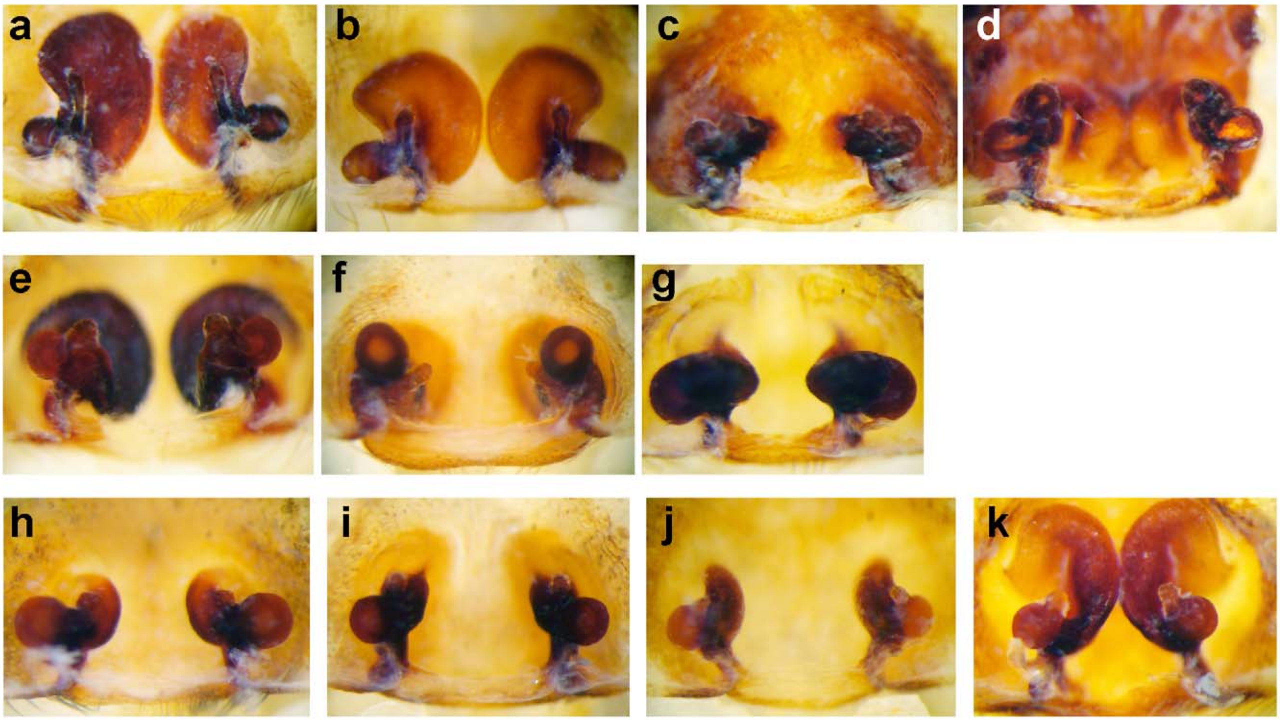
FIGURES 87a–k. *Psechrus* spp., photos of epigyne, ventral view. a *P. argentatus*. b *P. libelti*. c *P. mulu*. d *P. borneo*. e *P. annulatus*. f *P. aluco* **sp. nov.** g *P. decollatus* **sp. nov.** h *P. singaporensis*. i *P. elachys* **sp. nov.** j *P. norops* **sp. nov.** k *P. arcuatus* **sp. nov.** a ♀ SB 608 from Indonesia, Maluku Prov. b ♀ SB 969 from Brunei Darussalam. c ♀ paratype SB 239 from Malaysia, Borneo, Sarawak Prov. d ♀ holotype SB 279 from Indonesia, Kalimantan Timur Prov. e ♀ lectotype SB 829 from Indonesia, Jawa Tengah Prov. f ♀ holotype SB 123 from Indonesia, Jawa Barat Prov. g ♀ holotype SB 501 from Indonesia, Jawa Timur Prov. h ♀ SB 864 from Malaysia, Selangor Prov. i ♀ holotype SB 861 from Thailand, Satun Prov. j ♀ holotype SB 860 from Malaysia, Pahang Prov. k ♀ holotype SB 333 from Indonesia, Sumatera Barat Prov.



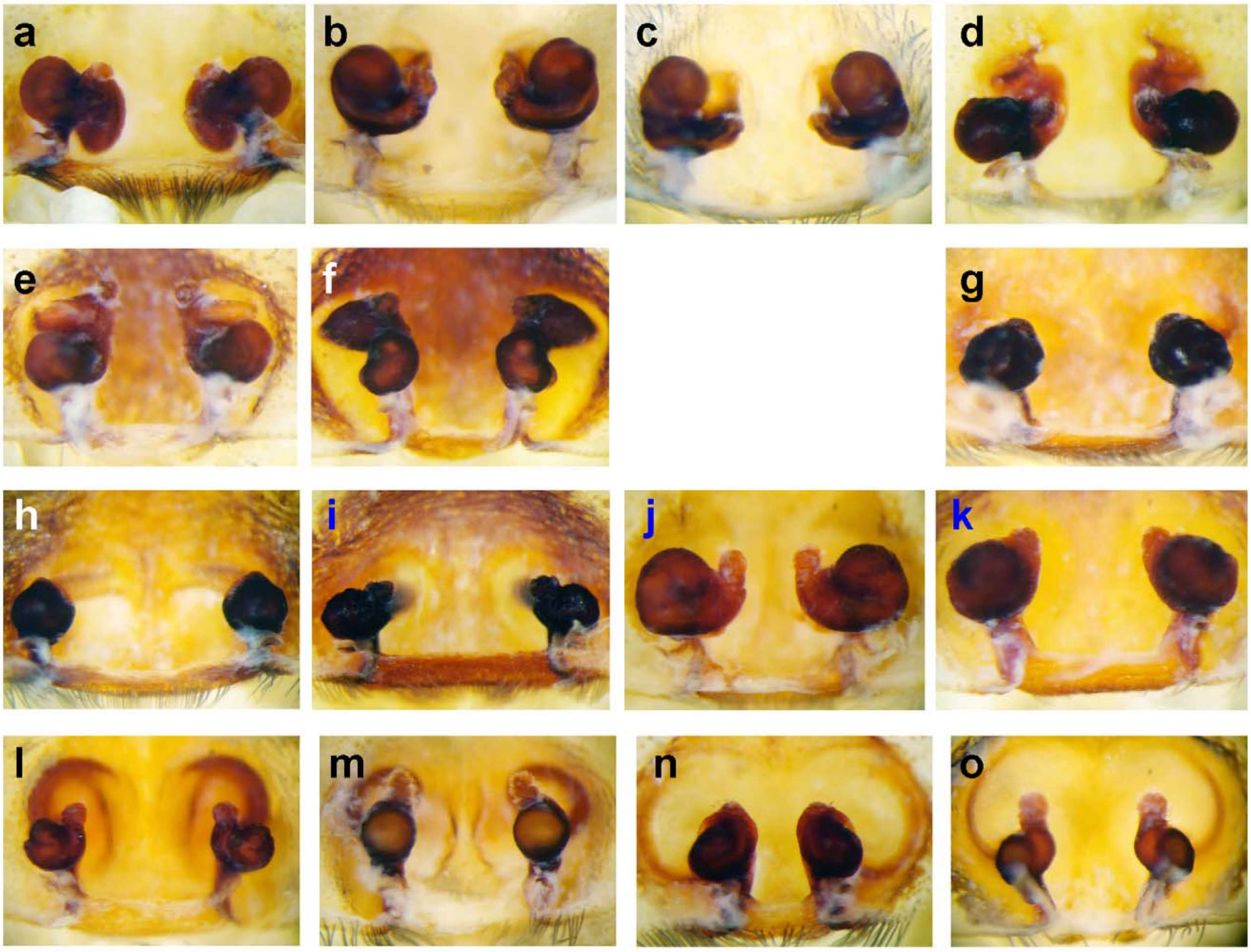
FIGURES 88a–o. *Psechrus* spp., photos of epigyne, ventral view. a *P. ancoralis*. b *P. rani*. c *P. laos* **sp. nov.** d *P. antraeus*. e *P. khammouan*. f *P. steineri*. g *P. inflatus* **sp. nov.** h *P. himalayanus*. i *P. marsyandi*. j *P. pakawini* **sp. nov.** k *P. ghecuanus*. l *P. demiror* **sp. nov.** m *P. luangprabang*. n *P. jaegeri* **sp. nov.** o *P. vivax* **sp. nov.** a ♀ SB 324 from Laos, Luang Prabang Prov. b ♀ SB 818 from China, Hongkong. c ♀ paratype SB 372 from Laos, Bolikhamsay Prov. d ♀ SB 294 from Laos, Vientiane Prov. e ♀ SB 382 from Laos, Khammouan Prov. f ♀ holotype SB 65 from Laos, Khammouan Prov., Xe Bangfai cave system. g ♀ paratype SB 961 from China, Yunnan Prov. h ♀ SB 607 from Bhutan, Timphu Prov. i ♀ paratype SB 227 from Nepal, Dhawalagiri Prov. j ♀ paratype SB 213 from Thailand, Chiang Mai Prov. k ♀ SB 39 from Laos, Luang Nam Tha Prov. l ♀ holotype SB 331 from "Indochina". m ♀ SB 424 from Laos, Vientiane Prov. n ♀ paratype SB 300 from Laos, Champasak Prov. o ♀ paratype SB 366 from Thailand, Trat Prov., Koh Chang.



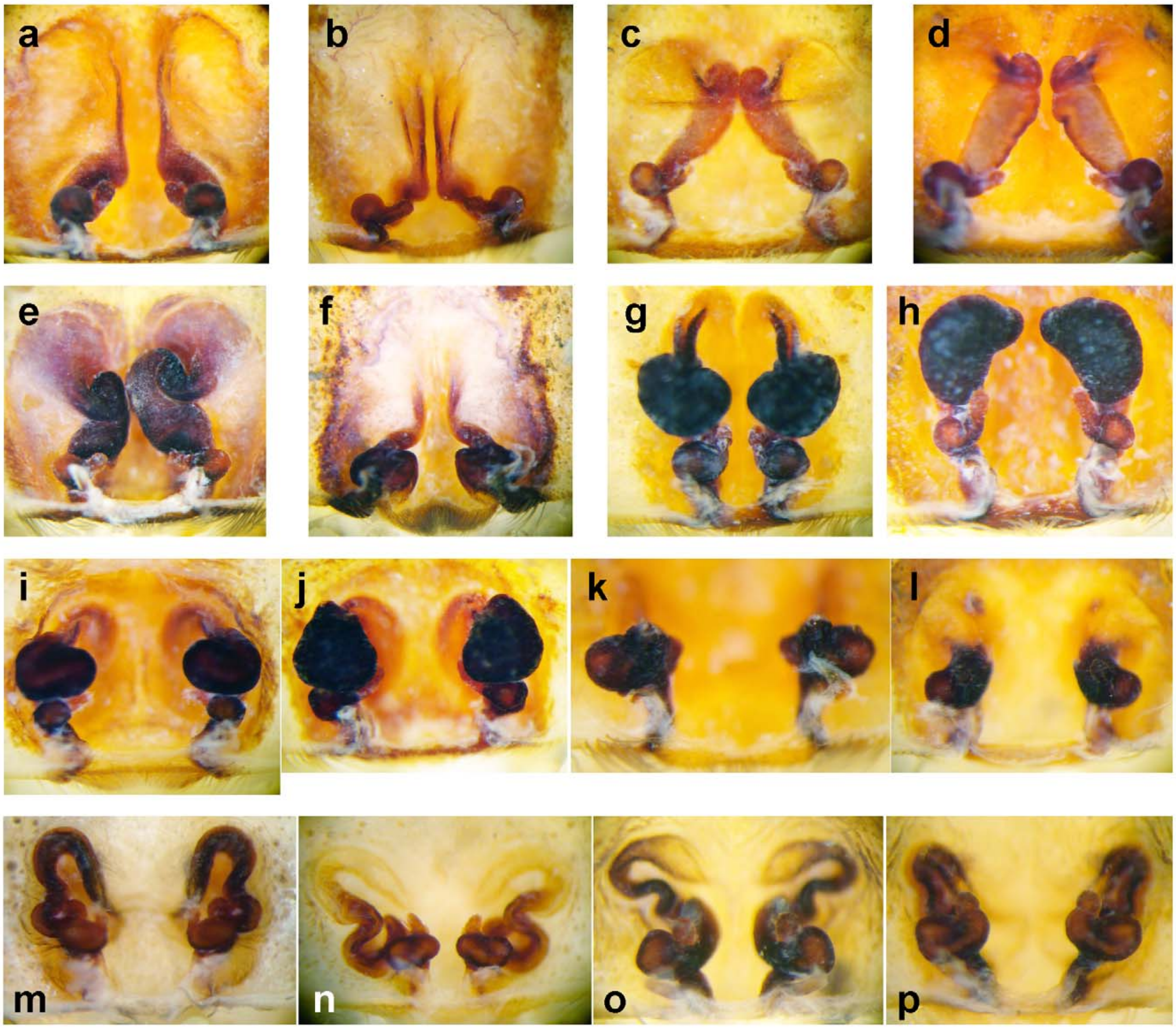
FIGURES 89a–p. *Psechrus* spp., photos of epigyne, ventral view. a *P. sinensis*. b *P. triangulus*. c *P. tingpingensis.* d *P. obtectus* **sp. nov.** e *P. fuscai* **sp. nov.** f *P. kunmingensis*. g *P. senoculatus*. h *P. clavis* **sp. nov.** i *P. kenting*. j *P. taiwanensis*. k *P. crepido* **sp. nov.** l *P. cebu*. m *P. torvus*. n *P. hartmanni* **sp. nov.** o *P. zygon* **sp. nov.** p *P. tauricornis* **sp. nov.** a ♀ paratype SB 524 from China, Guizhou Prov. b ♀ holotype SB 881 from China, Yunnan Prov. c ♀ paratype SB 194 from China, Hunan Prov. d ♀ paratype SB 1153 from Vietnam, Bac Thai Prov. e ♀ holotype SB 954 from China, Yunnan Prov. f ♀ SB 953 from China, Yunnan Prov. g ♀ SB 886 from China, Sichuan Prov. h ♀ paratype SB 614 from Taiwan, Taoyuan County. i ♀ paratype SB 618 from Taiwan, Taitung County. j ♀ holotype SB 238 from Taiwan. k ♀ paratype SB 984 from India, Tamil Nadu Prov. l ♀ paratype SB 151 from Philippines, Cebu Prov. m ♀ SB 941 from Sri Lanka, Central Prov. n ♀ paratype SB 845 from Sri Lanka, Central Prov. o ♀ holotype SB 846 from Sri Lanka, Central Prov. p ♀ paratype SB 849 from Sri Lanka, Central Prov.



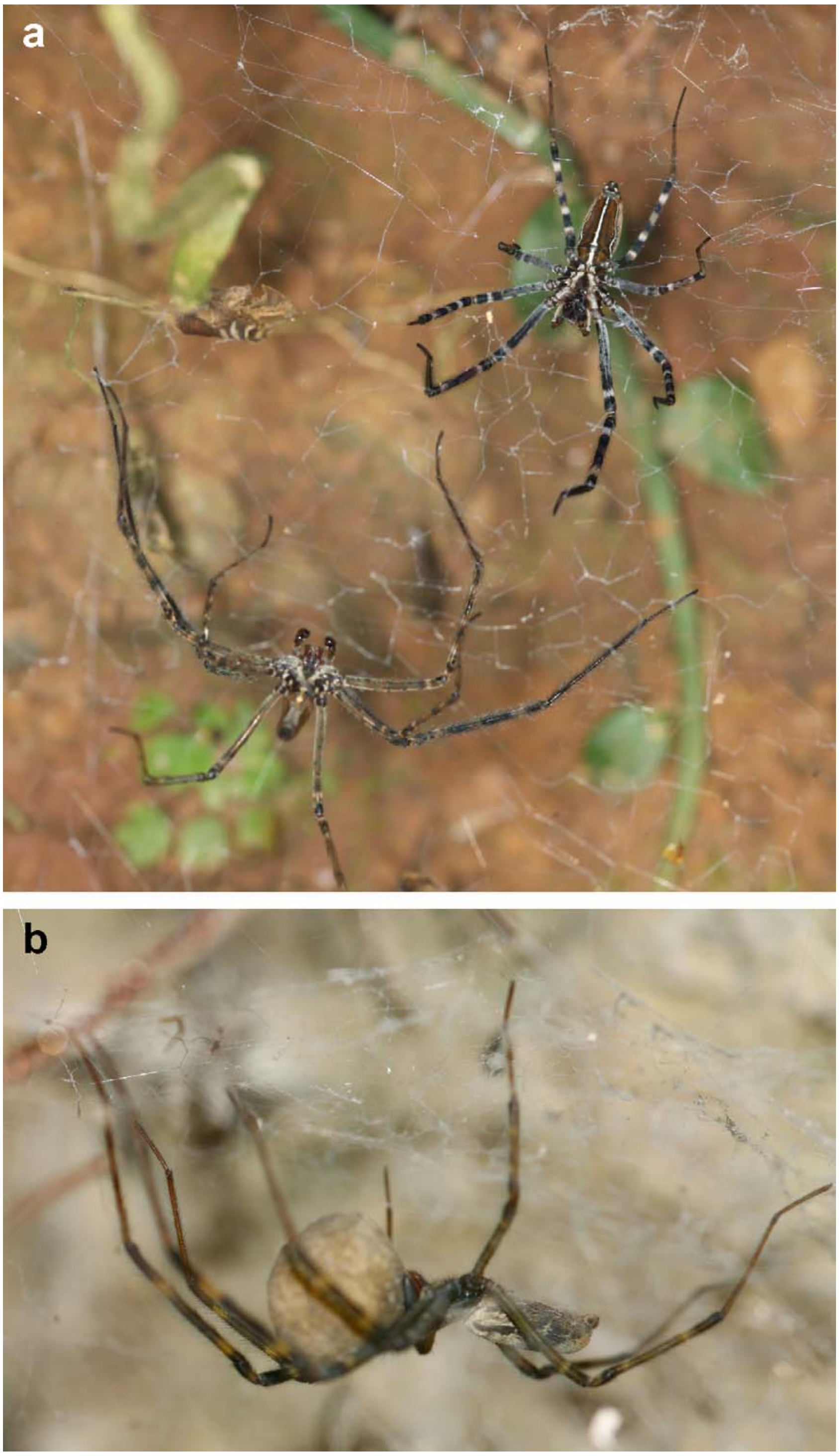
FIGURES 90a–k. *Psechrus* spp., photos of vulva, dorsal view. a *P. argentatus*. b *P. libelti*. c *P. mulu*. d *P. borneo*. e *P. annulatus*. f *P. aluco* **sp. nov.** g *P. decollatus* **sp. nov.** h *P. singaporensis*. i *P. elachys* **sp. nov.** j *P. norops* **sp. nov.** k *P. arcuatus* **sp. nov.** a ♀ SB 551 from Papua New Guinea, Morobe Prov. b ♀ SB 87 from Indonesia, Sumatra, Mentawei Islds. c ♀ SB 253 from Malaysia, Borneo, Sarawak Prov. d ♀ holotype SB 279 from Indonesia, Kalimantan Timur Prov. e ♀ lectotype SB 829 from Indonesia, Jawa Tengah Prov. f ♀ holotype SB 123 from Indonesia, Jawa Barat Prov. g ♀ holotype SB 501 from Indonesia, Jawa Timur Prov. h ♀ SB 220 from Singapore. i ♀ holotype SB 861 from Thailand, Satun Prov. j ♀ holotype SB 860 from Malaysia, Pahang Prov. k ♀ holotype SB 333 from Indonesia, Sumatera Barat Prov.



FIGURES 91a–o. *Psechrus* spp., photos of vulva, dorsal view. a *P. ancoralis*. b *P. rani*. c *P. laos* **sp. nov.** d *P. antraeus*. e *P. khammouan*. f *P. steineri*. g *P. inflatus* **sp. nov.** h *P. himalayanus*. i *P. marsyandi*. j *P. pakawini* **sp. nov.** k *P. ghecuanus*. l *P. demiror* **sp. nov.** m *P. luangprabang*. n *P. jaegeri* **sp. nov.** o *P. vivax* **sp. nov.** a ♀ SB 324 from Laos, Luang Prabang Prov. b ♀ SB 818 from China, Hongkong. c ♀ paratype SB 374 from Laos, Bolikhamsay Prov. d ♀ SB 294 from Laos, Vientiane Prov. e ♀ SB 382 from Laos, Khammouan Prov. f ♀ holotype SB 65 from Laos, Khammouan Prov., Xe Bangfai cave system. g ♀ paratype SB 951 from China, Yunnan Prov. h ♀ SB 988 from India, Uttarakhand Prov. i ♀ paratype SB 227 from Nepal, Dhawalagiri Prov. j ♀ paratype SB 214 from Thailand, Chiang Mai Prov. k ♀ SB 39 from Laos, Luang Nam Tha Prov. l ♀ holotype SB 331 from “Indochina”. m ♀ SB 424 from Laos, Vientiane Prov. n ♀ paratype SB 300 from Laos, Champasak Prov. o ♀ paratype SB 366 from Thailand, Trat Prov., Koh Chang.



FIGURES 92a–p. *Psechrus* spp., photos of vulva, dorsal view. a *P. sinensis*. b *P. triangulus*. c *P. tingpingensis*. d *P. obtectus* **sp. nov.** e *P. fuscai* **sp. nov.** f *P. kunmingensis*. g *P. senoculatus*. h *P. clavis* **sp. nov.** i *P. kenting*. j *P. taiwanensis*. k *P. crepido* **sp. nov.** l *P. cebu*. m *P. torvus*. n *P. hartmanni* **sp. nov.** o *P. zygon* **sp. nov.** p *P. tauricornis* **sp. nov.** a ♀ paratype SB 524 from China, Guizhou Prov. b ♀ holotype SB 881 from China, Yunnan Prov. c ♀ paratype SB 194 from China, Hunan Prov. d ♀ paratype SB 1155 from Vietnam, Bac Thai Prov. e ♀ holotype SB 954 from China, Yunnan Prov. f ♀ SB 953 from China, Yunnan Prov. g ♀ SB 886 from China, Sichuan Prov. h ♀ paratype SB 831 from Taiwan, Chiayi County. i ♀ paratype SB 618 from Taiwan, Taitung County. j ♀ holotype SB 238 from Taiwan. k ♀ paratype SB 984 from India, Tamil Nadu Prov. l ♀ paratype SB 151 from Philippines, Cebu Prov. m ♀ SB 941 from Sri Lanka, Central Prov. n ♀ paratype SB 845 from Sri Lanka, Central Prov. o ♀ holotype SB 846 from Sri Lanka, Central Prov. p ♀ paratype SB 849 from Sri Lanka, Central Prov.



FIGURES 93a–b. *Psechrus* spp., photos of mating behaviour (a) and female carrying egg sac (b). a ♀ (above) and ♂ (below) *P. luangprabang* from Laos, Vientiane Prov. b ♀ *P. senoculatus* from China, Sichuan Prov. Photos by Peter Jäger, Frankfurt am Main.

FIGURE 94. Distribution of *Psechrus* in southern India and Sri Lanka. Symbols: species belonging to the *torvus*-group. Arrow: Distribution of *P. crepido* **sp. nov.**

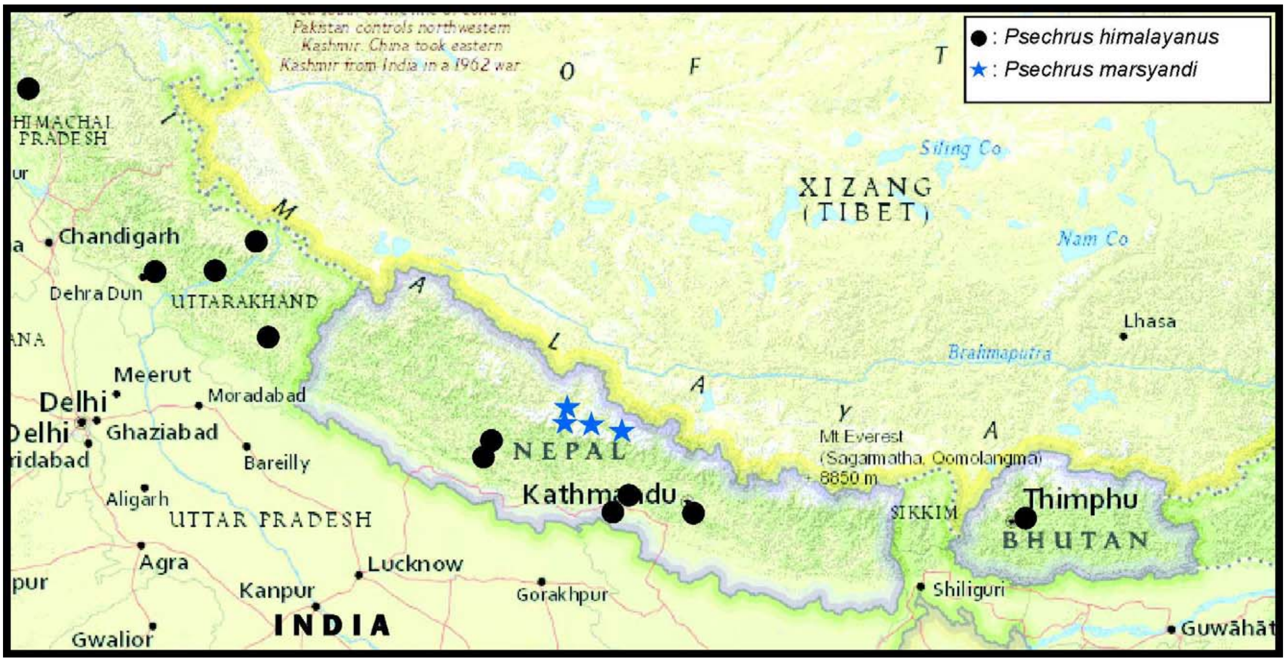


FIGURE 95. Distribution of *Psechrus himalayanus* and *P. marsyandi* (both *himalayanus*-group).

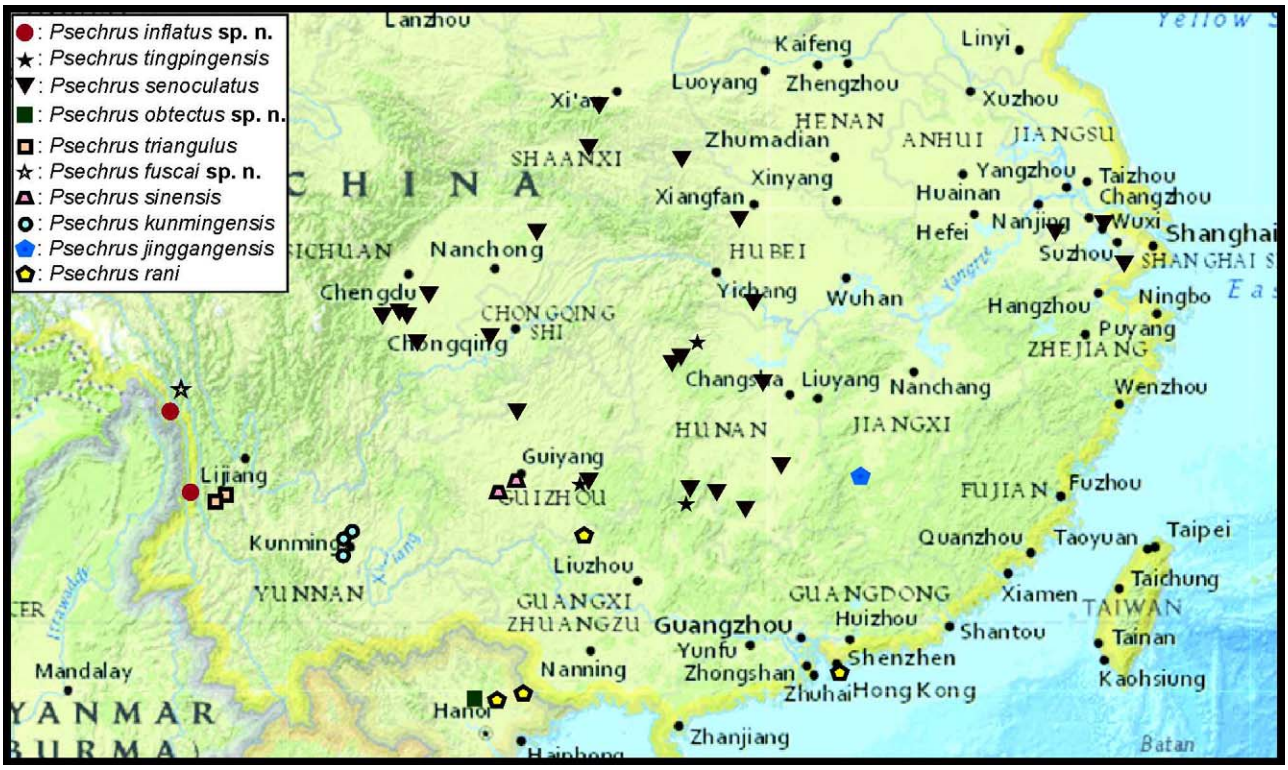


FIGURE 96. Distribution of *Psechrus* in China and northern Vietnam. All species belong to the *sinensis*-group except *P. inflatus* **sp. nov.** (*himalayanus*-group) and *P. rani* (*ancoralis*-group). Distribution of *Psechrus* in Taiwan, see Fig. 97. For the distribution of *P. ghecuanus* in China, see Fig. 98.

FIGURE 97. Distribution of *Psechrus* on Taiwan. All species belong to the *sinensis*-group.

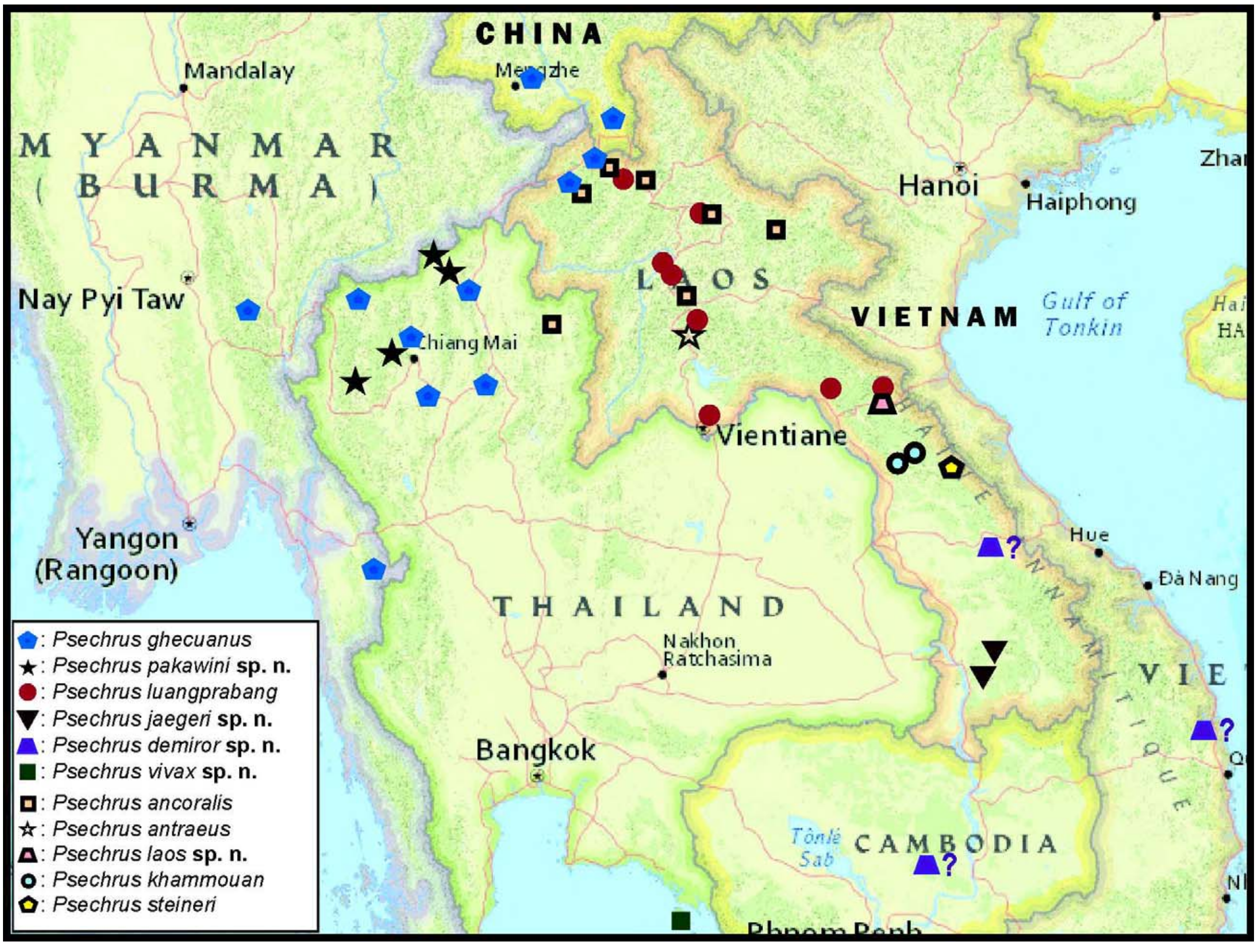


FIGURE 98. Distribution of *Psechrus* in continental South East Asia. Symbols (unicoloured): species belonging to the *himalayanus*-group. Symbols (black, filled with light colour): species belonging to the *ancoralis*-group. Distribution of *Psechrus* in northern Vietnam, see Fig. 96. The distribution of *P. demiror* **sp. nov.** is unclear (see corresponding species description), hence the violet, unicoloured trapezes are depicted with question mark each.

FIGURE 99. Distribution of *Psechrus* in western Malaysia and Sumatra. Symbols: species belonging to the *singaporensis*-group. Arrow: Distribution of *P. libelti* (*argentatus*-group).

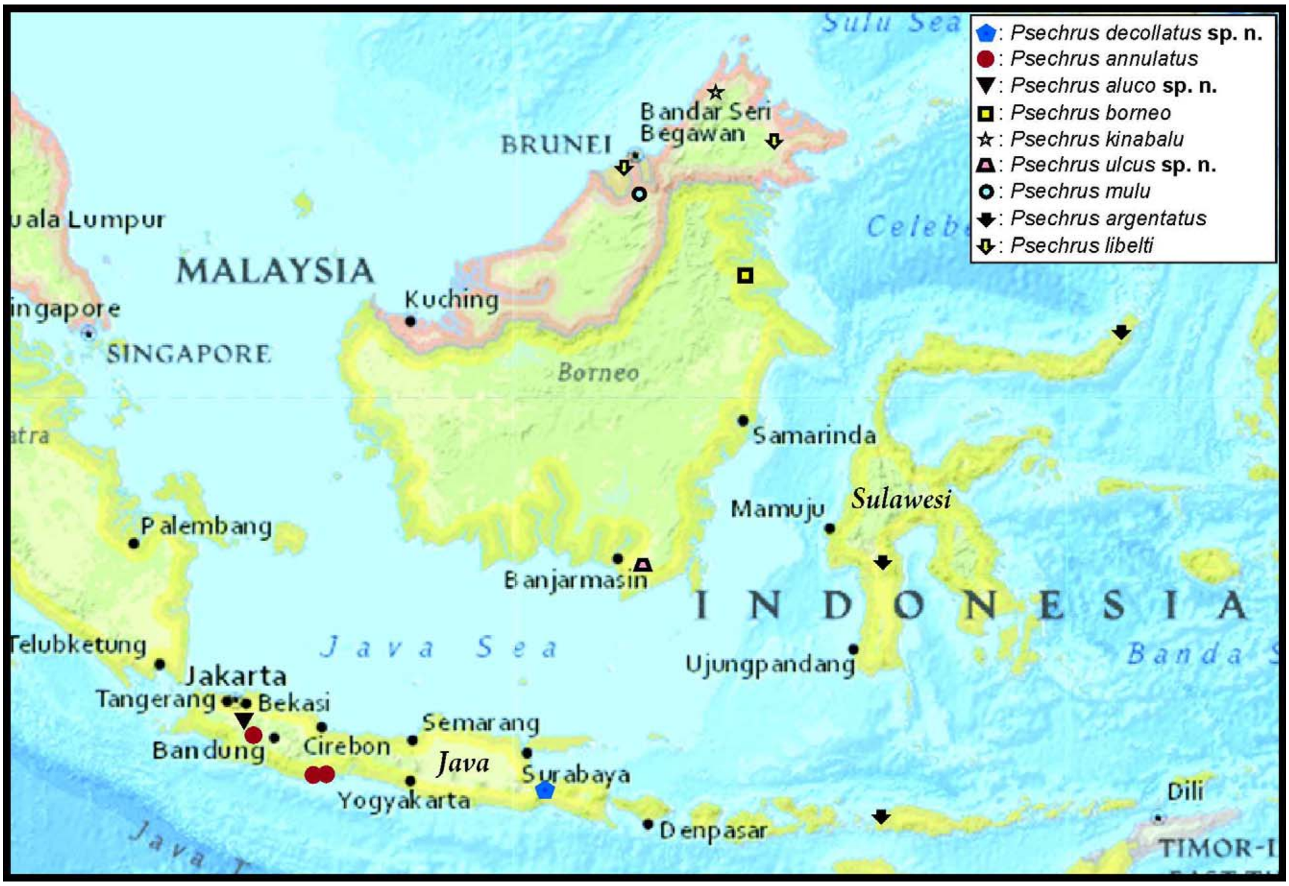


FIGURE 100. Distribution of *Psechrus* in eastern Malaysia and central Indonesia. Symbols (unicoloured): species belonging to the *annulatus*-group. Symbols (black, filled with light colour): species belonging to the *mulu*-group. Arrows: species belonging to the *argentatus*-group.

FIGURE 101. Distribution of *Psechrus argentatus* in New Guinea and adjacent islands.

FIGURE 102. Distribution of *Psechrus* on the Philippines.

Discussion

Several taxonomic misinterpretations detected in the literature are corrected in the present revision. Species unjustifiably synonymised are revalidated, namely *Psechrus libelti* Kulczyński, 1908 and *P. annulatus* Kulczyński, 1908. The differences in the shapes of copulatory organs are in both cases clearly outside the range of intraspecific variation of *P. singaporensis* Thorell, 1894, the considered senior synonym sensu Levi (1982) for both species. On the other hand, the nominal species *P. xinping* Chen, Zhang, Song & Kim, 2002 has turned out to be conpecific with *P. tingpingensis* Yin, Wang & Zhang, 1985 and is hence synonymised with the latter. As noted in the remark of the species description of *P. tingpingensis* this misinterpretation was caused by relying to illustrations in a preceding publication. It is likely that Chen *et al.* (2002) had not checked the female types of *P. tingpingensis*. To check the type material of species concerned for a particular, taxonomic study (e.g. describing a new species), however, is imperative, especially if one or more closely related species from the respective country or region are involved. If the curator(s) are not willing to loan the material, it is not only a pity for the taxonomic science but also for the respective museum collection itself. In this respect it would be fine if the respective author(s) and the curator(s) of the museum(s)/institution(s) storing type material work in full cooperation with one another. The higher the quality of the scientific output, the better it is for both parties involved.

In some cases, actually new and undescribed species at each respective point of time were disregarded, due to misidentifications. Most of the misidentifications concerned *P. torvus* (O. Pickard-Cambridge, 1869). Simon (1906) reported this species from Java. The respective female deposited in MNHN was examined and illustrated by Lehtinen (1967), also sub *P. torvus*. After the examination of the respective female specimen it became clear, that those authors dealt with a new species out of the *annulatus*-group, *P. decollatus* **sp. nov.** It is difficult to say, why Simon, who was one of the most experienced and skilled arachnologists of his time, had misidentified this specimen, whose epigyne is clearly different from that of *P. torvus*. Lehtinen (1967, fig. 476) most likely had not checked the types of *P. torvus*, but just relied on the identification of Simon. In his species list of *Psechrus* under *P.*

torvus (*Tegenaria torva*) there is just one note saying that the male type [sic.] is presumably deposited in Oxford (Lehtinen 1967, p. 260). He had not recognised that O. Pickard-Cambridge (1869) noted that he had examined several male and female individuals. Levi (1982) lumped several species under *P. torvus*. He had checked material from several localities of Central Sri Lanka. For the present study material from most of these localities was available. The species *P. hartmanni* **sp. nov.**, *P. zygon* **sp. nov.** and *P. tauricornis* **sp. nov.**, which are certainly similar to *P. torvus*, were all examined by Levi (1982) and misidentified as *P. torvus*. Nevertheless, in illustrating all these forms as intraspecific variants he showed that he had not overlooked those differences. His misidentifications were probably due to his conservative species concept. As already mentioned in the introduction, *P. torvus* had been reported from Taiwan by some authors. All of these reports have turned out to be based on misidentifications. Lee (1966) possibly treated *P. taiwanensis* Wang and Yin (2001), and Hu (1984) reproduced Lee's illustrations. Kayashima (1962) had not examined and illustrated *P. taiwanensis* like Yoshida (2009) stated, but *P. clavis* **sp. nov.** Yoshida himself had not checked the female holotype of *P. taiwanensis*, but relied on the illustrations in Levi (1982, sub *P. sinensis*) and Wang and Yin (2001) and thus misinterpreted and misidentified his specimens from Northern Taiwan, which are in fact conspecific with the female illustrated by Kayashima (1962, sub *P. torvus*), as *P. taiwanensis*. In *P. taiwanensis* the bulbous part of copulatory duct (CD), which Yoshida (2009) denotes as "anterior part of seminal receptacle" is a bit higher than in *P. kenting* Yoshida, 2009. In *P. clavis* **sp. nov.**, which is regarded as *P. taiwanensis* by Yoshida (2009), the bulbous part of CD is also higher than in *P. kenting*. Maybe Yoshida (2009) considered the somewhat higher bulbous section of CD, which is recognisable in Wang and Yin's (2001) and Levi's (1982) illustrations of *P. taiwanensis* and *P. sinensis*, respectively, as intraspecific variation of the species he regarded as *P. taiwanensis*. But in fact he dealt with an —at that time— undescribed, new species. *Psechrus sinensis* was also misidentified in some papers. Chen (1996; 1999; 2001) most likely attended to *P. clavis* **sp. nov.** and definitely not to *P. sinensis*; I do not know of any records of the latter species from Taiwan. Possibly Chen referred to Levi's (1982) publication concerning his identifications. Silva (2003, fig. 16a) showed an SEM photo of the male palp of *P. rani* Wang and Yin, 2001 which was misidentified as *P. sinensis*. The *Psechrus* specimens from Bac Thai Province, Vietnam examined by Wang and Yin (2001) were misidentified as *P. tingpingensis* and actually represented a new species, *P. obtectus* **sp. nov.** Even though these two species are very similar, the distinctive characters are unambiguous. One female specimen of another new species, *P. crepido* **sp. nov.** from Tamil Nadu Province, India, had already been examined by both Reimoser (1934) and Levi (1982) who considered it conspecific to *P. torvus* (O. Pickard-Cambridge, 1869) and *P. ghecuanus* Thorell, 1897, respectively. The recorded locality together with the respective illustrations in Levi (1982, figs 32–33) show that this female is conspecific with *P. crepido* **sp. nov.**

Even though several taxonomic misinterpretations in the genus *Psechrus* could be clarified with the present revision, there are still some "problem cases" that leave open questions; e.g. some specimens from Malaysia belonging to the *singaporensis*-group, or a male from Taiwan belonging to the *sinensis*-group could not be definitely identified. More material from the respective regions is necessary to find out if they belong to already described species or to new species.

In the present work for the first time species groups are established for the genus *Psechrus*. The eight groups are characterised mainly by the copulatory organs of their representatives. As the somatic characters of the species groups differ just slightly, if at all, I refrain from establishing new genera for the representatives of the different species groups (but if, the representatives of the *argentatus*-group would of course remain in *Psechrus*; for the ones of the *torvus*-group *Lancaria* Karsch, 1879 would have to be re-established). Generally, the species groups reflect geographical clusters, which means that the complete distribution area of a particular species group is continuous and mostly not larger than 3000 km in diameter. This in turn means that the distribution potential of *Psechrus* is not very high. Some species could not be assigned to any of the species groups. This does not necessarily mean that these "isolated" species represent long-separated lineages. It seems more likely that further species remain to be discovered, since some particular regions within the large known range of *Psechrus* are to date only poorly explored, e.g. the Philippines, Southern India, Borneo, Java or Cambodia.

The male palps of the different *Psechrus* species generally provide distinct and specific structures useful to distinguish them. Exceptions may be the males of the *argentatus*-, *torvus*- and *ancoralis*-group, where the distinguishing characters are mostly differences in relative length or strength of corresponding structures or the exact position of these structures on the tegulum. The female copulatory organ, however, is mostly simply shaped and contains similar structures that differ only in relative measurements. Especially, the epigyne is mostly similarly shaped. However, at the same time in many species the simple epigyne is additionally variable among the different specimens. Hence some species are very hard to identify (if at all) by their epigyne, e.g. *P. singaporensis*, *P. elachys*

sp. nov., *P. norops* **sp. nov.**, *P. tingpingensis*, *P. obtectus* **sp. nov.**, *P. jaegeri* **sp. nov.**, *P. vivax* **sp. nov.**, *P. rani* Wang and Yin, 2001 and *P. laos* **sp. nov.** These species should be identified by characters of the vulva. At first, the vulva characters have been found to show less variation and secondly, they generally provide more structures useful for species discrimination. The intraspecific variation of epigynal characters may even lead to confusion with species belonging to other species groups; e.g. the epigynes of the female SB 217 of *P. ancoralis* Bayer & Jäger, 2010 from Nantaburi Province, Thailand and SB 197 of *P. pakawini* **sp. nov.** from Chiang Mai Province, Thailand are very similar (Fig. 22d cf. Fig. 42c) so that they may be confused. Their vulvae, however, are clearly different (Fig. 22c cf. Fig. 42d). From the vulva sections the copulatory duct is most useful for species discrimination. In some very similar species the two respective vulvae are only distinguishable by using exactly this section, e.g. *P. tingpingensis*/*P. obtectus* **sp. nov.** or *P. himalayanus* Simon, 1906/*P. marsyandi* Levi, 1982.

The primordial copulatory organs of subadult females have been examined in 20 of the 46 (43%) *Psechrus* species recently known. In 14 species two or more subadult females have been examined and generally showed continuity in the character states concerned. In pairs or groups of species where the copulatory organs of adult females are very similar, the ones of the subadults are also. But if the primordial copulatory organs were thoroughly prepared, the (fine) species-specific differences can be recognised (see e.g. *P. himalayanus*/*P. marsyandi*, Figs 32g,f, 34g,h or *P. jaegeri* **sp. nov.**/*P. vivax* **sp. nov.**, Figs 49d,e, 51d,e). Consequently, a determination via pre-epigynes or pre-vulvae, like in *Fecenia* (Bayer 2011), may be possible in *Psechrus*, too. However, the following three aspects should be considered: At first, presently only from 43% of the species described in *Psechrus* the primordial copulatory organ is known. For that reason it makes no sense to include the primordial character states in the identification key for *Psechrus*. But a key based on those characters may be established in the future. Secondly, from several species only one subadult female was available for examination, so it remains unclear if the characters are always consistent. Thirdly, from several pairs or groups of very similar species concerning the shape of epigyne and vulva, the primordial copulatory organ is only known from one of the species concerned. It would, for instance, be interesting to check the pre-epigyne and pre-vulva of *P. elachys* **sp. nov.**/*P. norops* **sp. nov.** (differences to *P. singaporensis*?), *P. inflatus* **sp. nov.** (differences to *P. ghecuanus*?) or *P. tingpingensis* (differences to *P. obtectus* **sp. nov.**?).

Some *Psechrus* species are found in caves, specifically the entrance areas (see generic description, biology, above). However, according to colleagues' and my own observations in Laos, there seems to be no species that is strictly linked to caves as the only habitat. In contrast, in other spider families, e.g. Sparassidae, which are also not principally known for living in caves, there are some species that seem to be adapted to caves; e.g. some species of *Heteropoda* Latreille (Sparassidae), which only appear in particular caves in Laos (Bayer and Jäger 2009).

In all 20 new species of lace-sheet-weavers are described for the first time in the present study. Thus, in contrast to previous studies (Lehtinen 1967; Levi 1982), this genus can without any doubt be considered quite diverse. Moreover, some parts of the generic distribution area are poorly explored (see above), and even in regions where several species have been recorded and many specimens collected, it is likely that additional new species will be found. Laos, for example, is a rather small country, but eight *Psechrus* species are found there and at least five of them are endemic. There are several provinces and regions remaining unexplored within Laos. If other, larger countries are explored more thoroughly, many more new species may be expected. I estimate, that not more than one fourth of the *Psechrus* species occurring worldwide are currently described. This "long story" will engage arachnologists and I hope the present publication will not only encourage arachnologists, but also biologists in general to increase their efforts in collecting lace-sheet-weavers in future expeditions.

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Phylogenetic relationships of the spider family Psechridae inferred from molecular data, with comments on the Lycosoidea (Arachnida: Araneae)

Abridged title: Phylogenetic relationships of Psechridae

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Abstract. We investigated the relative phylogenetic position of the spider genera *Psechrus* Thorell, 1878 and *Fecenia* Simon, 1887 comprising the family Psechridae Simon, 1890 within the order Araneae (plus 50 outgroup taxa) using molecular data of the nuclear 28S rRNA and the mitochondrial COI gene. We further revised the placement of genera formerly hypothesized in Psechridae and tested morphological species and species-group hypotheses recently proposed for *Psechrus* and *Fecenia*. Our results show both genera as monophyletic and included within Lycosoidea but no support for a monophyletic family Psechridae. Support for relationships to particular genera of other families (Lycosidae, Pisauridae) was found to be equally low. Previous removal of the genera *Stiphidion* Simon, 1902, *Poaka* Forster & Wilton, 1973, *Tengella* Dahl, 1901 (*Metafecenia* F. O. Pickard-Cambridge, 1902), and *Themacrys* Simon, 1906 from Psechridae, is confirmed by recovering most of them outside Lycosoidea. For *Tengella* (part of Lycosoidea) a close relation to Psechridae is not supported. In the species-rich genus *Psechrus* morphologically predefined species groups were generally recovered as monophyletic. COI information was applied to test the morphological species hypotheses for 28 Psechridae species, most of them represented by more than one specimen. Our analyses corroborated all proposed species and indicated COI as reliable for barcoding both *Psechrus* and *Fecenia*. COI enabled assignment of a juvenile specimen to *Fecenia protensa*, establishing the first species record for Brunei.

Additional keywords: *Psechrus*, *Fecenia*, *Stiphidion*, *Poaka*, *Themacrys*, *Tengella*, Desidae, Thomisidae, Ctenidae, Miturgidae, Lycosidae, Pisauridae, Oxyopidae, Zoropsidae, Zorocratidae, COI, 28S rRNA, calamistrum, Laos, Thailand, DNA barcoding.

Introduction

Taxonomic History of Psechridae

The type genus of the family Psechridae, *Psechrus*, was established by Thorell (1878) based on the type species *Tegenaria argentata* Doleschall, 1857 and originally placed in the subfamily Amaurobiinae Thorell, 1870 within the family Agelenoidae [sic.]. This latter taxon previously contained today’s Amaurobiidae Thorell, 1870, Agelenidae C. L. Koch, 1837, and several related taxa. In 1881, Thorell established the genus *Mezentia* with *M. angustata* Thorell, 1881 as type species. He also assigned this genus to the subfamily Amaurobiinae within the family Agelenoidae (Thorell 1881). Four years later, Simon (1885) described a new species of *Mezentia*, *M. macilenta* Simon, 1885, and transferred *Tegenaria ochracea* Doleschall, 1859 to *Mezentia*. Subsequently, Simon (1887) recognised the genus name *Mezentia* to be preoccupied and offered *Fecenia* Simon, 1887 as a replacement name.

The family Psechridae was established by Simon (1890), who did not provide a description or diagnosis, and included the two genera *Psechrus* and *Fecenia*. Shortly thereafter, Simon (1892) added an exhaustive definition considering the following characters as the most important to outline the family: the tufts at the tips of the three-clawed, long, gracile, elastic tarsi; the calamistrum consisting of at least three rows of setae (or the setae irregularly arranged in a band); in combination with a distinctly broad and short cribellum, medially divided by a keel. Additionally, he listed the long legs of Psechridae with the anterior two pairs clearly longer than the posterior. As an interesting behavioural character, Simon (1892) noted that the females carry their egg sacs in the chelicerae like *Pisaura* Simon, 1885. Pocock (1900) and Dahl (1901) confirmed these characters and the latter author added "row of trichobothria dorsally on each tarsus" to the description of Psechridae.

In the following years further genera were described and assigned to the Psechridae: *Metafecenia* F. O. Pickard-Cambridge, 1902, *Stiphidion* Simon, 1902, *Themacrys* Simon, 1906, *Matachia* Dalmas, 1917 and *Stiphidiellum* Dalmas, 1917. Due to this growing morphological heterogeneity, Dalmas (1917) proposed the division of the family Psechridae into four subfamilies (Psechrinae, Themacryinae, Stiphidiinae and Matachiinae) and based them on characters of the chelicerae, cribellum, calamistrum, and claw tufts or scopulae on tarsi and metatarsi. The subfamily Psechrinae was defined by combination of: tarsi with claw tufts on the tips, but without scopulae; the chelicerae rather short with more teeth retro- than promarginally; the two anterior leg pairs longer than the two posterior ones, and the divided cribellum. Dalmas (1917) not only included *Psechrus* and *Fecenia* but also *Metafecenia* within the Psechrinae. Subsequently, two genera were later described and assigned to the Matachiinae, *Paramatachia* Dalmas, 1918 and *Neomatachia* Hickman, 1950. Marples (1962) synonymised *Neomatachia* with *Paramatachia* and transferred *Matachia* and *Paramatachia* to the Dictynidae O. Pickard-Cambridge, 1871. *Matachia* and *Paramatachia* were subsequently transferred to the Amaurobiidae by Lehtinen (1967) and later to the Desidae Pocock, 1895 by Forster (1970). The family assignment of the sole Themacryinae genus, *Themacrys*, also changed several times. Petrunkevitch (1923) transferred it to the Tengellidae Dahl, 1908, Lehtinen (1967) to the Amaurobiidae Thorell, 1870 and Griswold *et al.* (1999) to the Phyxelididae Lehtinen, 1967, where it remains. Other reassignments were more straightforward. Forster (1955) synonymised *Stiphidiellum* with *Laestrygones* Urquhart, 1894 (currently Desidae) and Lehtinen (1967) proposed the synonymy of *Metafecenia* with *Tengella* Dahl, 1901 (Tengellidae). The subfamily Stiphidiinae was removed from Psechridae by elevation to family rank (Stiphidiidae) by Forster and Wilton (1973). The same authors established two genera, *Poaka* and *Haurokoa* Forster & Wilton, 1973, which they placed in the Psechridae; *Poaka*, however, was included with "considerable doubt" (Forster and Wilton 1973). Raven and Stumkat (2003) transferred *Poaka* to the Amaurobiidae and *Haurokoa* to the Tengellidae. After all these taxonomic changes, only Simon's (1890) original genera *Psechrus* and *Fecenia* remained in the Psechridae.

Placement of Psechridae and its genera based on morphological evidence

Simon (1892) followed a concept of dividing the Araneae verae [sic.] (today's Araneomorphae) into the sections Cribellatae and Ecribellatae. As Psechridae possess a cribellum and a calamistrum, Simon (1892) placed them in the Cribellatae, next to the families Uloboridae and Zoropsidae. Dalmas (1917) followed this concept, whereas Petrunkevitch (1923, 1928, 1939) postulated a close relationship of the Psechridae with the Amaurobiidae, Tengellidae and most notably with the Agelenidae. In addition to the characteristic features for Psechridae listed in Simon (1892), Petrunkevitch (1923, 1928, 1939) noted the single row of trichobothria dorsally on the tarsi and the chelicerae having a boss. Giltay (1926) suggested a relationship with the same families as Petrunkevitch (1923, 1928, 1939). However, he suggested the Tengellidae to be the closest relative. The main diagnostic characters of Psechridae at this time did not apply to every genus included within this family (e.g. claw tufts distally on the three-clawed tarsi not present in *Matachia*, *Stiphidion*, and *Themacrys*). This lead Gerhardt and Kästner (1932) to state: "the Psechridae nowadays are difficult to define". Nevertheless, they followed the concept of Petrunkevitch (1923, 1928). Bristowe (1938) thought differently and concluded the Psechridae were unlikely to be closely related to the Agelenidae based on the lack of plumose hairs [sic.; remark: with 'plumose' Bristowe meant what in more recent studies is referred to as 'feathery' (e.g. Griswold et al. 2005); in Griswold et al. (2005) 'plumose' is used in another sense]. He also noted the distinctly different way they move within their webs (i.e. upside down). Bristowe (1938) therefore grouped the Psechridae in the Dictynoidea within the Cribellatae. Lehtinen (1967) followed the system of Petrunkevitch (1923, 1928, 1939) in his comprehensive work on cribellate spider families, placing the Psechridae among the "isolated derivative groups" as their characters did not completely fit to any of the superfamilies he had defined.

An excellent and seminal study on the secondary eyes of spiders was provided by Homann (1950). He not only investigated the characteristics of the secondary eyes, especially the different types of tapeta, but also provided taxonomic considerations based on his anatomical findings. He discovered that the Psechridae possess secondary eyes with grate-shaped tapeta like in the families Zoropsidae Bertkau, 1882, Ctenidae Keyserling, 1877, Acanthoctenidae Simon, 1892, Lycosidae Sundevall, 1833, Pisauridae Simon, 1890, Senoculidae Simon, 1890, Oxyopidae Thorell, 1870, and Stiphidiidae Dalmas, 1917 (listed *sub* Stiphidiinae). In his study the Zoridae F. O. Pickard-Cambridge, 1893, which show several similarities to Ctenidae, Lycosidae, and Pisauridae concerning the eye arrangement, habitus and life-style, were represented only by *Zora* C. L. Koch, 1847 (however, under Ctenidae). He found that in *Zora* the tapeta were absent in all posterior eyes and in the anterior lateral eyes the tapeta were "in conformity with the canoe-shaped type" (Homann 1950). Homann (1950) also stated that at least some representatives of the Thomisidae Sundevall, 1833, among them *Misumenops asperatus* (Hentz, 1847), currently *Mecaphesa asperata*, have grate-shaped tapeta. Homann (1950) considered this type of tapetum as the most complicated and derived. Including additional ontogenetic data of the secondary eyes, Homann (1971) inferred families possessing grate-shaped tapeta to form a monophyletic group. Levi (1982), who revised the Psechridae for the first time, generally followed Homann's (1950, 1971) opinion.

Rainbow (1898) described *Uloborus flavolineatus* Rainbow, 1898, which later turned out to be *Psechrus argentatus* Doleschall, 1857 (Davies and Gallon 1986). It is possible that the habitus and the shape of the cribellum of the female specimens he examined reminded Rainbow (1898) of *Uloborus* Latreille, 1806. Unlike *Psechrus*, *Fecenia* produces a web remarkably similar to those of Uloboridae Thorell, 1869 and typical Araneidae Clerck, 1757 (as well as some related families, e.g. Tetragnathidae Menge, 1866). Coddington (1990), who studied the relationships of orb-weaving spiders and their relatives, stated that the resemblances of the webs of *Fecenia* with those of araneids and related families were most likely superficial, as there were no significant homologies in web building and exact web structure (e.g. radii and capture spiral). Coddington (1990) focused on the structures of male palps and noted the completely different basic structures of the palpal tibiae and bulbi of *Fecenia* to those of araneids.

In their review paper on the systematics and evolution of spiders Coddington and Levi (1991) placed the Psechridae within the Lycosoidea, whose chief synapomorphic character was considered the presence of secondary eyes with grate-shaped tapeta. Thus, these authors followed the concept of Homann (1971) and additionally proposed the Tengellidae as sister group of Lycosoidea based on unpublished data provided by Griswold. Griswold (1993) was the first to provide a cladistic analysis including members of Psechridae; he proposed the elongated, oval (or rectangular) calamistrum (consisting of more than two rows of setae) as an additional synapomorphic character of his focus group Lycosoidea. This character is only present in members that have retained the cribellum and calamistrum. Griswold (1993) also included *Trechalea* Thorell, 1869 (currently grouped *sub* Trechaleidae Simon, 1890) in the Lycosoidea close to the family Lycosidae. In his phylogenetic tree, the Psechridae not only appeared within the Lycosoidea but also within what he called "higher lycosoids" as sister taxon to Stiphidiidae, Senoculidae and *Tapinillus* Simon, 1885 (Oxyopidae). A morphology based phylogeny of entelegyne spiders (Griswold *et al.* 1999), also recovered Psechridae (represented only by *Psechrus*) belonging to the Lycosoidea. For the Lycosoidea as well as the family Zorocratidae an additional character was considered diagnostic; the dorsal scopula on the cymbium of males. However, these authors removed the Stiphidiidae from the Lycosoidea, due to differences in the arrangement of the paracribellar spigots on the posterior median spinnerets and additional, minor aspects. Silva (2003), who did not include the Stiphidiidae, corroborated Griswold's (1993) phylogeny, including the monophyly of the Lycosoidea and the placement of Psechridae, but renamed Lycosoidea together with the families Tengellidae, Zorocratidae and Zoridae as "grate shaped-tapetum (GST)-clade" and the "higher lycosoids" as "true lycosoids". Stiphidiidae were again supported as sister group of Psechridae by Raven and Stumkat (2005) who agreed with Griswold (1993) in the placement of this clade. Coddington *et al.* (2004) presented a comprehensive phylogenetic framework for the Araneae in general, summarising the results of the most important phylogenetic studies on spiders to date. Coddington *et al.* (2004) also considered Psechridae as members of the higher Lycosoidea, which, in turn, were sister to the Zoropsidae, Ctenidae and Miturgidae Simon, 1886. In a cladistic investigation of cribellate representatives of entelegyne spiders (Griswold *et al.* 2005), the Psechridae were recovered within the Lycosoidea together with Tengellidae, Zorocratidae Dahl, 1913 (at least in their tree based on implied weights), and Zoropsidae. Wunderlich (2008) defined and described the 'Lycosoidea *sensu lato*', where he included several additional families, e.g. the Amaurobiidae, Agelenidae, and Dictynidae. In Wunderlich's (2008) work the Psechridae were not discussed explicitly.

In summary many studies hint towards including the genera of Psechridae within the Lycosoidea, while further relationships remained ambiguous.

Placement of Psechridae and its genera based on other evidence

Chen (1999) performed cytological studies on representatives of five different spider families. He stated that the number and arrangement of chromosomes as well as the sex-determining mechanism may support the phylogenetic position of the Ctenidae, Oxyopidae and Psechridae within the Lycosoidea (Chen 1999). However, as the known chromosome data in most other families of this superfamily were poor, Chen (1999) regarded the result as tentative.

A molecular study including eight families (Fang *et al.* 2000) corroborated previously proposed family groupings in the Lycosoidea (Griswold 1993, Griswold *et al.* 2005, Raven and Stumkat 2005). Fang *et al.* (2000) examined partial mitochondrial 12S and 16S rRNA sequences and showed that Agelenidae, Tetragnathidae, and Uloboridae represent distinct lineages, separated from a monophyletic group including Psechridae, Oxyopidae, Pisauridae and Lycosidae. Their analysis revealed the Psechridae —therein represented by more specimens than in the other families— as sister taxon of Oxyopidae. The study of

Fang *et al.* (2000), however, was based upon a rather small taxon set and *Fecenia* specimens were not included. The second and to date last molecular study including Psechridae (with only *P. senoculatus* Wang & Yin 2001), examined combined sequences of fragments of the genes 12S, 16S, 18S and 28S rRNA (Pan *et al.* 2007). Focusing on the phylogeny of the Araneoidea and Deinopoidea, *Psechrus* was merely included as additional outgroup and as sole representative of the Lycosoidea. So far, no molecular study has included samples of the second Psechridae genus *Fecenia*.

Species groups and species delineation in Psechrus and Fecenia

Relationships within the genus *Psechrus* have been recently investigated based on different morphological characters (mainly copulatory organs, Bayer 2012). In this context, Bayer (2012) established eight species groups uniting species with corresponding traits. He defined species limits and pointed out the diagnostic characters to discriminate all species of *Psechrus* (Bayer 2012) and *Fecenia* (Bayer 2011). Yet, comprehensive studies investigating the relationship of species within the genera *Psechrus* and *Fecenia* applying morphological cladistic or molecular methods are virtually absent. Lin *et al.* (1999) examined the genetic relationship of Taiwanese pschrid spiders using the RAPD (randomly amplified polymorphic DNA)-estimation method. They found distinct differences in the RAPD patterns between the *Psechrus* samples of populations from the northern and the central regions and the southern and south-eastern parts of the island (Lin *et al.* 1999). However, it is evident that more than one species occurs in Taiwan (Yoshida 2009, Bayer 2012). Bayer (2012) recognised three Taiwanese *Psechrus* species with *P. clavis* Bayer, 2012 (central and north) and either *P. kenting* Yoshida, 2009 or *P. taiwanensis* Wang & Yin, 2001 (south and south-east) most likely corresponding to the different geographical "populations" in Lin *et al.* (1999). In this way Lin *et al.* (1999) provided the first molecular indication of the presence of more than one *Psechrus* species in Taiwan.

Aim of this study

Bayer (2011, 2012) recently provided a morphological framework in *Fecenia* and particularly *Psechrus* (and presented hypotheses of species interrelation in *Psechrus* (Bayer 2012). Our study aims to provide further insights into the phylogenetic relationships within the Psechridae and of its position within the Araneomorphae. For this purpose fragments of the nuclear gene 28S rRNA (28S) and the mitochondrial gene cytochrome *c* oxidase subunit I (COI) were sequenced and analysed. 28S (in combination with other genes) has been shown useful for the reconstruction of family- and subfamily level relationships in spiders (e.g. Arnedo *et al.* 2004, Bruvo-Mađarić *et al.* 2005, Hedin and Maddison 2001, Rix *et al.* 2008, Wang *et al.* 2008). We include a large number of *Psechrus* and —for the first time— *Fecenia* species and many genera and families that have been hypothesized to be closely related or previously assigned to Psechridae. We primarily aimed to answer the following questions:

1) What is the phylogenetic position of the Psechridae and other genera formerly placed in this family within the Araneomorphae?

2) Are the species group hypotheses proposed in the morphological study of the genus *Psechrus* (Bayer 2012) corroborated with molecular evidence, and how are the species of *Fecenia* interrelated?

COI is less conservative and has enabled insights into relationships between species (e.g. Blaxter 2003, Copley *et al.* 2009, Vink and Dupérré 2010) and even at the intraspecific level (e.g. Chang *et al.* 2007, Hebert *et al.* 2003, Hedin and Maddison 2001). Hebert *et al.* (2003) postulated that identifications of animals via barcoding of COI are possible. This opinion obtained support from several studies of successful COI-barcoding in spiders (e.g.

Barrett and Hebert 2005; Astrin *et al.* 2006; Robinson *et al.* 2009). The 'barcode gap', which is a typical discontinuity between levels of intraspecific and interspecific sequence divergence, generally indicates the existence of different species (Robinson *et al.* 2009). Barcode gaps can be recognised in NJ-phylograms, too, if one compares the branch lengths of the different sections of the tree (Robinson *et al.* 2009). Focusing on representatives of Psechridae we additionally aimed to address the following questions:
3) Are the multiple morphological species hypotheses by Bayer (2011, 2012) congruent with molecular data? This question particularly concerns species pairs, where the morphological difference in key characters is low. This eventually aids to re-evaluate if and which morphological characters are applicable for validly discerning species and may aid further delineation of morphological species in the future. In this context it will be tested if Psechridae species can be assigned discrete genetic information. If so, it should become possible to identify currently unasignable specimens such as juveniles.

Materials and Methods

Spider specimens examined. Most specimens used for this study (Table 1) were collected during an expedition to Thailand and Laos in 2009. Additional material of Psechridae and other spider families provided on loan by several museum curators (see below). All *Psechrus* and *Fecenia* specimens were identified by the first author according to Bayer (2011, 2012). Outgroup taxa identification is acknowledged in Table 1. Additional outgroup taxa were accessed from GenBank and are listed in Table 2. For detailed information on those taxa/specimens please refer to the respective webpage (http://www.ncbi.nlm.nih.gov/GenBank). Spider tissue samples are referenced with 'SD'; the respective SD-number is used as prefix in the phylogenetic trees to indicate specimens initially sequenced for this study (which means those listed in Table 1). These are stored either in the arachnology collection of the Research Institute and Natural History Museum Senckenberg, Frankfurt/Main, Germany or in collections of other natural history museums (see Table 1). Consequently, all taxa listed in the trees without any prefix number were accessed from GenBank (NCBI, Accession Numbers see Table 2). 'SB' (or 'MM') indicate individual numbers of vouchers that were thoroughly examined morphologically. This concerns the species of Psechridae (and Sparassidae in the few cases listing MM) and the respective SB numbers can also be found in the previous taxonomical revisions (Bayer 2011, 2012).
Vouchers for this study are deposited in the following museum collections (curators):
AMNH – American Museum of Natural History, New York, USA (N. I. Platnick, L. Sorkin). CAS – California Academy of Sciences, San Francisco, USA (C. E. Griswold, A. Carmichael). MHNG – Muséum d´histoire naturelle, Geneva, Switzerland (P. Schwendinger). NSMT – National Science Museum, Tokyo, Japan (H. Ono). SMF – Senckenberg Museum, Frankfurt am Main, Germany (P. Jäger, J. Altmann). WAM – Western Australian Museum, Perth (M. S. Harvey).
The outgroups included representatives of the superfamily Lycosoidea (GST-clade *sensu* Silva 2003), in which the Psechridae are currently placed, i.e. Lycosidae, Pisauridae, Oxyopidae, Zoropsidae, Zorocratidae, Ctenidae (Trechaleidae, Senoculidae and Zoridae were not available for the present study). Several taxa previously placed in or associated with the Psechridae were included, i.e. Stiphidiidae, Tengellidae, Desidae, Amaurobiidae (notably *Poaka*), and Phyxelididae (*Themacrys*). Some representatives of other entelegyne spider families belonging to the RTA-clade (Coddington and Levi 1991) were also included. To focus on interspecific relationships within *Psechrus* and *Fecenia* using COI, outgroup taxa were reduced to Lycosidae, Pisauridae, Oxyopidae and Stiphidiidae.

Table 1. Records and sources of spider specimens sequenced exclusively for the present study.

Species name **{family;** ***Psechrus* & *Fecenia* belong to the Psechridae}**	**SD-number/ sex/ SB-number** (as far as examined morphologically also)	**Date collected**	**Locality**	**Collector(s)/ Voucher deposited in (Museum collection, abbr.)**	**GenBank-Acc. No.**	
					COI	**28 S rRNA**
Cambridgea ambigua Blest & Vink 2000 **{Stiphidiidae}**	936/ male	12.I.2011	NEW ZEALAND: MC, Lincoln	G. S. Francis/ SMF; identified by Cor Vink		JX137252
Clubiona meraukensis Chrysanthus 1967 **{Clubionidae}**	914/ male	04.IV.2009	PAPUA NEW GUINEA: East New Britain Prov. (New Britain Island), Keravat	I. Agnarsson/ SMF; identified by Steffen Bayer		JX137243
Eusparassus walckenaeri (Audouin 1826)	804/ female/ MM 128	26.VIII.2010	TURKEY: Mugla Prov., Milas, GüllückYeni Oba	R.Zeelan & D.Kunz/ SMF; identified by Peter Jäger		JX137225
Fecenia cylindrata Thorell 1895	999/ female/ SB 318	25.XI.2009	LAOS: Champasak Prov., Muang Bachieng, Thad Paxuam	P. Jäger & S. Bayer/ SMF.	JX137193	
Fecenia cylindrata	1032/ female/ SB 485	15.XI.2009	LAOS: Luang Prabang Prov., near Luang Prabang, Tham Sieng Mang	P. Jäger & S. Bayer/ SMF.	JX137209	
Fecenia cylindrata	1035/ male/ SB 488	15.XI.2009	LAOS: Luangprabang Prov., Luang Prabang, Phou Si	P. Jäger & S. Bayer/ SMF.	JX137210	
Fecenia cylindrata	1042/ female/ SB 525	22.XI.2009	LAOS: Champasak Prov., Muang Pathoumphone, Ban Tha Hou	P. Jäger & S. Bayer/ SMF.	JX137212	JX137266
Fecenia cylindrata	1044/ female/ SB 511	23.XI.2009	LAOS, Champasak Prov., Muang Pathoumphone, Ban Nog Hoy	P. Jäger/ SMF	JX137213	
Fecenia cylindrata	1048/ juvenile/ SB 1178	03.III.2010	LAOS: Bolikhamsay Prov., 1 km W of Lak Sao	P. Jäger/ SMF	JX137214	
Fecenia cylindrata	1180/ juvenile/ SB 351	27.XI.2009	LAOS, Champasak Prov., near Pakse, Ban Ke	P. Jäger & S. Bayer/ SMF.	JX137218	
Fecenia ochracea (Doleschall 1859)	915/ s.a male/	05.IV.2009	PAPUA NEW GUINEA: East New Britain Prov. (New Britain Island), Keravat	I. Agnarsson/ SMF	JX137156	
Fecenia ochracea	917/ s.a. female/ SB 540	03.IV.2009	PAPUA NEW GUINEA: East New Britain Prov. (New Britain Island), Keravat	I. Agnarsson/ SMF	JX137157	JX137244
Fecenia ochracea	942/ female/ SB 947	17.II.1978	PAPUA NEW GUINEA: Wau (Ecology Center)	E.I. Schlinger/ CAS	JX137169	
Fecenia protensa Thorell 1891	908/ female/ SB 196	16.III.2009	INDONESIA: Bali, Candi Dasa	S. Huber/ SMF	JX137152	JX137240
Fecenia protensa	909/ male/ SB 137	20.III.2009	INDONESIA: Bali, Candi Dasa	S. Huber/ SMF	JX137153	
Fecenia protensa	911/ female/ SB 195	06.VI.2009	THAILAND: Krabi Prov. & Distr., Thab Khaek - Hang Nak Hill Nature Trail	P. Schwendinger/ SMF	JX137154	
Fecenia protensa	913/ male/ SB 219	24.III.2009	INDONESIA: Flores, East of Labuan Bajo, Tobedo	S. Huber/ SMF	JX137155	
Fecenia protensa	943/ juvenile/ SB 948	14.X.2009	BRUNEI DARUSSALAM: Tutong Dist., Tasek Merimbum Heritage Park	C. Griswold & J.K.H. Koh/ CAS	JX137170	
***Fecenia* sp.**	1030/ female/ SB 458	03.XI.2009	THAILAND: Trat Prov., Koh Chang Island, Khlong Chao Luam Waterfall	P. Jäger & S. Bayer/ SMF.	JX137207	JX137265
***Fecenia* sp.**	1031/ male/ SB 512	03.XI.2009	THAILAND: Trat Prov., Koh Chang Island, Khlong Chao Luam Waterfall	P. Jäger & S. Bayer/ SMF.	JX137208	
Fecenia travancoria Pocock 1899	877/ female/ SB 982	16.I.2011	SRI LANKA: Sabaragamuwa Prov., Sinharaja Nature Reserve, near Pitadeniya	V. Hartmann/ SMF	JX137138	JX137231
Leucorchestris arenicola Lawrence 1962	442/ s.a. female/ MM 156	2007	NAMIBIA: Gobabeb Field Station	T. Bird/ SMF; identified by Peter Jäger		JX137222
Mituliodon tarantulinus (L. Koch 1873) **{Miturgidae}**	932/ female	XII.2010	AUSTRALIA, New South Wales, Drake (Sugarloaf Rd.)	I. & R. Gray/ SMF; identified by Rob Raven		JX137250
***Oxyopes* sp.**	880/ male	24.III.2011	LAOS: Bolikhamsay Province, Nam Kading National Protected Area	P. Jäger & L. Nophasead/ SMF; identified by Peter Jäger		JX137234
Pisaura mirabilis (Clerck 1757) **{Pisauridae}**	1055/ male	22.IV.2011	GERMANY: Rheinland-Pfalz, Landkreis Kaiserslautern, Hauptstuhl	S. Bayer & H. Bayer/ SMF; identified by Steffen Bayer	JX137215	JX137267
Poaka graminicola Forster & Wilton 1973 **{Amaurobiidae}**	900/ juvenile	19.III.2007	NEW ZEALAND: Christchurch, Hagley Park, near Albert Park	C. Vink/ entire specimen used; no voucher; identified by Cor Vink		JX137236
Psechrus ancoralis Bayer & Jäger 2010	905/ female/ SB 13	15.I.2009	LAOS: Huaphan Prov., Vieng Thong, Tham Mue	H. Steiner/ SMF	JX137149	
Psechrus ancoralis	962/ male/ SB 320	13.XI.2009	LAOS: Luang Prabang Prov., Phou Khoun, way to Tham Seua	P. Jäger & S. Bayer/ SMF.	JX137180	
Psechrus ancoralis	973/ female/ SB 383	13.XI.2009	LAOS: Luang Prabang Prov., Phou Khoun, way to Tham Seua	P. Jäger & S. Bayer/ SMF.	JX137183	
Psechrus ancoralis	980/ male/ SB 321	13.XI.2009	LAOS: Luang Prabang Prov., Phou Khoun, way to Tham Seua	P. Jäger & S. Bayer/ SMF.	JX137186	
Psechrus ancoralis	981/ juvenile/ SB 297	19.XI.2009	LAOS, Luang Nam Tha Prov., Nam Ha Protected area (NAMHA 5)	P. Jäger & S. Bayer/ SMF.	JX137187	
Psechrus ancoralis	990/ female/ SB 314	19.XI.2009	LAOS, Luang Nam Tha Prov., Nam Ha Protected area (NAMHA 4)	P. Jäger & S. Bayer/ SMF.	JX137189	
Psechrus ancoralis	991/ male/ SB 296	19.XI.2009	LAOS, Luang Nam Tha Prov., Nam Ha Protected area (NAMHA 5)	P. Jäger & S. Bayer/ SMF.	JX137190	JX137260
Psechrus ancoralis	994/ female/ SB 315	19.XI.2009	LAOS, Luang Nam Tha Prov., Nam Ha Protected area (NAMHA 4)	P. Jäger & S. Bayer/ SMF.	JX137191	
Psechrus ancoralis	1009/ female/ SB 344	16.XI.2009	LAOS: Luangprabang Prov., Nong Khiao, Tham Pathok	P. Jäger & S. Bayer/ SMF.	JX137196	
Psechrus ancoralis	1028/ female/ SB 457	31.I.2010	LAOS: Oudomxay, Namor District, Tham Na Thong	H. Steiner/ SMF	JX137205	
Psechrus ancoralis	1132/ female/ SB 299	19.XI.2009	LAOS, Luang Nam Tha Prov., Nam Ha Protected area (NAMHA 5)	P. Jäger & S. Bayer/ SMF.	JX137217	
Psechrus antraeus Bayer & Jäger 2010	978/ female/ SB 294	12.XI.2009	LAOS: Vientiane Prov., Vang Vieng, Tham Phou Kham	P. Jäger & S. Bayer/ SMF.	JX137184	JX137259
Psechrus antraeus	979/ female/ SB 295	12.XI.2009	LAOS: Vientiane Prov., Vang Vieng, Tham Phou Kham	P. Jäger & S. Bayer/ SMF.	JX137185	
Psechrus antraeus	1566/ s.a. male/ SB 298	12.XI.2009	LAOS: Vientiane Prov., Vang Vieng, 200m before Tham Phou Kham	P. Jäger & S. Bayer/ SMF.	JX137221	
Psechrus argentatus (Doleschall 1857)	910/ female/ SB 138	27.III.2009	INDONESIA: Flores, East of Labuan Bajo, Tobedo	S. Huber/ SMF		JX137241
Psechrus clavis Bayer 2012	881/ male/ SB 1008	II.2011	TAIWAN: Nantou County, Yuchih	R.C. Cheng/ SMF	JX137141	
Psechrus clavis	883/ female/ SB 1010	II.2011	TAIWAN: Nantou County, Yuchih	R.C. Cheng/ SMF	JX137142	
Psechrus clavis	891/ female/ SB 1021	XI.2010	TAIWAN: Taichung county, Dongshih	R.C. Cheng/ SMF	JX137143	JX137235
Psechrus clavis	893/ female/ SB 1025	XI.2010	TAIWAN: Taichung county, Dongshih	R.C. Cheng/ SMF	JX137144	
Psechrus clavis	895/ s.a. female/ SB 1027	XI.2010	TAIWAN: Taichung county, Dongshih	R.C. Cheng/ SMF	JX137145	

Species name {family; *Psechrus* & *Fecenia* belong to the Psechridae**}**	**SD-number/ sex/ SB-number** (as far as examined morphologically)	**Date collected**	**Locality**	**Collector(s)/ Voucher deposited in (Museum collection, abbr.)**	**GenBank-Acc. No.**	
					COI	**28S rRNA**
Psechrus clavis	920/ s.a. female/ SB 276	IX.2009	TAIWAN: Taichung County, Wushihkeng	R.C. Cheng/ SMF		JX137245
Psechrus clavis	921/ juvenile/ SB 277	IX.2009	TAIWAN: Taichung County, Wushihkeng	R.C. Cheng/ SMF	JX137158	
Psechrus clavis	922/ juvenile/ SB 278	IX.2009	TAIWAN: Taichung County, Wushihkeng	R.C. Cheng/ SMF	JX137159	
Psechrus clavis	924/ female/ SB 614	30.X.2003	TAIWAN: Taoyuan County, Ssuleng	H. Ono/ NSMT	JX137161	
Psechrus crepido Bayer 2012	861/ s.a. female/ SB 980	31.XII.1989	INDIA: Tamil Nadu Prov., Kodaikanal	V. & B. Roth/ CAS.	JX137135	
Psechrus crepido	863/ female/ SB 984	30.XII.1989	INDIA: Tamil Nadu Prov., Kodaikanal	V. & B. Roth/ CAS		JX137228
Psechrus fuscai Bayer 2012	949/ female/ SB 954	16.VIII.2006	CHINA: Yunnan Prov., Gongshan Co., Bingzhongluo Township, trail between Niwaluo and Fuscai	J.A. Miller/ CAS	JX137173	JX137256
Psechrus ghecuanus Thorell 1897	923/ male/ SB 613	14.X.2009	THAILAND: Chiang Mai, not far from Chian Mai City, Mae-Rim	H. Ono/ NSMT	JX137160	JX137246
Psechrus ghecuanus	931/ juvenile/ SB 817	18.XII.2003	THAILAND, Chiang Mai, Doi Suthep, Monthathan Waterfall	S. Huber/ SMF	JX137165	JX137249
Psechrus ghecuanus	1026/ s.a. male/ SB 421	30.XII.2009	THAILAND: Chiang Mai Prov. & Distr., Doi Suthep	P. Schwendinger/ SMF	JX137203	JX137264
Psechrus hartmanni Bayer 2012	878/ female/ SB 1007	10.I.2011	SRI LANKA: Central Prov., Pattipola, NP Horton Plains	V. Hartmann/ SMF	JX137139	JX137232
Psechrus himalayanus Simon 1906	875/ s.a. female/ SB 990	13.III.2011	INDIA: Uttarakhand, Dehra Dun, campus	P. Jäger/ SMF	JX137136	JX137230
Psechrus himalayanus	876/ s.a. female SB 991	13.III.2011	INDIA: Uttarakhand, Dehra Dun, campus	P. Jäger/ SMF	JX137137	
Psechrus himalayanus	940/ female/ SB 907	25.X.2009	INDIA, Uttarakhand., Govind Ghat	S. Quasin/ SMF	JX137168	
Psechrus inflatus Bayer 2012	854/ female/ SB 961	14.X.1998	CHINA: Yunnan Prov., Nujiang Prefecture, Lushui Co., Ganfang Sancha Lukou	C. Griswold, D. Kavanaugh & C.-L. Long/ CAS	JX137133	
Psechrus inflatus	946/ female/ SB 951	30.VIII.2006	CHINA: Yunnan Prov., Gongshan Co., Dulongjiang Township, trail to Makucun, Yakou, 0.5 air km WSW of Makucun village	J.A. Miller & D.H. Kavanaugh/ CAS	JX137171	
Psechrus inflatus	947/ male/ SB 952	30.VIII.2006	CHINA: Yunnan Prov., Gongshan Co., Dulongjiang Township, trail to Makucun, Yakou, 0.5 air km WSW of Makucun village	J.A. Miller & D.H. Kavanaugh/ CAS	JX137172	JX137254
Psechrus inflatus	853/ female/ SB 960	16.V.2005	CHINA: Yunnan Prov., Nujiang Prefecture, Lushui Co., Pianma Township, Xuetang, 0-4 km E Ganfang, Sancha Lukou	C. Griswold & D. Kavanaugh/ CAS	JX137132	
Psechrus jaegeri Bayer 2012	995/ female/ SB 300	25.XI.2009	LAOS: Champasak Prov., Muang Bachieng, Ban Lak 35, That I-Tou Waterfall	P. Jäger & S. Bayer/ SMF.	JX137192	
Psechrus jaegeri	1006/ male/ SB 303	27.XI.2009	LAOS, Champasak Prov., Muang Bachieng, Ban Lak 38, That Fane	P. Jäger & S. Bayer/ SMF.	JX137195	JX137262
Psechrus jaegeri	1012/ juvenile/ SB 348	22.XI.2009	LAOS, Champasak Prov., Muang Pathoumphone, Ban Tha Hou	P. Jäger & S. Bayer/ SMF.	JX137198	
Psechrus jaegeri	1433/ female/ SB 309	25.XI.2009	LAOS: Champasak Prov., Muang Bachieng, That Paxuam	P. Jäger & S. Bayer/ SMF.	JX137219	
Psechrus khammouan Jäger 2007	954/ female/ SB 382	06.XI.2009	LAOS: Khammouan Prov., Thakek, 'Sinopoda'-cave (outside)	P. Jäger & S. Bayer/ SMF.	JX137176	JX137257
Psechrus khammouan	956/ female/ SB 380	06.XI.2009	LAOS, Khammouan Prov., Thakek, Ban Kouanphavang I	P. Jäger & S. Bayer/ SMF.	JX137177	
Psechrus khammouan	959/ male/ SB 381	06.XI.2009	LAOS: Khammouan Prov., Thakek, 'Sinopoda'-cave (outside)	P. Jäger & S. Bayer/ SMF.	JX137178	
Psechrus kunmingensis Yin, Wang & Zhang 1985	948/ female/ SB 953	21.–23.VI.2000	CHINA: Yunnan Prov., Kunming Prefecture, Kunming, Heilongtan Distr., Kunming Institute of Botany	D.H. Kavanaugh & C. Griswold/ CAS		JX137255
Psechrus laos Bayer 2012	961/ female/ SB 368	08.XI.2009	LAOS: Bolikhamsay Prov., Lak Sao, 'LAKSA1'	P. Jäger & S. Bayer/ SMF.	JX137179	
Psechrus laos	968/ female/ SB 377	09.XI.2009	LAOS: Bolikhamsay Prov., Lak Sao, Tham Man Kone	P. Jäger & S. Bayer/ SMF.	JX137181	JX137258
Psechrus laos	971/ female/ SB 374	09.XI.2009	LAOS: Bolikhamsay Prov., Lak Sao, 'LAKSA1'	P. Jäger & S. Bayer/ SMF.	JX137182	
Psechrus laos	1022/ male/ SB 367	09.XI.2009	LAOS: Bolikhamsay Prov., Lak Sao, 'LAKSA1'	P. Jäger & S. Bayer/ SMF.	JX137201	
Psechrus libelti Kulczyński 1908	856/ female/ SB 969	14.X.2009	BRUNEI DARUSSALAM: Tutong Distr., Tasek Merimbum Heritage Park	C. Griswold & J.K.H. Koh/ CAS	JX137134	JX137227
Psechrus luangprabang Jäger 2007	982/ juvenile/ SB 360	14.XI.2009	LAOS: Luangprabang Prov., Luang Prabang, Phou Si	P. Jäger & S. Bayer/ SMF.	JX137188	
Psechrus luangprabang	1011/ s.a. female/ SB 346	16.XI.2009	LAOS: Luangprabang Prov., Nong Khiao, Tham Pathok	P. Jäger & S. Bayer/ SMF.	JX137197	
Psechrus luangprabang	1014/ male/ SB 353	16.XI.2009	LAOS: Luangprabang Prov., Nong Khiao, Tham Pathok	P. Jäger & S. Bayer/ SMF.	JX137199	JX137263
Psechrus luangprabang	1021/ s.a. male/ SB 359	19.XI.2009	LAOS: Luang Nam Tha Prov., Nam Ha Protected area (NAMHA6)	P. Jäger & S. Bayer/ SMF.	JX137200	
Psechrus luangprabang	1023/ male/ SB 402	18.XI.2009	LAOS, Luang Nam Tha Prov., Luang Nam Tha, Ban Tavan (3)	P. Jäger & S. Bayer/ SMF.	JX137202	
Psechrus luangprabang	1027/ female/ SB 424	12.XI.2009	LAOS: Vientiane Prov., bei Vang Vieng, Ban Phoxay	P. Jäger & S. Bayer/ SMF.	JX137204	
Psechrus luangprabang	1029/ male/ SB 459	19.XI.2009	LAOS: Luang Nam Tha Prov., Nam Ha Protected area (NAMHA6)	P. Jäger & S. Bayer/ SMF.	JX137206	
Psechrus luangprabang	1036/ female/ SB 508	18.XI.2009	LAOS, Luang Nam Tha Prov., Luang Nam Tha, Ban Tavan (3)	P. Jäger & S. Bayer/ SMF.	JX137211	
Psechrus obtectus Bayer 2012	1058/ male/ SB 1150	02.V.1999	VIETNAM: Bac Thai Prov, Tam Dao Mt. Forest Park (45km NW of Hanoi)	X.P. Wang/ AMNH	JX137216	JX137269
Psechrus rani Wang & Yin 2001	929/ female/ SB 819	11.XII.2003	HONG KONG: New Territories, Kadoorie Farm	S. Huber/ SMF	JX137163	JX137248
Psechrus rani	930/ female/ SB 818	13.XII.2003	HONG KONG, New Territories, Tai Po Kau Nature Park	S. Huber/ SMF	JX137164	
Psechrus senoculatus Yin, Wang & Zhang 1985	903/ female/ SB 9	02.XI.2008	CHINA: Hunan Prov., Linwu County, Nanqiang Country, Dengjia Village, Wuming hole	X. Xu *et al.*/ SMF	JX137147	JX137237
Psechrus senoculatus	904/ female/ SB 10	02.XI.2008	CHINA: Hunan Prov., Linwu Cnty., Nanqiang Ctry., Dengjia Vill., Wuming hole	X. Xu *et al.* / SMF	JX137148	
Psechrus sinensis Berland & Berl. 1914	899/ female/ SB 1176	30.IX.1997	CHINA: Guizhou Prov., Guiyang	X.P. Wang/ AMNH	JX137146	
Psechrus singaporensis Thorell 1894	912/ female/ SB 220	02.IV.2009	SINGAPORE: Bukit Timah Nature Reserve	S. Huber/ SMF		JX137242
Psechrus singaporensis	928/ juvenile	17.VI.2009	MALAYSIA, Selangor, Batu Caves, Dark Cave, Chamber C	M.S. Harvey & K.L. Edward/ WAM	JX137162	
***Psechrus* sp.** [from *singaporensis*-group]	927/ juvenile	25.VI.2009	MALAYSIA: Pahang, Gua Tongkat, near Tekam Plantation Resort	M.S. Harvey & K.L. Edward/ WAM		JX137247
Psechrus* sp. (*tauricornis Bayer 2012 **?)**	939/ juvenile/ SB 885	16.I.2011	SRI LANKA: Sabaragamuwa Prov., Sinharaja, near Pitadeniya	V. Hartmann/ SMF	JX137167	
Psechrus* sp. prope *elachys Bayer 2012	906/ male/ SB 134	05.VI.2008	MALAYSIA: Terengganu State, Pulau Perhentian Besar	P. Schwendinger/ MHNG	JX137150	

Species name **{family;** ***Psechrus* & *Fecenia* belong to the Psechridae}**	**SD-number/ sex/ SB-number** (as far as examined morphologically)	**Date collected**	**Locality**	**Collector(s)/ Voucher deposited in (Museum collection, abbr.)**	**GenBank-Acc. No.**	
					COI	**28S rRNA**
Psechrus torvus (O. Pickard-Cambridge 1869)	879/ female/ SB 941	10.I.2011	SRI LANKA: Central Prov., Labugolla, Mackwoods Tea Centre	V. Hartmann/ SMF	JX137140	JX137233
Psechrus ulcus Bayer 2012	907/ male/ SB 141	31.X.2008	INDONESIA: South Kalimantan Prov., ca. 25 km E of Banjarbaru, near Riamkanan Dam	P. Schwendinger/ MHNG	JX137151	JX137239
Psechrus vivax Bayer 2012	951/ male/ SB 364	02.XI.2009	THAILAND: Trat Prov., Koh Chang Island, Kheeri Phet Waterfall	P. Jäger & S. Bayer/ SMF.	JX137174	
Psechrus vivax	952/ s.a. female/ SB 366	01.XI.2009	THAILAND: Trat Prov., Koh Chang Island, Klong Phlu School	P. Jäger & S. Bayer/ SMF.	JX137175	
Psechrus vivax	1003/ female/ SB 293	31.X.2009	THAILAND: Trat Prov., Koh Chang Island, Kheeri Phet Waterfall	P. Jäger & S. Bayer/ SMF.	JX137194	JX137261
Psechrus vivax	1565/ male/ SB 291	01.XI.2009	THAILAND: Trat Prov., Koh Chang Island, Klong Phlu School	P. Jäger & S. Bayer/ SMF.	JX137220	JX137270
Spariolenus iranomaximus Moradmand & Jäger 2011	618/ female/ MM 16	16.IV.2009	IRAN: Ilan Prov., Dehloran, Khofash cave	M. Moradmand/ SMF; identified by Majid Moradmand		JX137224
Stiphidion facetum Simon 1902 **{Stiphidiidae}**	933/s.a. male	29.X.2010	AUSTRALIA, New South Wales, Gerringong	R. Raven/ SMF; identified by Rob Raven	JX137166	JX137251
Stiphidion facetum	937/ male	11.V.2004	NEW ZEALAND: Wellington, Stokes Valley, Raukawa Street	B.M. Fitzgerald/ SMF; identified by B.M. Fitzgerald		JX137253
***Thalassinae* gen. sp.**	826/ s.a. male		ETHIOPIA: Wendo Genet, tropical forest, Woreka River	M. Moradmand/ SMF; identified by Peter Jäger	JX137131	JX137226
Themacrys* sp. *cf. ukhahlamba Griswold 1990 **{Phyxelididae}**	867/ female	11.I.2011	REPUBLIC SOUTH AFRICA: Eastern Cape Prov., Silaka Nature Reserve	C. Haddad/ SMF; identified by Steffen Bayer		JX137229
***Viridasius* sp.** **{Ctenidae}**	586/ male	06.VII.2008	Madagascar	ded. A. Leetz/ SMF; identified by Peter Jäger		JX137223
Zoropsis spinimana (Dufour 1820) **{Zoropsidae}**	1056/ male	22.X.2008	GERMANY: Rheinland-Pfalz, Mainz, Mombach	A. Schönhofer/ SMF; identified by Peter Jäger		JX137268

Abbreviations: Genus names: *P.*: *Psechrus*, *F.*: *Fecenia*; s.a.: subadult. SD: Subsequent numbers of spider tissue samples stored in the arachnology collection of the Research Institute and Natural History Museum Senckenberg, Frankfurt/ Main, Germany. SB: Serial individual numbers of Psechridae morphologically examined by the first author. MM: Serial individual numbers of particular specimens of Sparassidae morphologically examined and deposited in SMF. Via SB (and MM) numbers (listed on each label) each specimen previously morphologically examined can be traced both physically in each collection and in each description, either in Bayer (2011) or Bayer (2012). Abbreviations of museum collections see under 'Materials and Methods'.

Table 2. Specimens/taxa with sequences accessed from GenBank.
Respective accession numbers are given, for further information see NCBI webpage (http://www.ncbi.nlm.nih.gov/GenBank).

Species name **{family}**	**GenBank-Acc. No.**	
	COI	**28 S rRNA**
Agelenopsis aperta (Gertsch 1934) **{Agelenidae}**		FJ607517.1
Agelenopsis potteri (Blackwall 1846)	GU682460.1	
Allagelena gracilens (C.L. Koch 1841) **{Agelenidae}**	DQ628606.1	DQ628661.1
Allagelena difficilis (Fox 1936)		AY633850.1
Alopecosa hirtipes (Kulczynski 1907) **{Lycosidae}**	GU683933.1	
Alopecosa kochi (Keyserling 1877)		DQ628662.1
Amaurobius fenestralis (Ström 1768) **{Amaurobiidae}**		FR694066.1
Amaurobius ferox (Walckenaer 1830)	HQ979294	FR694065.1
Amaurobius similis (Blackwall 1861)	DQ628608.1	DQ628663.1
Anyphaena californica (Banks 1904) **{Anyphaenidae}**	DQ628605.1	DQ628660.1
Badumna longiqua (L. Koch 1867) **{Desidae}**	FJ607558.1	FJ607523.1
***Callobius* sp.** **{Amaurobiidae}**	FJ607559.1	FJ607524.1
***Castianeira* sp.** **{Corinnidae}**	AY297419.1	AY297292.1
Cheiracanthium mildei L. Koch 1864 **{Miturgidae}**	GU682639.1	
***Cheiracanthium* sp.**	AY297421.1	AY297294.1
Clubiona pallidula (Clerck 1757)	HQ924480.1	
Clubiona pseudogermanica Schenkel 1936		AY633858.1
Desis formidabilis (O. Pickard-Cambridge 1890) **{Desidae}**		FJ948953
Dolomedes tenebrosus Hentz 1844 **{Pisauridae}**		FJ607527.1
Dolomedes triton (Walckenaer 1837)	GU682708.1	
Drassodes lapidosus (Walckenaer 1802) **{Gnaphosidae}**	AY560798.1	AY560767.1
Habronattus mexicanus (Peckham & Peckham 1896) **{Salticidae}**	AY297381.1	AY297251.1
Habronattus oregonensis (Peckham & Peckham 1888)	NC_005942.1	
Hogna jacquesbreli Baert & Maelfait 2008 **{Lycosidae}**	GU395027.1	GU395068.1
Hygropoda higenaga (Kishida 1936) **{Pisauridae}**		AB374066.1
Leucorchestris arenicola Lawrence 1962		
Marpissa pikei (Peckham & Peckham 1888) **{Salticidae}**		AF327936.1
***Marpissa* sp. 1**	HQ924616.1	
Mecaphesa asperata (Hentz 1847) (in GenBank *sub* ***Misumenops asperatus***) **{Thomisidae}**		AY210461.1
Misumenops dalmasi Berland 1927 **{Thomisidae}**	FJ590798	
Misumenops nepenthicola (Pocock 1898)	EF419094.1	EF419029.1
Mituliodon tarantulinus (L. Koch 1873) **{Miturgidae}**		
Mituliodon tarantulinus		DQ019732.1
Miturga gilva L. Koch 1872 **{Miturgidae}**		DQ019733.1
Pardosa fuscula (Thorell 1875) **{Lycosidae}**	GU683902.1	
Pardosa wagleri (Hahn 1822)		AY560770.1
Peucetia viridans (Hentz 1832) **{Oxyopidae}**	FJ607580.1	FJ607541.1
Pisaurina brevipes (Emerton 1911) **{Pisauridae}**	GU682536.1	
Stiphidion facetum	DQ628631.1	DQ628693.1
Tegenaria ariadnae Brignoli 1984 **{Agelenidae}**		FR694068.1
Tegenaria domestica (Clerck 1757)	GU682893.1	
Tengella radiata (Kulczyński 1909) **{Tengellidae}**		DQ628684.1
Trochosa ruricola (De Geer 1778) **{Lycosidae}**		HM171114.1
Trochosa terricola Thorell 1856	GU682472.1	
Uloborus diversus Marx 1898 **{Uloboridae}**		FJ525380.1
***Xysticus* sp.**		EF201665.1
***Zelotes* sp.** **{Gnaphosidae}**	DQ628624.1	DQ628686.1
Zelotes sula Lowrie & Gertsch 1955	GU684406.1	
Zorocrates fuscus Simon 1888 **{Zorocratidae}**	FJ607588.1	FJ607549.1

DNA extraction. DNA was extracted using the CTAB-Method with subsequent phenol extraction (after Shahjahan *et al.* 1995; Wallace 1987). Pieces of legs were torn in very small pieces, air-dried and homogenised with pestle and mortar in 750 µl homogenisation solution (CTAB (Cetyltrimethylammoniumbromid) (2%), 0.1 M Tris-HCl (pH 8), 1.4 M NaCl (Natriumchlorid), 2.5 mM EDTA (Ethylendiamintetraacetic acid), 2% SDS (Dodecylsulfat, Natriumsalt); 1.5 µl ß-Mercaptoethanol (14.3 M); 1.5 µl Proteinase K (15 mg/ml)). Following digestion of the tissue for 3 hrs (partially overnight) at 56 °C, coarse debris were removed by centrifugation, and the supernatant extracted up to three times with 1.5 volumes of a standard phenol-chloroform-isoamylalcohol solution (Sambrook and Russell 2001). Following a final chloroform-isoamylalcohol extraction step, the DNA was precipitated using 1/10 volume 3 M Na-acetate, pH 5.2 and 2.2 volumes of ice cold ethanol at –20°C. After washing the pellet in ice cold 70% EtOH once, the air-dried DNA was finally dissolved in 30 µl ultrapure, sterile H_2O and DNA concentration was determined using a spectrophotometer and ranged from 72–900 ng/µl. Most of the extractions were carried out by SRD (Scientific Research and Development GmbH), Bad Homburg, Germany.

Amplification of DNA fragments and Sequencing. In total 648 base pairs (barcoding region) of COI were amplified using the newly developed primers
'Heteropoda-fw ' (5'-TCTACTAATCATAAAGATATTGG-3') and
'Psechrus-rv' (5'-TCCSGCAGGGTCAAAAAATGAAG-3'), based on Folmer *et al.* (1994) and Barrett and Hebert (2005). 770–785 base pairs of 28S were amplified using the primers '28S O' (5' –GAAACTGCTCAAAGGTAAACGG– 3') and
'28S C' (5' -GGTTCGATTAGTCTTTCGCC- 3') (Hedin and Maddison 2001).
For the amplification of the COI and 28S fragments the polymerase chain reaction (PCR) was carried out in 25 µl under standard conditions, but at an elevated $MgCl_2$ concentration (3.5 mM). 2.5 µl of the genomic spider DNA was used as template (concentration: 30–35 ng/ µl). For the PCR a first cycle was run for 5 min at 94 °C, followed by 4 cycles at a relatively low annealing temperature (1 min [30 s for 28S amplification] at 94 °C, 1 min at 50 °C [52 °C for 28S amplification], 1 min at 72 °C) and 34 cycles at a higher annealing temperature (1 min at 94 °C, 1 min at 54 °C, 1 min at 72 °C) and a final elongation step (10 min, 72 °C). Prior to sequencing, DNA was tentatively quantified by gel electrophoresis after Sambrook and Russell (2001) and the fragments purified using the QIAquick PCR purification kit (Qiagen). Most PCR and sequencing (performed with BigDye Terminator Cycle Sequencing Kit v. 3.1 using primers as mentioned) was executed by SRD. Fragments were sequenced from both directions to validate the resulting chromatograms. All data were edited manually using BioEdit (Hall 1999).

Alignment and phylogenetic analysis. Sequences were initially aligned using the programs ClustalX (Thompson et al. 1997) and GeneDoc (Nicholas and Nicholas 1997) checking for correct amino acid translation in COI. To incorporate structural information 28S was further aligned with MAFFT (v. 6; http://mafft.cbrc.jp/alignment/software/) using the Q-INS-i strategy as recommended by Katoh & Toh (2008). The program jModeltest 0.1.1 (Posada, 2008) was used to evaluate models of DNA sequence evolution under three substitution schemes (JC, HKY, GTR) on a fixed BIONJ tree, allowing for unequal base frequencies and among-site rate variation. The Akaike Information Criterion (AIC) and the hLRTs selected the GTR + Γ + I as best-fitting nucleotide models for the 28S and the COI alignment. This model was applied in all subsequent analyses and all datasets partitioned by gene and COI in addition by codon position.
For phylogenetic analysis we applied Bayesian inference and Maximum Likelihood (ML). Bayesian inference used MrBayes v3.2.0 (Huelsenbeck and Ronquist 2001; Ronquist &

Huelsenbeck, 2003). Bayesian analyses were run for 2,000,000 generations for COI, 3,000,000 for 28S and 8,000,000 for the concatenated data, where in all cases the standard deviation of split frequencies had dropped below 0.01 (Ronquist *et al.*, 2005). Analyses were repeated to further check for convergence. The first 40% of trees were discarded as burn-in, with remaining trees used to reconstruct a 50% majority rule consensus tree. Split frequencies were interpreted as posterior probabilities (pp) of clades.

ML was performed using the programme raxmlGUI v. 0.95 (Silvestro and Michalak 2011) for analysing the 28S rRNA dataset and the concatenated dataset of 28S rRNA and COI. Node support was assessed from 1,000 non-parametric bootstrap pseudoreplications (Felsenstein 1985) as implemented in raxmlGUI (according to Stamatakis *et al.* 2008).

To evaluate the usability of the COI data for barcoding a Neighbour Joining (NJ)-analysis (Saitou and Nei 1987), representing a distance method (no phylogenetic method *sensu stricto*), was performed using MEGA 4.1b (Tamura *et al.* 2007). The Kimura-2-parameter correction model was applied and bootstrap support for nodes assessed from 2,000 pseudoreplications. The neighbour joining analysis was also re-run with uncorrected p-distances and the topology and the branch lengths were exactly the same.

Results

The 28S dataset included 82 sequences, 32 of which were downloaded from GenBank. In total 73 spider species were included, 24 of which belong to *Psechrus* and four to *Fecenia*. The COI and 28S trees were congruent, so the analysis of a combined dataset was justified. This concatenated dataset of 28S and COI sequences included 130 sequences from 76 specimens and 66 species, among them 22 *Psechrus* and four *Fecenia* species. Forty-six sequences of 31 specimens and 29 species were accessed from GenBank. Reconstructions to assess species limits in *Psechrus* and *Fecenia* were based upon COI, only, and included 103 sequences, 11 of which downloaded from GenBank; these sequences represented 42 species including 24 *Psechrus* species and four *Fecenia* species.

For the following *Psechrus* species only COI or 28S could be sequenced, either because of the lack of fresh material, or because a *Wolbachia* infection was identified by its specific sequence: *P. argentatus* (Doleschall, 1857), *P. kunmingensis* Yin, Wang & Zhang, 1985 (only 28S); *P. sinensis* Berland & Berland, 1914, *Psechrus* sp. *cf. tauricornis* Bayer, 2012 (only COI). For *P. crepido* Bayer, 2012 and *P. singaporensis* Thorell, 1894 28S and COI sequences could only be generated from different individuals and were therefore combined as species in the concatenated analysis as indicated by different SD numbers. For the same reason and as we focused on higher level relationships, we combined sequences of closely related species of the respective genus for nine outgroup taxa in the same manner (compare Figs 3–4 & Table 1).

In general 28S did not resolve relationship at the base of the Lycosoidea and within *Psechrus* very well (Figs 1–2). In both Bayesian analysis and ML respective branches were very short and lacked reliable support. COI resolved and supported most species and some species groups in the psechrid genera, while support at deeper nodes was lacking. The concatenated data set combined these trends and support values increased in general. Support of nodes in the Bayesian analysis was slightly higher (given that a reliable pp value should be at least 95% [Zander 2004]).

Higher phylogenetic relationships and the position of current and former Psechridae within Araneomorphae

The genera *Psechrus* and *Fecenia* each were strongly supported as monophyletic and both were recovered within the superfamily Lycosoidea together with Lycosidae, Pisauridae, Zoropsidae, Oxyopidae, Tengellidae and Zorocratidae in all analyses of 28S data and the concatenated dataset (Figs 1–4). Thomisidae were either recovered within the Lycosoidea (Figs 3–4) or as a weakly supported sister group (Figs 1–2), while the combining clade always received high support. Further support of basal nodes was not reliable but high for a 'Lycosidae and Pisauridae'-clade while the split of the two families was only exhibited in the Bayesian analysis of the concatenated dataset (Fig. 3). In all analyses based on the 28S and concatenated datasets, *Fecenia* did not group with *Psechrus* but both remained in the unresolved relationship with the majority of Lycosoidea (+Thomisidae) families (Figs 1–4). Most genera previously placed or associated with the Psechridae turned out to be excluded from the Lycosoidea (or Lycosoidea+Thomisidae in Figs 1–2): 1) *Stiphidion* and its sister taxon *Cambridgea* L. Koch 1872 (Stiphidiidae) were sister to the Desidae (*Desis* Walckenaer 1837 and *Badumna* Thorell 1890), and also *Poaka* (Figs 3–4, concatenated dataset). The 'Desidae + Stiphidiidae + *Poaka*'-clade was well supported in all analyses (Figs 1–4), and was sister to the Agelenidae. 2) *Themacrys* grouped with the Sparassidae in both analyses of the 28S dataset, however, the support for this subclade was weak (Figs 1–2). 3) *Uloborus*, as a member of the Orbiculariae Walckenaer, 1802, exhibited a sequence clearly deviating from all other taxa included herein and was hence fixed as the basal outgroup. *Tengella radiata* (Kulczyński, 1909), first described *sub Metafecenia*, was found as sister group to *Zorocrates* Simon, 1888 within a basal subclade of the Lycosoidea (Figs 1–2), but without reliable support. Most other families outside the Lycosoidea were well supported, even if represented by only a few taxa, e.g. Miturgidae, Agelenidae and Amaurobiidae. *Viridasius* Simon, 1889, which belongs to the Ctenidae, was not recovered within the Lycosoidea (Figs 1–4).

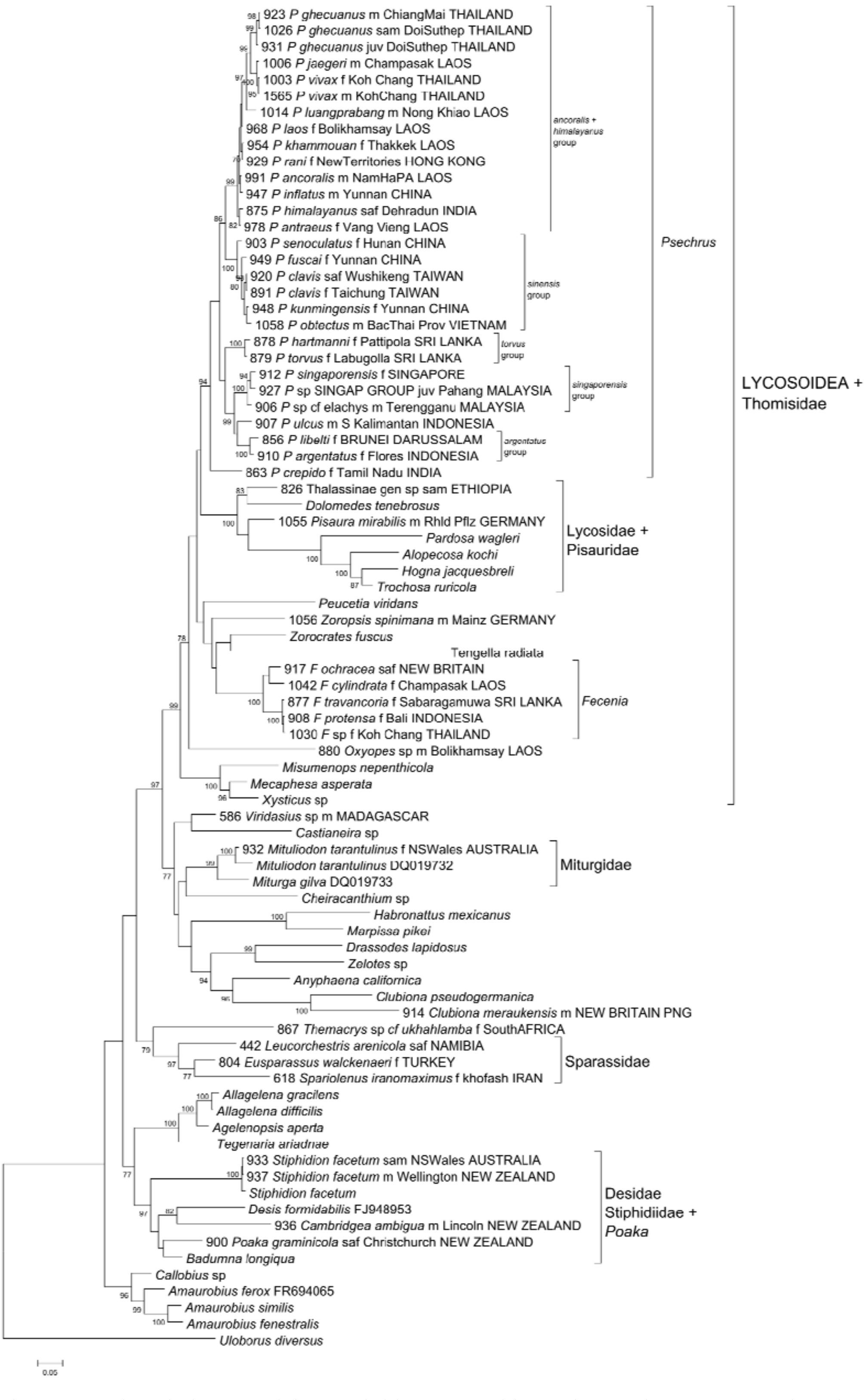

Fig. 1. Bayesian phylogram of the Psechridae, Lycosoidea and several outgroup taxa based on the sequences of the 28S rRNA gene. Support values indicated at nodes represent posterior probabilities. Values less than 70% are not denoted. Branch length is denoted by the rate of substitution (substitutions per nucleotide position), scale bar: see bottom, left. The number in front of several taxon names denotates the SD-number of the respective tissue sample.

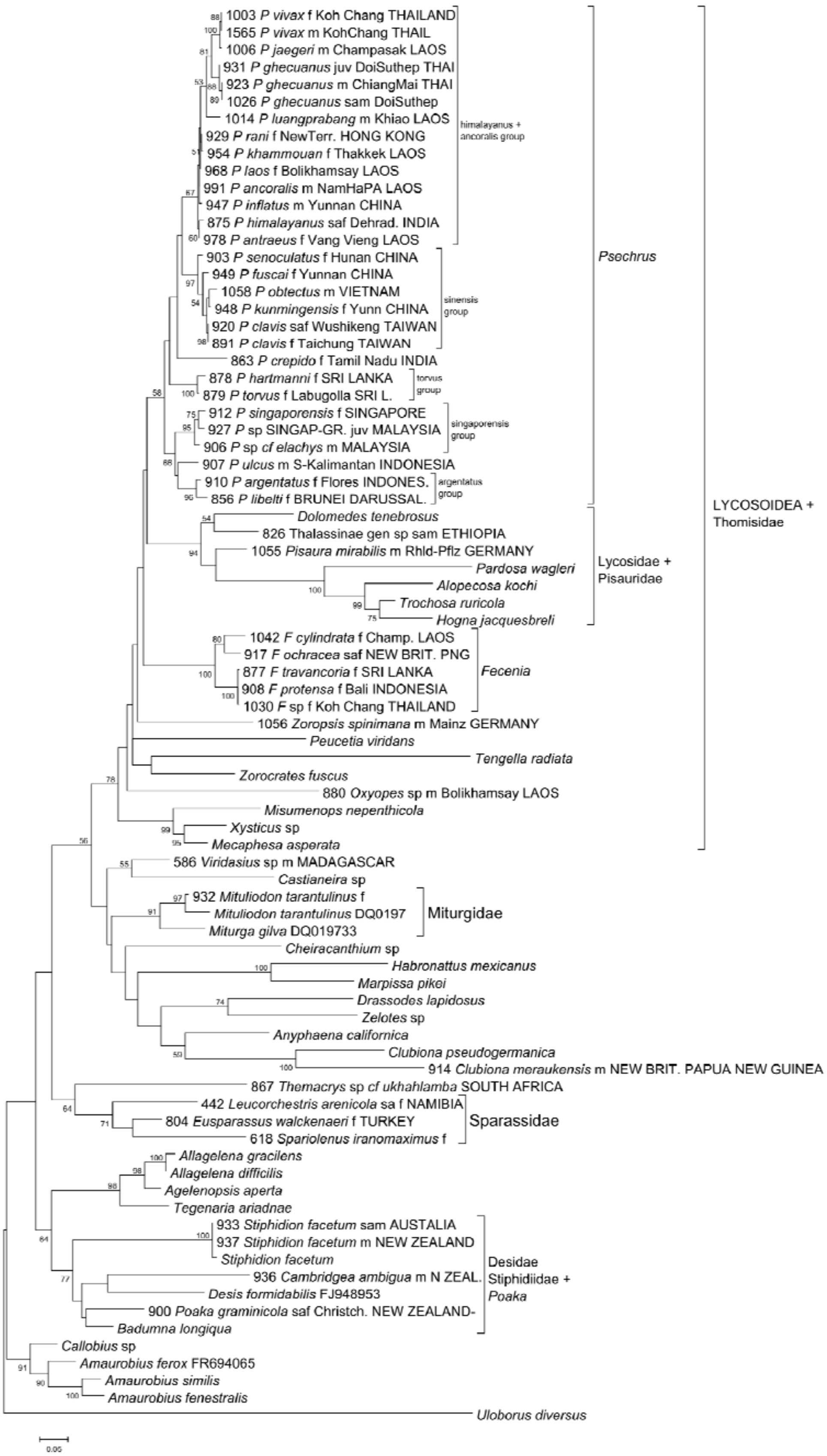

Fig. 2. Maximum Likelihood phylogram of the Psechridae, Lycosoidea and several outgroup taxa based on the sequences of the 28S rRNA gene. Support values indicated at nodes represent bootstrap values after 1000 pseudoreplicates. Values less than 50% are not denoted. Branch length is denoted by the rate of substitution (substitutions per nucleotide position), scale bar: see bottom, left. The number in front of several taxon names denotates the SD-number of the respective tissue sample.

Recovery of hypothesized species groups within Psechrus and Fecenia

In general, all *Psechrus* species groups defined in Bayer (2012) and included in the analysis were recovered as monophyletic with high bootstrap and pp-values. This was true for the *sinensis*-, *torvus*-, *singaporensis*- and *argentatus*-groups (the latter group only in the 28S analysis). However, the representatives of the *ancoralis*-group formed a well supported clade which was nested within the *himalayanus*-group and thus rendering the latter paraphyletic. Within that combined clade (*ancoralis* + *himalayanus*-group) a novel subclade including *P. ghecuanus*, *P. jaegeri*, and *P. vivax* was recovered as sister to the remaining species of the combined-clade (Figs 3–4). This sister relationship, however, was only supported in the Bayesian analysis (Fig. 3), did collapse in the 28S analysis (Figs 1–2), and received weak support in the ML analysis (65%, Fig. 4) of the concatenated dataset. Monophyly of the *ancoralis* + *himalayanus*-group was generally recovered with reliable support, with the exception of the ML 28S analysis (Figs 1, 3–4 *cf.* Fig. 2). Of the *mulu*-group only one species, *P. ulcus* Bayer, 2012, could be included in the analysis. Within *Psechrus*, it represented a distinct lineage within a clade including all representatives of the *singaporensis*- and the *argentatus*-group (Figs 1–4). The species *P. crepido* Bayer, 2012, which Bayer (2012) did not assign to any of the eight established species groups, confirmed its status as isolated and swapped position without reliable support (Figs 1–4). A subclade, uniting all species-groups from the northern half of the distribution range of *Psechrus* (Fig. 8) (additionally *P. crepido*), was well supported in the Bayesian analysis of the concatenated dataset (Fig. 3), but was not in the ML analysis. *Psechrus crepido*, the western distributed *torvus*-group, and the ‘northern subclade’ (including the *ancoralis*-, *himalayanus*- and *sinensis*-species groups, which occupy the northern part of the generic distribution range, see Fig. 8) attained reliable support. This ‘north-western clade’ again was sister to a clade uniting all representatives of the south-eastern distributed species-groups (Fig. 3; for distribution see Fig. 8) including the *singaporensis*-group, *P. ulcus* (*mulu*-group), and *P. libelti* Kulczyński, 1908 (*argentatus*-group). This ‘south-eastern clade’ was supported with 100% pp in the Bayesian analysis (Fig. 3) and 95% bootstrap value in ML (Fig. 4).

Within *Fecenia*, two subclades were supported: 1) *F. cylindrata* Thorell, 1895 with the south-eastern distributed (see Fig. 7) *F. ochracea* (Doleschall, 1859), in all analyses (Figs 2–6) except the Bayesian inference of the 28S dataset (Fig1), and 2) *F. travancoria* Pocock, 1899 with *F. protensa* Thorell, 1891 with highest support from all analyses.

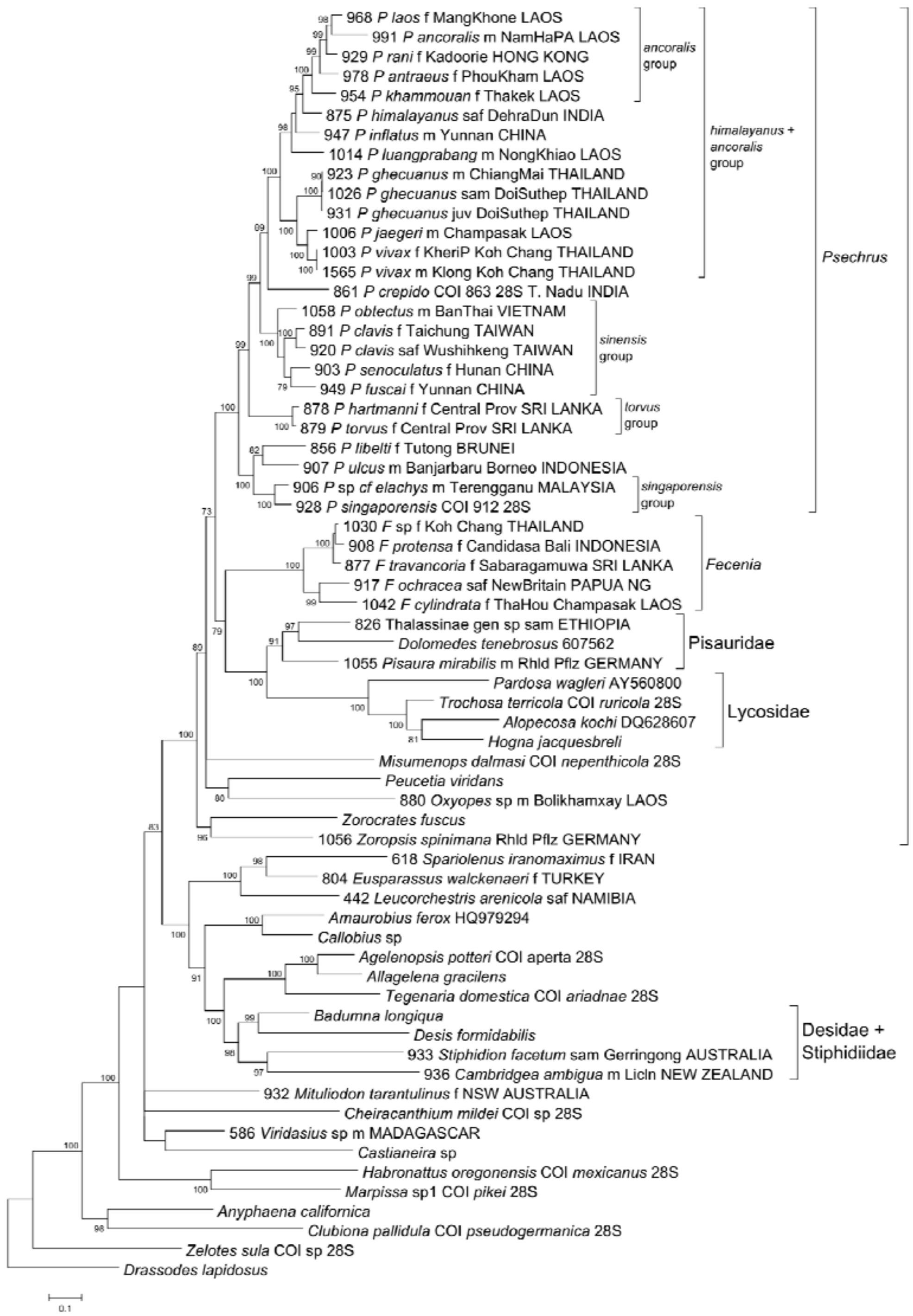

Fig. 3. Bayesian phylogram of the Psechridae, Lycosoidea and several outgroup taxa based on the combined sequences of the 28S rRNA and COI genes. Support values indicated at nodes represent posterior probabilities. Values less than 70% are not denoted. Branch length is denoted by the rate of substitution (substitutions per nucleotide position), scale bar: see bottom, left. The number in front of several taxon names denotates the SD-number of the respective tissue sample.

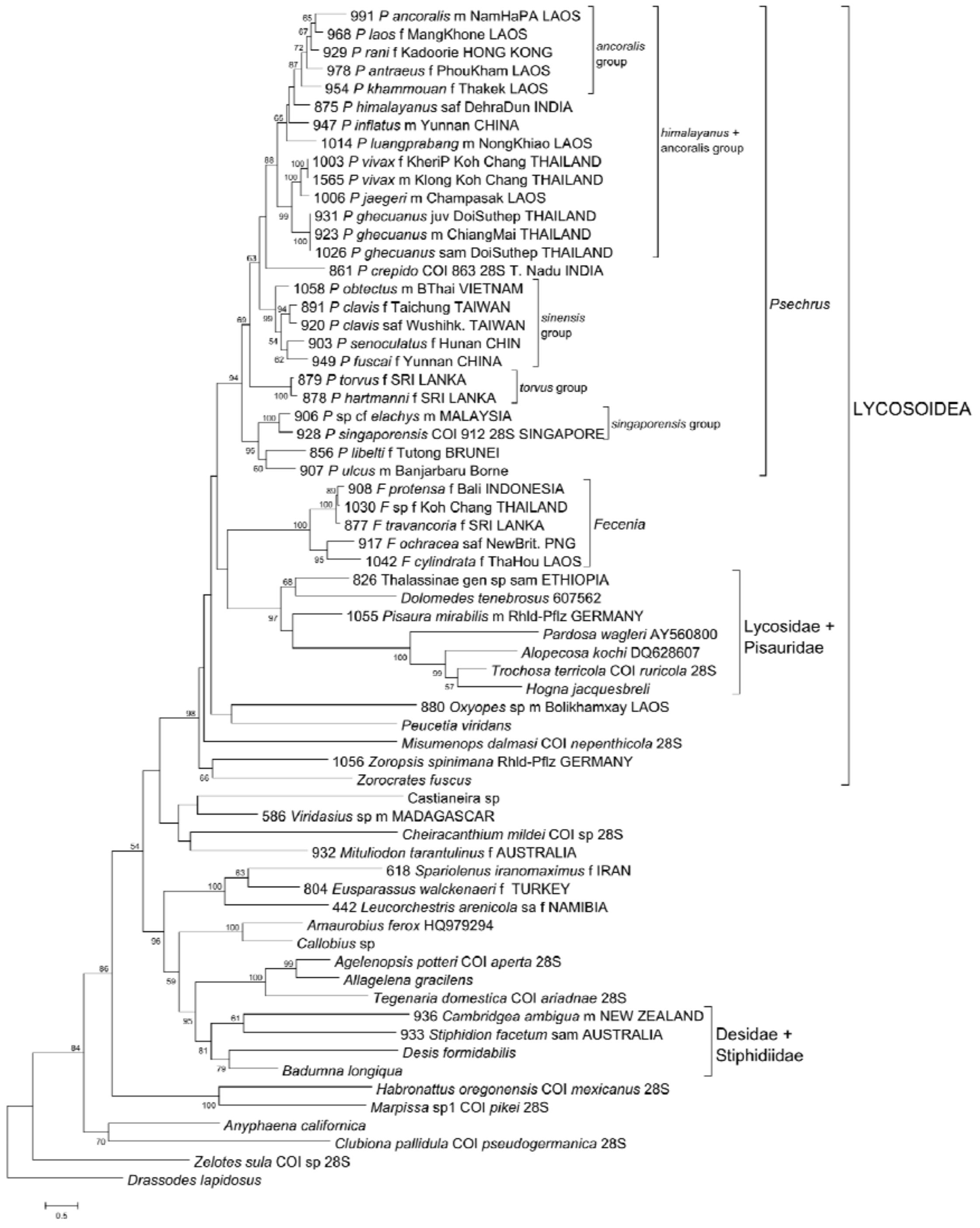

Fig. 4. Maximum Likelihood phylogram of the Psechridae, Lycosoidea and several outgroup taxa based on the combined sequences of the 28S rRNA and COI genes. Support values indicated at nodes represent bootstrap values after 1000 pseudoreplicates. Values less than 50% are not denoted. Branch length is denoted by the rate of substitution (substitutions per nucleotide position), scale bar: see bottom, left. The number in front of several taxon names denotates the SD-number of the respective tissue sample.

Test of species hypotheses in Psechrus and Fecenia

Phylogenetic reconstructions using COI (Bayesian analysis: Figs 5; NJ: Fig. 6), especially NJ, grouped all specimens to previously defined (diagnosed) *Psechrus* and *Fecenia* species (Bayer 2011, 2012). Some juveniles included in the present study, e.g. *Psechrus antraeus* SD 1566, *P. luangprabang* SD 982 were collected together with adults at the same site, and thus were hypothesised to be conspecific with these adults. In our barcoding analysis these juveniles were correctly placed (together with the other specimens of the respective species included herein). The juvenile *Fecenia* specimen SD 943 was collected without adult material. In the COI analysis it clustered together with the remaining *F. protensa* specimens collected in other countries. A 'barcode gap' between most *Psechrus* species was recognised, which was indicated by the different branch lengths connecting either different specimens of one particular species or specimens of different species. In *Psechrus* the maximum intraspecific divergence (apart from *P. ancoralis*) was 4.5% (the mean intraspecific divergence 1.5–2%). The mean interspecific divergence was ca. 10% and the minimum interspecific divergence recovered was 6.4% in the closely related species *P. jaegeri* and *P. vivax* (for lower divergence between *P. torvus* (O. Pickard-Cambridge, 1869) and *P. hartmanni* Bayer, 2012, see the 'test of species hypotheses in *Psechrus* and *Fecenia*' section in the Discussion). The divergence between two specimens of *P. clavis* Bayer, 2012 (SD 895 and SD 893) that had been collected at the same locality was 4.5%. Exceptional intraspecific sequence divergence was also recorded in *Psechrus ancoralis* (maximum divergence 13%, see Fig. 6). In *Fecenia* intraspecific sequence divergence of described species was generally higher (maximum: 5.3% in *F. ochracea*, Fig. 6) and partly exceeded interspecific divergence (minimum 4.7% between *F. protensa* and *F. travancoria*). The mean interspecific divergence in Fecenia was ca. 9%.

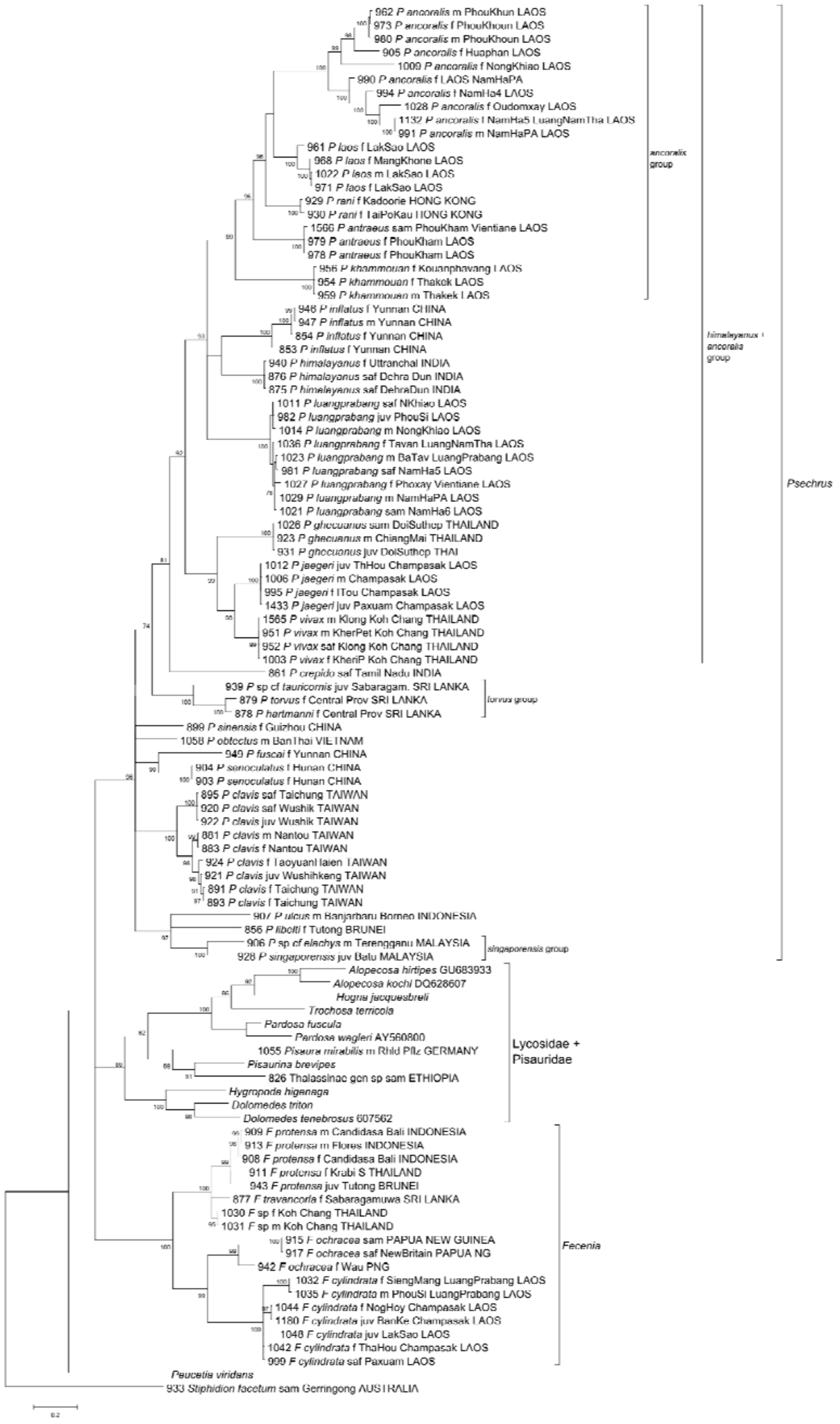

Fig. 5. Bayesian phylogram of the Psechridae, Lycosoidea and two outgroup taxa based on the sequences of the COI gene. Support values indicated at nodes represent posterior probabilities. Values less than 70% are not denoted. Branch length is denoted by the rate of substitution (substitutions per nucleotide position), scale bar: see bottom, left. The number in front of several taxon names denotates the SD-number of the respective tissue sample.

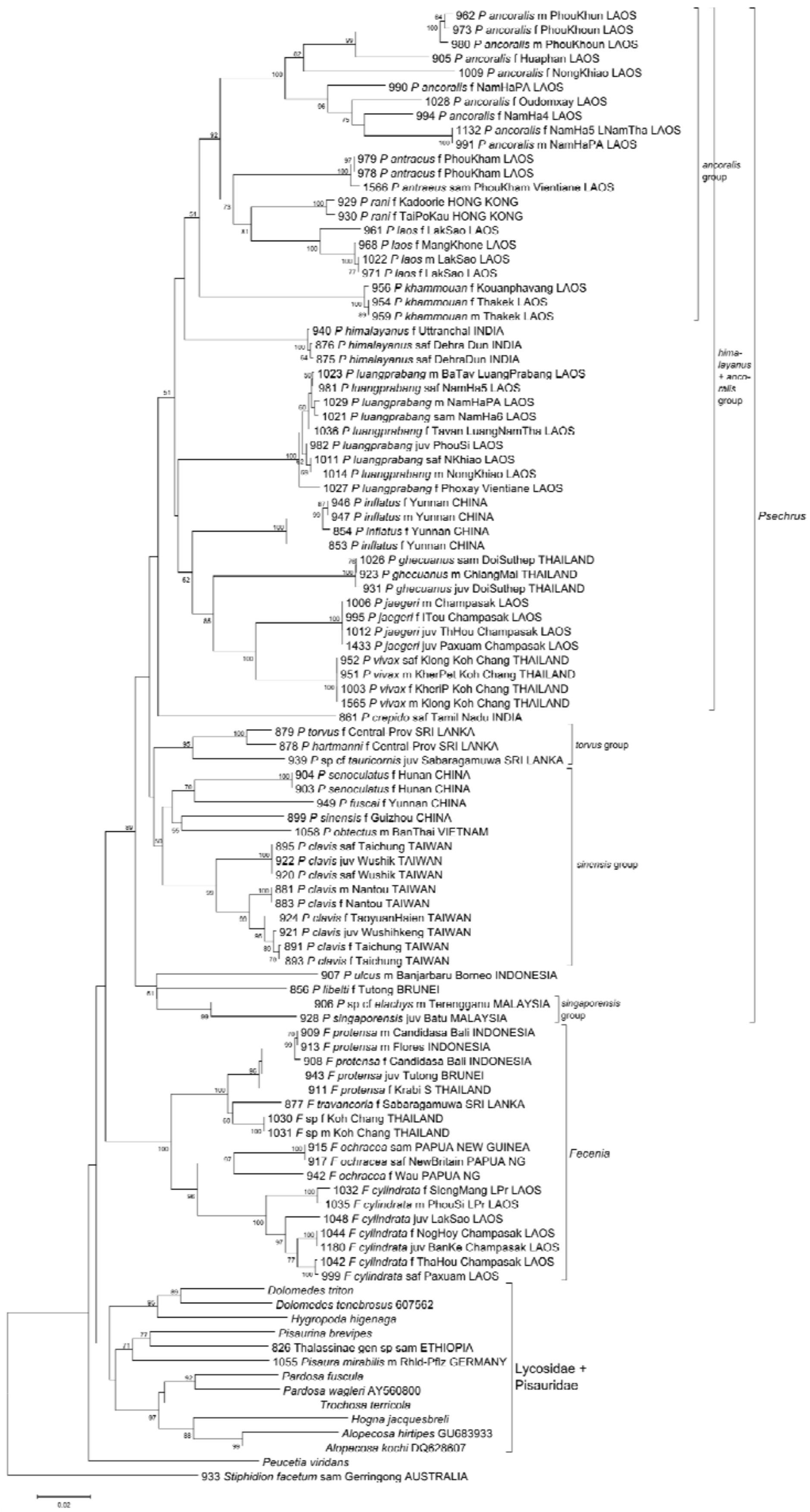

Fig. 6. Neighbour Joining phylogram (Kimura-2 parameter method) of the Psechridae, Lycosoidea and two outgroup taxa based on the sequences of the COI gene. Support values indicated at nodes represent bootstrap values after 2000 pseudoreplicates. Values less than 50% are not denoted. Branch length is denoted by the

ratio of the complete p-distance, scale bar: see bottom, left. The number in front of several taxon names denotates the SD-number of the respective tissue sample.

Discussion

Phylogenetic position of Psechridae within Araneomorphae and the relationships between Psechrus and Fecenia

The genera *Psechrus* and *Fecenia* have been repeatedly hypothesised to belong to the superfamily Lycosoidea (Griswold 1993, Griswold *et al.* 1999, Silva 2003, Coddington *et al.* 2004, Raven and Stumkat 2005, Griswold *et al.* 2005), including the families Zorocratidae, Tengellidae and Zoridae also referred to as 'grate-shaped tapetum-clade' (Silva 2003). A wider definition, 'Lycosoidea *sensu lato*' including additional families, such as Amaurobiidae, Agelenidae and Dictynidae, was suggested by Wunderlich (2008) and is not considered here. In our analyses, the phylogenetic position of the Psechridae (Figs 1–6) within the Lycosoidea corroborates the results of the cladistic investigations based on morphological characters mentioned above (Griswold 1993; Griswold *et al.* 1999; Silva 2003; Coddington *et al.* 2004; Raven and Stumkat 2005; Griswold *et al.* 2005) as well as molecular data (Fang *et al.* 2000).

In all analyses (except for the analyses based on the COI dataset, Figs 5–6, which included fewer outgroups) the family Psechridae was not recovered as monophyletic. *Fecenia* remained in an unresolved relationship with the majority of Lycosoidea (including Thomisidae) families (28S, Figs 1–2). The concatenated analyses (Figs 3–4) grouped *Fecenia* as sister with the Lycosidae and Pisauridae, but without reliable support. Our results thus provide weak indication that the Psechridae may not be monophyletic. This could be further resolved by the analysis of additional genetic markers. In addition, including further Lycosoidea taxa, as Senoculidae, Trechaleidae and Zoridae, is necessary to comprehensively explore the phylogenetic position of *Fecenia*. Another genus that would ideally be included in further studies is *Acanthoctenus* Keyserling, 1877 (Ctenidae). Prior to 1967, it was placed in its own family Acanthoctenidae and, like *Fecenia*, exhibits grate shaped tapeta solely in the posterior eyes (according to Homan 1971; *contra* Levi 1982, who detected grate-shaped tapeta in all secondary eyes of *Fecenia*). Also, the Homalonychidae, though having all secondary eyes with canoe-shaped tapeta, were associated with Lycosoidea by some authors (Dominguez and Jimenez 2005). Broadening the systematic sampling within the Lycosidae, Pisauridae, Oxyopidae, Zoropsidae, Tengellidae, and Ctenidae is likely to further resolve the phylogenetic relationships of the Psechridae.

The ML tree based on the combined dataset (Fig. 4) generally shows the strongest correspondence to the recent morphological studies (Griswold *et al.* 1999, 2005, Coddington *et al.* 2004, Bayer 2012). It is interesting that both analyses of the combined dataset (Figs 3–4) grouped *Misumenops* F. O. Pickard-Cambridge, 1900 (Thomisidae) within the well supported Lycosoidea, contradicting the phylogeny presented in Coddington *et al.* (2004). In the 28S analyses (Figs 1–2) the Thomisidae (*Mecaphesa*, *Misumenops* and *Xysticus*) formed a sister clade to the Lycosoidea, but with low support of both associated branches. According to Homan (1950, 1971) however, the Thomisidae exhibit at least grate-shaped tapeta, like the Lycosoidea.

Another discrepancy that we found with morphology-based cladistic studies was the position of representatives of the Ctenidae (*Viridasius*) and the Miturgidae (e.g. *Miturga* Thorell, 1870 or *Mituliodon* Raven & Stumkat, 2003), which were recovered outside the Lycosoidea in all our analyses (Figs 1–4). At least concerning *Viridasius* (Ctenidae), our results are surprising, because Ctenidae possess grate-shaped tapeta and those that have maintained the cribellum, have an (elongated) oval calamistrum; both are diagnostic characters for the Lycosoidea *sensu* Coddington and Levi (1991) and Griswold (1993). According to Silva (2003) the Viridasinae are a basal group within the Ctenidae. However, to date there is no morphological investigation providing evidence that *Viridasius* does not belong to the Ctenidae, so our results in recovering this genus outside the Lycosoidea are puzzling. The Miturgidae comprise only ecribellate representatives and thus do not have a calamistrum, therefore the oval calamistrum character is redundant for this family. Homann (1950, 1971) did not include the Miturgidae (Miturgeae *sensu* Simon) in his investigations of the tapeta of the secondary eyes of the Araneae, which was erroneously reported by Raven and Stumkat (2003). Griswold (1993, page 3) and Raven (2009, page 24, fig. 14a, inset), however, investigated the secondary eyes of several miturgid genera and detected grate-shaped tapeta. Previous morphological studies suggested the Miturgidae belong to the Lycosoidea (Raven and Stumkat 2003; Silva 2003; Coddington *et al.* 2004). Several authors (e.g. Lehtinen 1967; Ramírez *et al.* 1997; Raven and Stumkat 2003) mainly characterised the Miturgidae by particular features of the male palp and the posterior spinnerets. The assignment of some groups to the Miturgidae is still controversial, such as the Eutichurinae and especially the genus *Cheiracanthium* C. L. Koch, 1839 (see Ramírez *et al.* 1997 *contra* Deeleman-Reinhold 2001, Raven and Stumkat 2003, Wunderlich 2011b). In principle, the diverse family Miturgidae is hard to diagnose (Wunderlich 2008, 2011a, Paquin *et al.* 2010), which in turn makes it difficult to assess its phylogenetic position using morphological characters. According to our 28S analyses *Mituliodon* Raven & Stumkat, 2003 belongs to the Miturgidae (Figs 1–2), but is not included in the Lycosoidea. The position of *Cheiracanthium* remains ambiguous but is definitely outside the Lycosoidea (Figs 1–4).

Vink *et al.* (2011a) reported paralogous copies of 28S in *Trite planiceps* Simon, 1899 (Salticidae) and stated that this phenomenon had been recognised in other spider families, e.g. Lycosidae. However, in the present study, at least concerning the sequences generated herein, no paralogous sequences were recognised.

Systematic position of former Psechridae Poaka, Stiphidion, Tengella, and Themacrys

Several genera formerly placed in or associated with the Psechridae (F. O. Pickard-Cambridge 1902; Simon 1902, 1906; Dalmas 1917; Forster and Wilton 1973) were included in the present survey. The genus *Uloborus*, which was unwittingly "associated" with *Psechrus* by Rainbow (1898), showed strikingly different 28S sequence data (Figs 1–2). *Uloborus* does in fact belong to the Orbiculariae (Coddington *et al.* 2004), representing an outgroup to the RTA clade (Coddington and Levi 1991) to which all other taxa examined herein are attributed.

Stiphidion was resolved as sister group to *Cambridgea* (Stiphidiidae) in the analyses of the combined dataset and both formed a clade together with the Desidae (Figs 3–4). The 28S dataset also suggested a close relationship of the taxa belonging to the Desidae and Stiphidiidae but did not recover the Stiphidiidae (Figs 1–2). In the 28S analysis *Poaka* was recovered as a member of this clade, not included in the Lycosoidea. Hence *Stiphidion* and *Poaka* are only distantly related to Psechridae. *Stiphidion* was already excluded from Lycosoidea for morphological reasons (Griswold *et al.* 1999; 2005) and its exclusion is further supported by the following aspects: (1) Homan (1971) stated that *Stiphidion* possessed a grate-shaped tapetum only in the posterior median eyes. This tapetum, however, is only weakly undulated. It may not be justified to consider it fitting into the specific, continuous evolutionary process leading from the canoe- to the regular grate-shaped tapetum. Unlike Homan (1971) Griswold *et al.* (1999) considered it as independantly evolved. (2) Unlike other cribellate members of Lycosoidea Stiphidiidae possess a calamistrum consisting of only one row of setae. (3) The males of Stiphidiidae do not possess a dorsal scopula on the cymbium, which is diagnostic for the Lycosoidea [But consider: The cymbium scopula is reduced in many taxa. Interestingly, in the genus *Psechrus* it is present in most of the species described, but absent in several species of the *himalayanus*-group (Bayer 2012)].

As mentioned above, *Poaka* belonged to a well supported clade containing also Stiphidiidae and Desidae (Figs 1–4), and showed a weakly supported relationship with *Badumna* (Desidae; Figs 1–2, only). *Poaka*, currently placed in the Amaurobiidae, shares morphological characters with the Desidae in the basic structures of the male palps. This is especially obvious in direct comparison to *Badumna*, as male representatives of these genera exhibit parallels in the shape and position of the median apophysis, the flattened, semicircular, distal section of tegulum and the retrolateral tibial apophysis, which is split in three to four small 'subapophyses'. The 'Desidae + Stiphidiidae + *Poaka*'-clade was sister to the Agelenidae (see Figs 1–4). This placement is supported by the typical arrangement of trichobothria dorsally on the tarsi (in a single row and increasing in length from proximal to distal), and by the relatively long posterior lateral spinnerets in at least Stiphidiidae and *Poaka*. The relationship of Desidae and Stiphidiidae with Agelenidae — additional to that with several other families, e.g. Hahniidae— has been supported by other phylogenetic studies (Miller *et al.* 2010).

Both analyses based on the 28S dataset excluded *Themacrys* from the Lycosoidea. It clustered with the members of Sparassidae without reliable support (Figs 1–2). However, a relationship to the Sparassidae is unlikely due to several significant morphological differences including: three tarsal claws in *Themacrys*, two in Sparassidae; scopula at tarsi and metatarsi absent in *Themacrys*, present in Sparassidae; and the different habitus and leg direction. According to Griswold *et al.* (1999, 2005) *Themacrys* is a sister clade to the Titanoecidae, which were not included in the present study.

Our results recovered the genus *Tengella*, represented herein by *Tengella radiata* (originally described in *Metafecenia* in Psechridae), as member of the Lycosoidea (and thus it is more closely related to the Psechridae than the other taxa mentioned above). This result corroborates the morphological studies of Silva (2003) and Griswold *et al.* (2005). As a COI sequence of *Tengella* was not available for the present study and the resolution of the basal lycosoids was weak in all our analyses the relationship of *Tengella* to Psechridae is unclear. Nevertheless, the probability that *Tengella* is closely related to *Psechrus* or *Fecenia* is rather low for the following reason: *Zorocrates*, is a close relative to Tengellidae according to Silva (2003). The sister-group relationship of *Tengella* with *Zorocrates* in our 28S rRNA analyses —though not reliably supported— (Figs 1–2) may also suggest that these two taxa are closely related. In the concatenated analyses (see especially Fig. 3) *Zorocrates* merely belongs to a basal subclade within the Lycosoidea.

Our results mainly corroborate previous morphological studies that suggested withdrawal of all aforementioned taxa from Psechridae (Stiphidiinae to Stiphidiidae (Forster and Wilton 1973); *Poaka* removed from Psechridae (Raven and Stumkat 2003); *Themacrys* to Phyxelididae (Griswold *et al.* 1999); *Metafecenia* thus *Tengella* to the Tengellidae (Lehtinen 1967)).

Phylogenetic relationships of the Psechrus species groups and species

Based on the examination of morphological characters, mainly those of the copulatory organs, Bayer (2012) defined eight species groups in the genus *Psechrus*. All datasets (28S, COI and concatenated) generally assigned representatives of each included species-group to monophyletic clusters. The fast evolving, and therefore quickly saturating, COI generally fails in reconstructing deeper phylogenetic splits (Blaxter 2003; Copley *et al.* 2009; Vink and Dupérré 2010), hence, the COI dataset exhibited the lowest resolution on that score, whereas 28S could not recover some of the younger splits (e.g. within the *himalayanus*-group). The concatenated dataset showed highest concordance with species groups (one exception discussed below) and similar high concordance with species as the COI dataset. This confirms that in most cases within spiders thorough comparison of copulatory organs allows to assume phylogenetic relationships among the species within a genus. As a single exception, the *himalayanus*-group as proposed by Bayer (2012), turned out to be paraphyletic. The *ancoralis*-group was nested within a subclade together with *P. inflatus*, *P. himalayanus* and *P. luangprabang* as sister to a subclade including *P. ghecuanus*, *P. jaegeri* and *P. vivax* (the latter three species are members of the *himalayanus*-group) (Figs 3–4). This arrangement, however, was only reliably supported in the Bayesian Analysis of the concatenated dataset (Fig. 3) and might be artificial. Our survey lacks in including further, important species of both those groups (*himalayanus*-group: *P. pakawini* Bayer, 2012, *P. marsyandi* Levi, 1982, *P. demiror* Bayer, 2012; *ancoralis*-group: *P. steineri* Bayer & Jäger, 2010). The *ancoralis*- and the *himalayanus*-group are definitely closely related as their diagnoses in Bayer (2012) indicate. However, basic structures of the bulb, like the arising point of the embolus, especially indicate close relationship within species of the *ancoralis*- on one hand and those of the *himalayanus*-group on the other hand (Bayer 2012). For example, the male *P. demiror* shows a bulb that is amazingly similar to that of *P. himalayanus*, but the dorsal cymbium scopula is missing as in *P. ghecuanus*, *P. pakawini*, *P. jaegeri*, and *P. vivax*. Specific differences in female copulatory organs of *P. ghecuanus* and *P. inflatus* are very small (Bayer 2012), whereas our analyses (Figs 1–4) suggest these two species to be distantly related as they were recovered in different subclades (see above). The phylogenetic position of *P. crepido* remains dubious as its position changed in all phylogenetic trees (Figs 1–6). Thus our results support its treatment as “species without assignment to any of the eight *Psechrus*-species groups” (Bayer 2012). Presently, the *Psechrus* fauna of the southern half of India is just poorly investigated and the emergence of further species in this region is likely.

The relationships between the different species groups could only be partially resolved. According to our results, especially those based on the concatenated dataset (Figs 3–4), *Psechrus* is divided into a northern and western distributed clade (containing *Psechrus crepido* and the members of *ancoralis*-, *torvus*-, *sinensis*-, and *himalayanus*-group, distribution see Fig. 8) and a south-eastern distributed one (containing members of *singaporensis*-group, *P. libelti* from the *argentatus*-, and *P. ulcus* from the *mulu*-group). Though distantly related, only slight somatic differences can be used to discriminate these two groups (but only incompletely): the mean leg length is slightly longer in the south-eastern distributed species-groups; the dark, lateral bands on the carapace are generally broader in the south-eastern distributed species. However, this latter character-pattern is not consistent: in the western *P. crepido* and members of *torvus*- group (distribution see Fig. 8) the lateral bands are (at least) as broad as in the south-eastern distributed species. Albeit completely discriminating morphological characters are absent, our results suggest the arrangement of species groups to higher clusters according to the aforementioned geographical distribution patterns, which seems comprehensible.

There are no previous studies on Psechridae dealing with the relationships of the representatives within each genus. In several works on other spiders authors investigated intrageneric relationships, and, for example, tested species groups established in preceding morphological studies with the application of molecular methods. Copley *et al.* (2009) provided a phylogenetic reconstruction of *Cybaeus* species using COI in one analysis and histone subunit 3 (H3) in another. Their results (COI as well as H3) did support monophyly for just a minority of the species groups. In our present study the COI gene alone turned out to be at most partly useful in reconstructing reliable splits between species groups (Figs 5–6). Another species-rich genus, *Nephila* Leach, 1815, was examined by Su *et al.* (2011) who applied 18S rRNA, COI and 16S rRNA, all three combined. Their inferred phylogeny was mostly congruent with geographical distribution patterns, as in the present study and in Crews and Gillespie (2010; based on the genes H3, ND1, 16S and COI). Species groups of *Anelosimus* Simon, 1891, established in previous morphological publications, could be partly corroborated in the phylogenetic study by Agnarsson *et al.* (2007) using the genes H3, 18S, 28S, 16S, NADH dehygrogenase subunit 1 (ND1) and COI.

Phylogenetic relationships of the Fecenia species

Fecenia is a small genus consisting of five valid species, four of which were included in the present study. The topology of the *Fecenia* clade was identical in all analyses. The subclade containing *F. protensa* and *F. travancoria* unites morphologically very similar species (Bayer 2011; but see also next section herein), thus the close sister-group relationssship is understandable. The sister group relationship between *F. ochracea* and *F. cylindrata*, however, is unexpected, even though it received reliable support in most of our analyses (Figs 2–6). Bayer (2011) did not emphasise any particular genital-morphological characters these species have in common. Moreover, the distribution areas of *F. cylindrata* and *F. ochracea* are far distant from each other (Fig. 7). It remains to be seen how the topology will change, if the missing *F. macilenta* (Simon, 1885) and additional geographic sampling in *Fecenia* will be included.

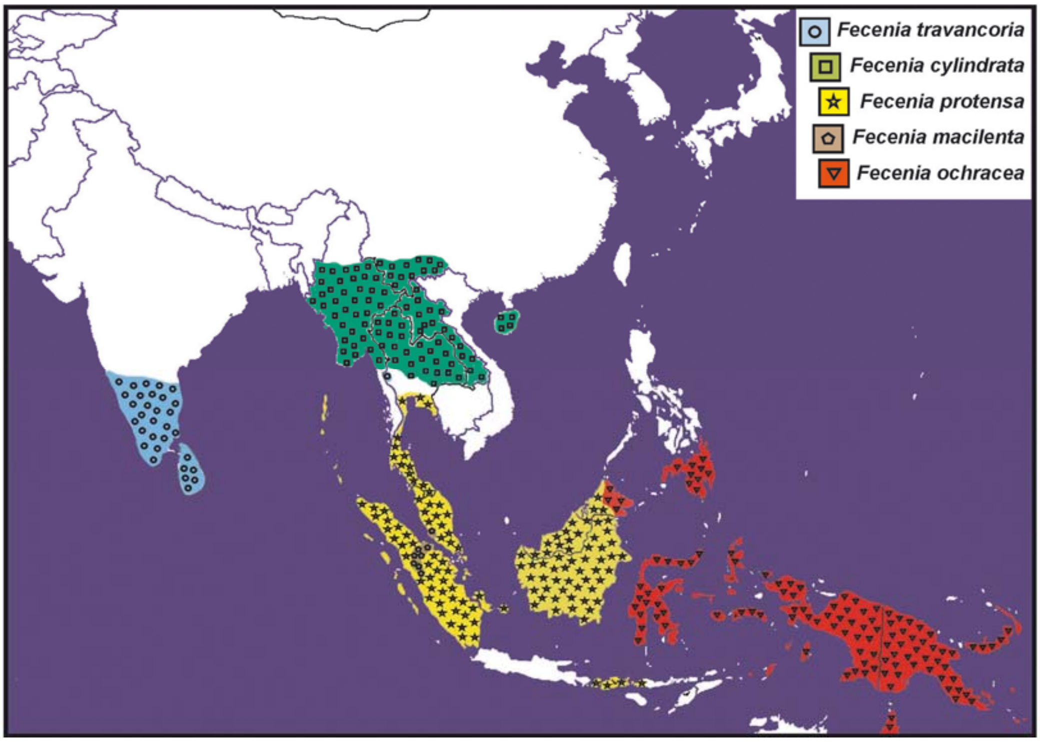

Fig. 7. Approximate distribution of *Fecenia* species in Southeast Asia and the central Indo-Pacific islands. Symbols in filled areas do not represent explicit sampling localities.

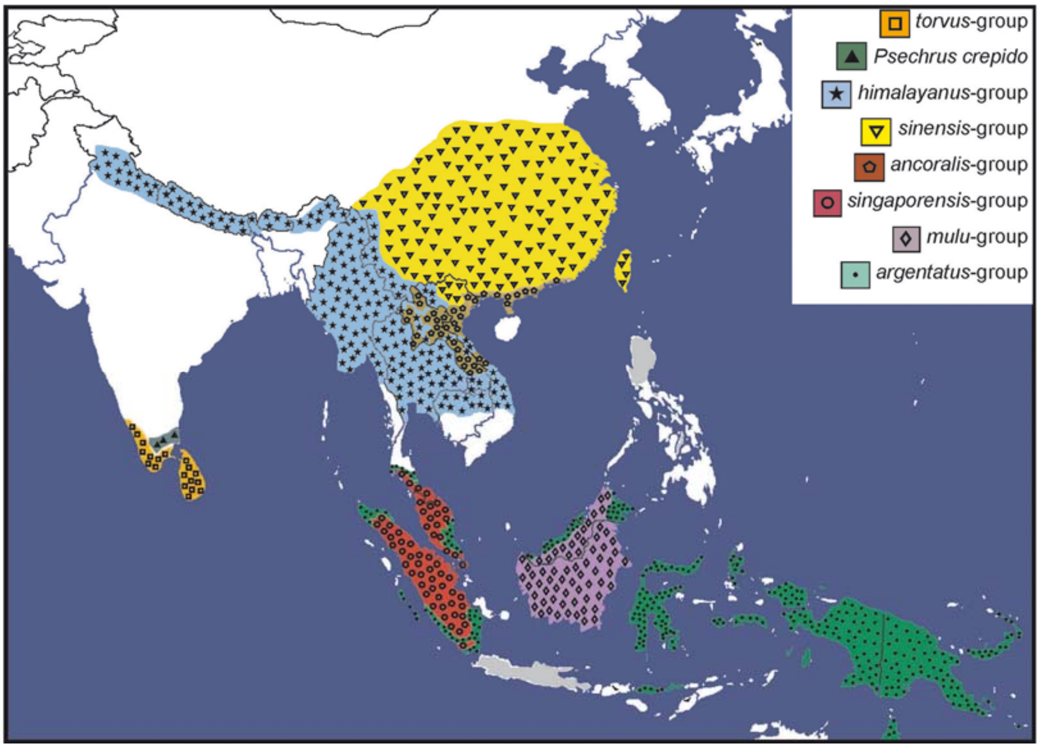

Fig. 8. Approximate distribution of *Psechrus* species-groups in Southeast Asia and the central Indo-Pacific islands. Symbols in filled areas do not represent explicit sampling localities. The representatives of the *annulatus*-group (Java) and the Philippine *Psechrus cebu* Murphy, 1986 and *P. schwendingeri* Bayer, 2012 (both not assigned to particular species groups in Bayer (2012)) were not included in the present study. Their distribution is shown in grey (without symbols).

Test of species hypotheses in Psechrus and Fecenia

In the NJ COI phylogram (Fig. 6), especially in the genus *Psechrus*, the presence of barcode gaps, which indicate the existence of different species (Robinson *et al.* 2009) is recognisable by the topology of the tree. The branches of the tip clades and those connecting the different specimens of one particular species are generally short, whereas those connecting the different species are distinctly longer (also in closely related species, like *P. rani* and *P. laos*). Robinson *et al.* (2009) examined intra- and interspecific sequence divergences of the barcoding region of the COI gene for 19 genera, 361 morphospecies and 1801 individuals of spiders in total to assess the utility of DNA barcoding to identify spiders and found the mean intraspecific divergence value to be 2.15% (average maximum 3.16%). The mean divergence between nearest interspecific neighbours was 6.77%. Of the 66% of morphospecies that formed monophyletic sequence clusters, the majority (92.5%) possessed a barcode gap (Robinson *et al.* 2009). Even though a barcode gap existed in most of the *Psechrus* species examined in the present study, there is one exception, the *P. ancoralis* subclade, with intraspecific differences (e.g. between SD 962 and SD 1009: 13%, see Fig. 6) partly higher than interspecific differences (e.g. distance of SD 990 to *P. rani*: 10.7%). In some cases even the sequences between specimens from the same locality differed strikingly (e.g. between SD 990 and SD 991, both from Nam Ha Protected Area in Laos: ca. 7%). In fact, *P. ancoralis* females show high variation concerning the shape of epigynes (Bayer and Jäger 2010, Bayer 2012). The variation of the vulva structures is not as high, but also noteworthy. In Bayer and Jäger (2010) and Bayer (2012) all these forms had been considered to be *P. ancoralis* as the changes in female character states were continuous, without correlations between particular morphological forms and geographical distribution. Copulatory organs of the males did not show appreciable variation, which indicates conspecificity (Bayer 2012). Hence, such high sequence divergence is unusual.

The relatively large distribution range of *P. ancoralis* does not necessarily provide an explanation, as other species, e.g. *P. luangprabang*, exhibit similar extensive distribution ranges while genetic divergence and morphological variation according to the epigynes and vulvae are clearly lower. In Barrett and Hebert (2005) and in Astrin et al. (2006), who dealt with molecular species identification, in some species extraordinarily high intraspecific sequence divergences were recognised as well. The high intraspecific sequence divergences in *Psechrus ancoralis* may indicate evolutionary rates of COI to be higher than in other *Psechrus* species. A similar situation is given in the species *P. clavis*, with divergence between specimens from the same locality (Taichung) of 4.5% (between SD 895 and SD 893); the maximum intraspecific divergence in *P. clavis* was 4.6%. These exceptional cases confirm the statement that for barcode based identification the clustering method is more reliable than a strict threshold method (Robinson *et al.* 2009). However, an approximate threshold of 5% provides a rough orientation in respect of the sequence analysis of morphologically very similar species in *Psechrus* ("special cases", as discussed herein, excluded). Vink *et al.* (2011a) reported a maximum intraspecific divergence of 3.65% in *Trite planiceps*, which in comparison to Robinson *et al.* (2009), is also relatively high. In the two well separable morphological species *P. torvus* and *P. hartmanni* the interspecific sequence divergence is exceptionally low (only 2.2%). At the moment we do not have any explanation for this phenomenon. *Psechrus torvus* and *P. hartmanni* are closely related, yet, clear-cut differences in the structure of copulatory organs are present, as described and illustrated in Bayer (2012).

In spiders of different genera, COI sequence analysis (Barrett and Hebert 2005; Astrin *et al.* 2006) has been shown to enable identification of species that had been thoroughly characterised and discriminated in recent morphological studies (e.g. revisions). In this present study the clustering method succeeded in identifying all focal species of *Psechrus* and *Fecenia* (not completely in the threshold method, see above). This was even true for some *Fecenia* specimens recorded in localities more than 2500 km separated from conspecific specimens. We were also able to assign juvenile specimens to the respective species, currently impossible using morphological methods. The juvenile *Fecenia* SD 943, recorded without conspecific adults, was unambiguously assigned to *Fecenia protensa* and thereby represents the first record of this species from Brunei. This indeed supports the statement in Hebert *et al.* (2003), that species identification via COI barcoding is possible. Likewise, Paquin and Hedin (2004) could identify juvenile spiders of *Cicurina* Menge, 1871 to species level using COI-analysis. By means of analysing the barcoding region of COI it was possible to disprove synonymies (Correa-Ramírez *et al.* 2010), to assign the corresponding sex to a particular species (Tanikawa 2011), or to give proof of the synonymy of two spider species (Vink *et al.* 2011b). Kuntner and Agnarsson (2011) tested current taxonomical hypotheses in a few species of hermit spiders (*Nephilengys* L. Koch, 1872) by using COI (1173 base pairs fragment; among other genes). The mean sequence distance divergence between two particular species, *N. dodo* and *N. borbonica*, was found to be only 4.2%, which is clearly lower than observed between most species examined herein. Even though the colouration between *N. dodo* and *N. borbonica* differs, the male and female copulatory organs are strikingly similar. In a molecular study on the pisaurid genus *Dolomedes* Latreille, 1804 unidirectional introgression was recognised (Lattimore *et al.* 2011). These authors investigated the genetic structure of COI (among others) for several *Dolomedes* species and recognised that COI haplotypes clearly assignable to *D. aquaticus* Goyen, 1888 were also present in specimens identified as *D. minor* L. Koch, 1876 (it should, however, be noted, that the delimitation of these two species is very complicated due to high similarity). Such a phenomenon had not been found in Psechridae within the framework of the present study, but according to the close relationship to the Pisauridae it cannot be excluded that it will be recognised in future studies.

The minimum interspecific divergence between two *Fecenia* species, *F. travancoria* and *F. protensa*, was only 4.7%. As these two species are very similar and hard to distinguish morphologically this low sequence divergence may indicate the presence of only one, widely distributed species (and hence synonymy of these two species). Two *Fecenia* specimens from Koh Chang, Thailand, identified as *F. protensa* in Bayer (2011) (due to similarities of the bulb of the male specimen to that of *F. protensa* and because of the occurrence within the geographical distribution range of *F. protensa*), were here left unassigned to species, as the first author recognised slight differences in the orientation of the median apophysis of the bulb in the male specimen. The associated female from Koh Chang died directly after the final moult with its copulatory organ deformed, making morphological comparison impossible. Genetic material from the type locality of *F. travancoria*, Madatory, Kerala Province, India was not available, and further sampling is necessary to assess if its species status can be maintained or synonymy with *F. protensa* has to be established. As males of *F. travancoria* are still unknown, investigation of males will also shed further light on this taxonomic problem.

Conclusions

Our investigations based on the 28S gene and the concatenated dataset suggested:

1) *Fecenia* and *Psechrus* are both monophyletic and are shown to belong to the Lycosoidea (Figs 1–6).

2) Our results provide weak indication that the Psechridae, as currently defined (Levi 1982; Griswold *et al.* 2005; Bayer 2011), may not be monophyletic. Further members of Lycosoidea and additional genetic markers need to be included to resolve the basal polytomy within the Lycosoidea and hence the relationships between *Fecenia* and *Psechrus*.

3) Several genera previously placed or associated with the Psechridae, were affirmed being only distantly related to that family (*Stiphidion*, *Poaka*, *Themacrys* and *Uloborus*) or had strong indication (*Tengella*) to disclaim a close relationship to the Psechridae.

4) The morphologically defined species groups in the genus *Psechrus* (Bayer 2012) were generally supported as monophyletic groups (Figs 1–4).

5) In *Fecenia* the two closely related species *F. protensa* and *F. travancoria* formed a well supported subclade and *F. cylindrata* and *F. ochracea* formed a second, but less supported subclade (Figs 1–4).

Our analyses of the sequences of the COI gene generally supported species hypotheses of *Psechrus* and *Fecenia* species established by previous morphological studies (Bayer 2011, 2012). In the respective trees (Figs 5–6) all specimens assigned to a particular species were recovered as monophyla. Identification via barcoding according to Hebert *et al.* (2003) is generally possible for Psechridae.

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4. DISKUSSION

Die Diskussionen der drei Einzelpublikationen (Bayer 2011, 2012; Bayer & Schönhofer 2012) enthalten vielfach Teilaspekte, auf die hier nicht mehr eingegangen wird. Die vorliegende Diskussion stellt vielmehr die wichtigsten Erkenntnisse und Folgerungen aus den Ergebnissen der drei Einzelpublikationen zusammenfassend dar, wobei im letzten Unterpunkt „Gesamtbetrachtungen“ diese Erkenntnisse im Lichte des Gesamtvorhabens, der Revision und phylogenetischen Bearbeitung der Psechridae, verdeutlicht werden.

4.1 Taxonomische Erkenntnisse in der Gattung *Psechrus*

Durch die folgenden Aspekte wurde der taxonomische Kenntnisstand in der Gattung *Psechrus* erheblich erweitert:
1) Neubeschreibungen von insgesamt 23 *Psechrus*-Arten (Bayer 2012; Bayer und Jäger 2010); 2) Aufstellung von Artengruppen; 3) Synonymien von *P. annulatus* und *P. libelti* mit *P. singaporensis* wurden als fehlerhaft erkannt; 4) Synonymie von *P. xinping* mit *P. tingpingensis*; 5) Taxonomische Bewertung und Illustration der Prä-Epigynen; 6) Erarbeitung eines Bestimmungsschlüssels.
Die von Illustrationen begleiteten Diagnosen wurden für die einzelnen Arten so formuliert bzw. revidiert, dass eine klare Abgrenzung der verschiedenen Arten möglich wurde. In Einzelfällen blieben taxonomische Unklarheiten bestehen, weil notwendiges Material aus bestimmten Regionen fehlte. Dies wurde dann stets explizit angemerkt (jeweils unter „remarks“). Für die Untersuchung der Prä-Epigynen standen die subadulten Weibchen (bzw. Exuvien von subadulten Stadien) von 43% der Arten zur Verfügung. Diese Arten konnten anhand der Struktur der Prä-Epigyne (und auch der Prä-Vulva) unterschieden werden. Hierdurch war selbst die Unterscheidung nahe verwandter Arten möglich, z.B. *P. jaegeri* und *P. vivax*. Allerdings ist damit nicht garantiert, dass diesbezüglich eine Unterscheidung auch zwischen anderen, nahe verwandten Arten möglich sein wird, bei denen sich bereits die Epigynen der adulten Weibchen sehr stark ähneln, z.B. *P. elachys* und *P. singaporensis*.
Unabdingbar für den Gewinn dieser Erkenntnisse war die Untersuchung einer ausreichenden Anzahl von Arten und Individuen. So konnten die Spektren an intraspezifischer Variabilität für die meisten Arten erkannt, illustrativ dargestellt und entsprechende Merkmalsabweichungen von interspezifischen Abweichungen durch alle Arten der Gattung hinweg unterschieden werden. Als Beispiel können die nahe verwandten Arten *Psechrus jaegeri* und *P. vivax* herangezogen werden: 20 Exemplare von *P. jaegeri* und 10 von *P. vivax* standen zur Verfügung und ermöglichten es, zu entscheiden, ob die geringen Merkmalsunterschiede in der Struktur der Kopulationsorgane tatsächlich interspezifischer Natur sind. Durch das Studium solch reichhaltigen Materials konnten im Laufe der Zeit auch die Einzelmerkmale der Kopulationsorgane nach ihrer taxonomischen Bedeutung eingeschätzt werden. So ist z.B. bei den Weibchen zwischen verschiedenen Individuen einer Art die Struktur der Epigyne in höherem Maße variabel als die der Vulva, weshalb zur Art-Bestimmung in *Psechrus* in vielen Fällen eine Vulva-Präparation notwendig und daher dringend zu empfehlen ist. Innerhalb der Vulva hat meist der Einführgang die größte taxonomische Bedeutung. Bei den männlichen Bulben kommt in erster Linie dem Embolus sowie dem Konduktor der größte Stellenwert zu, in einigen Fällen ist aber auch der Verlauf des Samenschlauches im Tegulum von Bedeutung. Eine solche qualitative Bewertung von Merkmalen stellt

somit nicht nur eine essentielle Basisinformation für die Charakterisierung der verschiedenen Arten, sondern auch für die Einschätzung möglicher Evolutions-Trends innerhalb der Gattung *Psechrus* dar. Aufgrund von Ähnlichkeiten und tendenziellen Übereinstimmungen der Kopulationsorgane wurden insgesamt acht *Psechrus*-Artengruppen unterschieden und jeweils nach einem typischen Vertreter benannt. Bei drei Arten, welche spezielle Merkmalsmuster aufwiesen, war keine Zuordnung zu Artengruppen möglich. Diese müssen daher vorerst als isoliert stehende Taxa aufgefasst werden. Diese Überlegungen bezüglich möglicher Verwandtschaftsverhältnisse auf Gattungsebene stellten für die nachfolgende phylogenetische Bearbeitung (siehe Abschnitt 4.3) eine wichtige Basisinformation dar.

4.2 Taxonomische Erkenntnisse in der Gattung *Fecenia*

Im Rahmen der Revision der Gattung *Fecenia* (Bayer 2011) wurden besonders die Charakteristika der Prä-Epigynen subadulter Weibchen herausgestellt. In dieser Gattung erwiesen sich die Prä-Epigynen als signifikant taxonomisches Merkmal, welches für vier der fünf derzeit bekannten *Fecenia* Arten ausführlich beschrieben und illustriert wurde. Anhand der Struktur der Prä-Epigyne war es sogar möglich, das subadulte Holotypus-Weibchen von *Fecenia protensa* aus Nanchowry, Nicobaren, dessen Status von vorhergehenden Autoren (Lehtinen 1967; Levi 1982) als schwer einzuschätzen galt und vor Inangriffnahme meiner Studien als zweifelhaftes Synonym von *F. macilenta* geführt wurde, einer bestimmten Form von (Adult-) Epigyne zuzuordnen. Und zwar wurden viele *Fecenia* Weibchen aus den Regionen Sumatra, Süd-Thailand, Malaysia, Singapur, Nordwest- Borneo und Bali untersucht, die alle gleichermaßen eine ganz bestimmte Epigynenform aufwiesen (Bayer 2011, Abb. 55). Zusammen mit solcherart Weibchen wurden in einigen Fällen subadulte Weibchen gefangen, welche stets eine ganz bestimmte Form von Prä-Epigyne aufwiesen (Bayer 2011, Abb. 66, 69). Auch das subadulte Holotypus-Weibchen von *F. protensa* (Bayer 2011, Abb. 58) wies diese Ausprägung der Prä-Epigyne auf. Auf diese Weise konnte die Synonymie von *F. sumatrana* mit *F. protensa* festgestellt und die von *F. protensa* mit *F. macilenta* widerlegt werden. Bei *Fecenia* (und übrigens ebenso auch bei *Psechrus*) erfolgt die Unterscheidung von Prä-Epigynen und Adult-Epigynen neben der unterschiedlichen Größe anhand der unterschiedlichen Ausprägung des Epigynenfeldes. Dieses reicht bei adulten Weibchen immer bis an die Muskelsigillen sowie Spaltsinnesorgane (zumindest nahezu) heran, die im Bereich anterior der Epigyne in der Kutikula stets vorhanden sind. Bei subadulten Weibchen ist entweder kein Epigynenfeld vorhanden oder dieses reicht bei weitem nicht an die oben genannten Strukturen heran. Weiterhin ist die Prä-Epigyne kaum länger als ein Muskelsigillum, die Adult-Epigyne hingegen ca. doppelt so lang oder noch länger. Zudem ist die Distanz zwischen den äußersten Spaltsinnesorganen in etwa doppelt so lang wie die Breite der Prä-Epigyne samt Epigynenfeld aber nicht oder kaum länger als die Breite der Epigyne. Die relative Position der Spaltsinnesorgane und Muskelsigillen variiert beim adulten und subadulten Weibchen nur sehr wenig, daher ist das Heranziehen dieser Strukturen zur Unterscheidung von Prä-Epigyne und Epigyne überaus hilfreich. Somit ist durch die in Bayer (2011) vorgestellten Relationsmaße Taxonomen zukünftig ein gutes Hilfsmittel zur Verfügung gestellt, Prä-Epigynen von Adult-Epigynen zu unterscheiden. Artneubeschreibungen basierend auf Typusexemplaren von subadulten Weibchen, so wie sie in der Vergangenheit hin und wieder aufgetreten sind (z. B. Thorell 1891, 1895, 1897; Chamberlin 1924) und später meistens für Unklarheiten gesorgt hatten, sollten nun nicht mehr vorkommen. Parallelen zwischen bestimmten Strukturen der Prä-Epigyne zu entsprechenden Strukturen der Adult-Epigyne ließen Überlegungen über mögliche ontogenetische Abläufe zu. Dies gestaltete sich bei *Fecenia ochracea* relativ einfach, da sich hier Prä-Epigyne und Epigyne schon recht stark ähneln. Durch diese Überlegungen konnten die Prä-Epigynen der einzelnen Arten charakterisiert werden. Im Allgemeinen zeigen die Prä-Epigynen verschiedener subadulter *Fecenia*-Weibchen einer Art eine stetige Merkmalsausprägung und sind daher taxonomisch relevant. Deshalb, und weil die Prä-Epigynen aller *Fecenia* Arten (außer einer) bekannt sind, konnte ihre jeweilige Merkmalsausprägung in den *Fecenia*-Bestimmungsschlüssel mit aufgenommen werden, eine Neuheit innerhalb der arachnologischen Forschung. Innerhalb der Art *Fecenia cylindrata* kann es in seltenen Fällen bei einzelnen subadulten Weibchen zu Unterschieden bezüglich der Form der Prä-Epigyne im Vergleich zu anderen subadulten Weibchen kommen. Es wurden Überlegungen angestellt (Bayer 2011, S. 50), welche diese Unterschiede möglicherweise erklären könnten. Und zwar ist die Gesamtanzahl der Häutungen und somit auch die Gesamtanzahl an juvenilen Stadien bei Spinnen nicht konstant. Selbst zwischen verschiedenen Individuen ein und derselben Art kann es, je nach Art, teils erhebliche Unterschiede geben (Sierwald 1989). Über *Fecenia* gibt es hierüber zwar keine Studien, allerdings ist für bestimmte *Pisaura* Arten nachgewiesen, dass die Anzahl an Häutungen zwischen 9 und 15 schwanken kann (Zimmermann und Spence 1998), was auch die große Variationsbreite der Körpergröße erklären würde. *Pisaura* ist als Vertreter der „higher Lycosoidea“ (Griswold 1993) mit *Fecenia* relativ nahe verwandt. Bei vielen amerikanischen Pisauridae, z.B. *Pisaurina*, konnten weiterhin eine unterschiedliche Zahl an Epigynenvorläuferstrukturen im Laufe der Entwicklung von verschiedenen weiblichen Individuen ein- und derselben Art festgestellt werden, welche von Stadium zu Stadium mehr der Adult-Epigyne ähnelten (Sierwald 1989). Manche besaßen demnach ab dem dritten Stadium vor dem Adultstadium eine Epigynenvorläuferstruktur, andere sogar bereits ab dem fünften. In solchen Fällen unterschieden sich die Prä-Epigynen der jeweils subadulten Weibchen (teilweise sogar deutlich). Nichtsdestotrotz wiesen die Epigynen der verschiedenen Tiere nach der Adult-Häutung keine auffälligen, strukturellen Unterschiede mehr auf (Sierwald 1989). Die Größenvariabilität ist bei *Fecenia cylindrata* ebenfalls recht groß. Eine unterschiedliche Anzahl an Häutungen bei verschiedenen Individuen könnte daher bei dieser Art durchaus wahrscheinlich sein. Möglicherweise könnte auch die Anzahl an Epigynenvorläuferstrukturen variieren. So würde sich eine Prä-Epigyne eines subadulten Weibchens im sechsten Entwicklungsstadium wahrscheinlich von der eines subadulten Weibchens im siebten oder gar achten Stadium unterscheiden. Die hormonelle Steuerung der Häutungen bis zur Reife, erfolgt bei Insekten, neben dem Ecdyson, was für den konkreten Häutungsvorgang benötigt wird, durch das Juvenilhormon (JH) sowie das prothorakotrope Hormon (PTTH) (Wigglesworth 1952). Die Existenz des JH ist bei Spinnen wahrscheinlich (Webber 2005). PTTH sollte bei Spinnen wohl nicht vorkommen, da auch eine Prothorax-Drüse nicht vorhanden ist. Es wäre jedoch denkbar, dass bei Spinnen ein adäquates, bisher noch nicht bekanntes Hormon, eine solche oder ähnliche Funktion übernimmt. Nichtsdestotrotz ist eine Bestimmung von subadulten Weibchen auch bei einer (selten auftretenden) Formenabweichung möglich, da die entsprechende Prä-Epigynen-Variante der Struktur der Adult-Epigyne dann bereits stärker ähnelt. Vor allem, wenn von einer bestimmten Art auch adulte sowie weitere subadulte Weibchen vorliegen, ist eine Zuordnung einer solchen, abweichenden („weiterentwickelten“) Prä-Epigyne zu dieser Art problemlos möglich, da ihre

Merkmalsausprägung intermediär zwischen dem „regulären“ subadulten und dem adulten Weibchen liegt (Bayer 2011, Abb. 80 *cf.* 79, 81).

Ferner konnte in dieser Arbeit die Synonymie von *F. nicobarensis* mit *F. protensa* aufgedeckt werden, obwohl die Typusexemplare von *F. nicobarensis* auf Anfrage nicht zur Verfügung gestellt wurden. Auch die Zeichnungen in der Originalpublikation (Tikader 1977) ließen vorerst keine klare Zuordnung zu. Wurden männliche Pedipalpen-Bulben von vorhandenem Material von *F. protensa* aber aus einem anderen Winkel betrachtet (ventro-distal), wurden spezifische Übereinstimmungen mit jenen Originalzeichnungen deutlich. Die sechs bislang als Synonyme von *F. ochracea* geführten nominellen Arten (*F. angustata, F. buruana*, *F. cinerea*, *F. maforensis*, *F. montana* und *F. oblonga*) konnten allesamt als solche bestätigt werden. Die meisten dieser nominellen Arten wurden basierend auf weiblichen Typen beschrieben. Nun zeigt die weitverbreitete Art *F. ochracea* eine beachtliche Variation was die Form der Epigyne des weiblichen Kopulationsorgans anbelangt (Bayer 2011, Abb. 1, 19, 27–33, 102). Da aber viele Weibchen dieser Art aus vielen verschiedenen Regionen untersucht wurden, konnten die unterschiedlichen Formen klar als intraspezifische Variation erkannt werden. Zum einen ist keine der Formen auf eine bestimmte geographische Region beschränkt (d.h. ganz ähnliche Formen tauchen teilweise Hunderte von Kilometern entfernt auf bzw. an ein- und derselben Fundstelle werden mitunter recht stark abweichende Formen vorgefunden), zum zweiten sind die Merkmalsübergänge fließend (keine klaren Abstufungen, welche Artgrenzen erkennen ließen) und zum dritten bezieht sich diese auffällige Variation lediglich auf die Epigyne, die Vulva hingegen zeigt deutlich geringere Variation. Somit ist klar, dass die Autoren der o.g. nominellen Arten jeweils intraspezifische Abweichungen von *F. ochracea* als diagnostische Merkmale der nach ihren Einschätzungen neuen Arten erachteten. Der Status von einer dieser nominellen Arten war jedoch schwierig einzuschätzen, und zwar *F. cinerea*, von der das Männchen unbekannt ist. Beim Holotypus-Weibchen von *F. cinerea* war auch eine relativ deutliche Abweichung der Vulva gegenüber den restlichen *F. ochracea* Weibchen festzustellen. An einer bestimmten Fundstelle (Mindiptana, Indonesisch-Neuguinea), nicht allzu weit von der Typuslokalität entfernt, wurden aber mehrere Weibchen gefunden, die mir zur Untersuchung vorlagen. Die meisten davon ähnelten dem Vulva-Typus von *F. cinerea* sehr stark, bei welchem die zweite Biegung des inneren Gangsystems relativ lang ist. Eines jedoch zeigte wiederum eine etwas kürzere zweite Biegung und somit eine Merkmalsausprägung, die man als Zwischenform von *F. cinerea* und *F. ochracea* auffassen konnte. Aus diesem Grund und weil unter dem Material aus Mindiptana auch ein Männchen dabei war, welches nur sehr geringe Abweichung zur Palpus-Struktur der übrigen, untersuchten *F. ochracea* Männchen aufwies, wurde am Status von *F. cinerea* nichts geändert (Bayer 2011), diese also weiterhin als Synonym von *F. ochracea* geführt. Eine abschließende Klärung des taxonomischen Status von *F. cinerea* kann nur dann erfolgen, wenn zukünftig weiteres Material davon (v.a. aus der Typuslokalität; vorzugsweise Männchen und Weibchen von der gleichen Fundstelle) gefunden wird. Ungünstigerweise lagen von dieser Form bislang auch keine frischen Gewebeproben zur DNA-Extraktion vor.

Auch in der Gattung *Fecenia* wurde eine große Menge an Exemplaren untersucht und intraspezifische Variabilität (auch der Prä-Epigynen) dargestellt (Bayer 2011), was zum besseren Verständnis der einzelnen Arten beiträgt.

Eine Vorhersage über mögliche phylogenetische Beziehungen aufgrund morphologischer Ähnlichkeiten, war in der Gattung *Fecenia* nur bedingt möglich. Zumindest kann man aber davon ausgehen, dass die beiden Arten *F. protensa* und *F. travancoria* sehr nahe verwandt sind (Bayer 2011, Abb. 55–59 *cf.* Abb. 71–78).

Eine Unterscheidung der beiden Arten kann nur über die spezifischen Strukturen der Vulva erfolgen. Es ist sogar möglich, dass *F. travancoria* ein jüngeres Synonym von *F. protensa* ist. Von *F. travancoria* ist allerdings das Männchen noch nicht bekannt. Erst wenn nachweislich konspezifische Männchen dieser Art (vorzugsweise aus der Typus-Lokalität) gefunden werden und deren Unterschiede zu den Männchen von *F. protensa* bewertet werden können, bzw. wenn weitere DNA Gewebeproben, vorzugsweise aus der Typuslokalität, vorliegen, kann eine abschließende Beurteilung des Status von *F. travancoria* erfolgen. In Bayer (2011) ist *F. travancoria* daher vorerst als valide Art aufgeführt. Was die Vulvastruktur anbelangt, wurden bislang auch keine Zwischenformen zwischen *F. protensa* und *F. travancoria* gefunden.

4.3 Phylogenie und systematische Position der Psechridae nach eingehender molekulargenetischer Bearbeitung

In den molekularen Untersuchungen wurden verschiedene Fragestellungen verfolgt. Die Analysen der unterschiedlichen Datensätzen (Sequenzdaten verschiedener Gene) erfolgten mit unterschiedlichen Auswertungsverfahren.

A) Verwandtschaftsverhältnisse zwischen *Psechrus* und *Fecenia* und phylogenetische Position der Psechriden im System der höheren Webspinnen (Araneomorphae):

Psechrus als auch *Fecenia* stellten sich in allen Stammbäumen jeweils als gut unterstützte Monophyla heraus, welche zu den ihrerseits gut unterstützten Lycosoidea gehörten (Bayer und Schönhofer 2012, Abb. 1–6). Damit bestätigten diese Ergebnisse eindeutig morphologisch-kladistische Studien, die sich mit den Lycosoidea beschäftigten (Griswold 1993; Griswold et al. 1999, 2005; Silva 2003; Coddington et al. 2004; Raven and Stumkat 2005). Die Stammbäume basierend auf dem kombinierten Datensatz von 28S rRNA und COI (Bayer und Schönhofer 2012, Abb. 3–4), und hier noch etwas stärker der Maximum Likelihood (ML)-Stammbaum (Bayer und Schönhofer 2012, Abb. 4), stimmen am besten mit Ergebnissen aktueller morphologischer Studien über die jeweiligen Taxa überein (Griswold et al. 1999, 2005; Coddington et al. 2004; Bayer 2012). Hier lagen die Informationen aus dem, in Relation zu anderen Genen, schnell evoluierenden COI mit denen des recht konservativen Gens 28S kombiniert vor. Es gab also zum einen keine Paare oder gar Gruppen von Haplotypen, zwischen welchen nur noch wenige Sequenzunterschiede zu verzeichnen gewesen wären, da die Sequenzen nahezu übereingestimmt hätten und zum anderen wurden Fehlinformationen wegen möglicher Übersättigung in Sequenzbereichen des COI von den konservativen Bereichen (der 28S Sequenz) kompensiert.

Die Psechriden wurden in keinem der für diese Fragestellung relevanten Stammbäume als Monophylum erkannt. Jedoch waren die eher basalen Knoten des Zweiges der Lycosoidea im allgemeinen nicht oder zumindest nicht ausreichend unterstützt, so dass die Verwandtschaftsverhältnisse zwischen *Psechrus*, *Fecenia* sowie den anderen zu den Lycosoidea gehörenden Familien nicht oder zumindest nicht eindeutig aufgelöst werden konnten. Die vorliegenden Ergebnisse können daher allenfalls einen zarten Hinweis auf eine mögliche Polyphylie der Psechridae darstellen. Um hier eindeutige Erkenntnisse zu erlangen, wäre es zum ersten nötig, weitere Taxa aus der Überfamilie der Lycosoidea in die Studie mit einzubeziehen. Zum Beispiel standen Vertreter aus den Familien Senoculidae, Zoridae und Trechaleidae, welche ebenfalls zu den Lycosoidea gestellt (bzw. mit diesen in Verbindung gebracht) wurden, für die vorliegende Studie nicht zur Verfügung, und von den Ctenidae konnte nur ein, und zwar eher basal stehendes, Taxon inkludiert werden. Zweitens sollten ein oder mehrere, weitere Gene in die Analyse mit einbezogen werden.

B) Systematische Position der früher zu den Psechriden gerechneten Taxa *Poaka*, *Stiphidion*, *Tengella* (*ad part*) und *Themacrys*:

In Bayer und Schönhofer (2012, Abb. 1–2) wurde *Stiphidion* zusammen mit *Cambridgea* L. Koch 1872 (ebenfalls Stiphidiidae) in einem Zweig vereint, der weiterhin *Poaka* und die Desidae enthielt. Dieser Zweig wiederum gehörte nicht den Lycosoidea an. *Poaka* gehört also nach vorliegender Analyse, entgegen aktueller morphologischer Auffassung (Raven und Stumkat 2003), nicht den Amaurobiidae an, sondern dem Verwandtschaftskreis der Desidae und Stiphidiidae. Dies wird auch durch Gemeinsamkeiten zwischen *Badumna* (Desidae) und *Poaka* in Bezug auf bestimmte, morphologische Besonderheiten der männlichen Pedipalpen deutlich, z.B. Form der retrolateralen Tibialapophyse oder Position und Form der Medianapophyse, auf die in Raven und Stumkat (2003) gar nicht eingegangen wurde. *Stiphidion* zeigt zwar, ebenso wie die Vertreter der Lycosoidea, Seitenaugen mit Tapeta vom rostförmigen Typus (*Poaka* lediglich welche vom kanuförmigen Typus). Jedoch sind diese bei *Stiphidion* nur in den hinteren Mittelaugen vorhanden (Homann 1971). Zudem bestehen die rostförmigen Tapeta bei *Stiphidion* nur aus wenigen Schlingen. D.h. selbst bei Betrachtung nur dieses Kriteriums (rostförmiges Tapetum) als diagnostisches Merkmal für die Lycosoidea, wären die Stiphidiidae allenfalls als ganz basales Taxon darin aufzufassen. Die vorliegende Studie (Bayer und Schönhofer 2012, Abb. 1–4) schließt aber *Stiphidion* ebenso wie *Poaka* von den Lycosoidea aus. Dies wird auch durch morphologische Aspekte unterstützt, da den männlichen Vertretern beider Gattungen eine Scopula dorsal auf dem Cymbium fehlt und das Calamistrum nicht aus mehreren Reihen wie bei den Lycosoidea und einigen ihnen nahe stehenden Familien (Griswold et al. 2005) besteht.

Die näheren Verwandtschaftsverhältnisse von *Themacrys* konnten zwar nicht aufgelöst werden, jedoch konnte eine Zugehörigkeit dieser Gattung zu den Lycosoidea ausgeschlossen werden (Bayer und Schönhofer 2012, Figs 1–2). Auch im Falle von *Themacrys* ist dies nachvollziehbar, da weder Tapeta vom rostförmigen Typus vorhanden sind (sondern solche vom kanuförmigen), noch eine Scopula dorsal auf dem Cymbium bei den Männchen. Zudem besteht das Calamistrum nicht aus mehreren Reihen.

Die ursprüngliche Eingruppierung von *Stiphidion* und *Themacrys* (siehe Simon 1902, 1906; Dalmas 1917) sowie *Poaka* (siehe Forster & Wilton 1973) innerhalb der Psechridae könnte in der Ähnlichkeit bezüglich des Habitus bzw. im ebenfalls vorhandenen cribellaten Spinnapparat begründet sein.

Tengella erwies sich zwar als Mitglied der Lycosoidea, jedoch hier mit unbekannter Position, da die entsprechenden, basalen Knoten keine zuverlässige Unterstützung aufwiesen (Bayer und Schönhofer 2012, Abb. 1–2). Eine nähere Verwandtschaft mit den Psechridae ist jedoch recht unwahrscheinlich, da *Zorocrates* (Zorocratidae), ein mit *Tengella* recht nahe verwandtes Taxon (Silva 2003), in den Analysen basierend auf dem kombinativen Datensatz lediglich eine basale Position innerhalb der Lycosoidea einnahm (Bayer & Schönhofer 2012, Abb. 3–4; Anmerkung: In der vorliegenden Arbeit waren dies die Stammbäume, welche am ehesten mit vorangegangenen morphologischen Studien übereinstimmten, s.o.).

C) Phylogenetische Beziehungen der Arten innerhalb der Gattung *Psechrus*:

In die Analysen basierend auf dem 28S- sowie dem kombinativen Datensatz (Bayer und Schönhofer 2012, Abb. 1–4) konnten die in Bayer (2012) zu keiner Artengruppe zugeordnete Spezies *Psechrus crepido* sowie Vertreter aller *Psechrus*-Artengruppen (nach Bayer 2012) außer der *annulatus*-Gruppe mit einbezogen werden. Im Grunde wurden die verschiedenen Arten der jeweiligen Artengruppen jeweils als Monophyla erkannt (Bayer und Schönhofer 2012, Abb. 1–4), was diese Einteilung (Bayer 2012) somit auch mit „molekularen Argumenten" untermauerte. Eine Ausnahme stellte allerdings die *himalayanus*-Gruppe dar, welche sich in den Analysen des kombinativen Datensatzes (Bayer und Schönhofer 2012, Abb. 3–4) als Paraphylum herausstellte. Und zwar gruppierten drei Arten der *himalayanus*-Gruppe (*P. himalayanus*, *P. inflatus* und *P. luangprabang*) zusammen mit der *ancoralis*-Gruppe in einem Unterzweig. Den anderen Unterzweig bildeten die drei restlichen Arten der *himalayanus*-Gruppe, *P. jaegeri*, *P. vivax* und *P. ghecuanus*. Die Kopulationsorgane der Vertreter der beiden Artengruppen (*ancoralis*- und *himalayanus*-Gruppe) zeigen in der Tat gewisse Parallelen, vor allem die der Weibchen, so dass eine nähere Verwandtschaft dieser beiden Gruppen sehr wahrscheinlich ist. Trotz allem wurden in Bayer (2012) eindeutige Unterscheidungsmerkmale aufgeführt, welche insbesondere bei den Männchen zum Ausdruck kommen. Die Position und Ausrichtung des Embolus, welcher nämlich zum größten Teil direkt mit dem Konduktor in Verbindung steht und zentral in der distalen Hälfte des Tegulums austritt (Bayer 2012, Abb. 31b, 85g), kann als Autapomorphie der *himalayanus*-Gruppe betrachtet werden. In der *ancoralis*-Gruppe entspringt der filiforme Embolus, der bei diesen Arten zumeist auffallend lang ist, stets retrolateral am Tegulum und steht mit dem membranösen bis fleischigen Konduktor allenfalls mit seiner distalen Hälfte in Verbindung. In der molekularen Analyse konnten nicht alle Arten der *himalayanus*- sowie *ancoralis*-Gruppe mit einbezogen werden. Daher, und weil die Auftrennung in die angesprochenen, beiden Unterzweige lediglich in der Bayesian Analyse des kombinierten Datensatzes verlässliche statistische Unterstützung erhielt, könnte die angezeigte Paraphylie möglicherweise auch artifizielle Gründe haben. Insbesondere das Männchen der hier nicht inkludierten Art *P. demiror* zeigt, was den Bulbus des Pedipalpus anbelangt, deutliche Übereinstimmungen zu *P. himalayanus*. Andererseits fehlt ihm, genauso wie *P. ghecuanus*, *P. jaegeri* und *P. vivax*, die Cymbium-Scopula (Bayer 2012). Die drei letztgenannten Arten gruppieren im Vergleich zu *P. himalayanus* in Bayer und Schönhofer (2012, Abb. 3–4) im anderen der angesprochenen Unterzweige! Weiterhin ist verwunderlich, dass die Arten *P. ghecuanus* und *P. inflatus*, bei denen sich vor allem die Epigyne und Vulva der Weibchen verblüffend ähneln (Bayer 2012, Abb. 36a–f *cf.* 37d–g), in der molekularen Analyse in unterschiedlichen Unterzweigen (s.o) gruppierten, also demnach lediglich entfernt miteinander verwandt sein müssten. Die phylogentische Position von *P. crepido*, welche keiner der acht *Psechrus*-Artengruppen zugeordnet wurde (Bayer 2012), konnte nicht aufgelöst werden, da die Topologien diesbezüglich stets keine ausreichend verlässliche Bootstrap- bzw. *posterior probability*-Unterstützung aufwiesen bzw. die verschiedenen Stammbäume sich „gegenseitig widersprachen". Dies könnte möglicherweise ein Hinweis darauf sein, dass diese Art einer expliziten Stammlinie angehört, von welcher entweder im Raum Süd-Indien, wo sich auch die Typus-Lokalität von *P. crepido* befindet, noch weitere, bislang unbekannte Arten existieren oder aber deren ursprünglich vorhandene Vertreter bereits ausgestorben sind. Fakt ist, dass dieses Gebiet nur schlecht untersucht ist und von dort bislang nur sehr wenige *Psechrus*-Nachweise existieren. Die Verwandtschaft zwischen den acht Artengruppen konnte nur geringfügig aufgelöst werden. Alle Artengruppen mit nördlicher oder westlicher Verbreitung (*sinensis*-, *himalayanus*-, *ancoralis*- und *torvus*-Gruppe sowie *P. crepido*) bildeten einen *Psechrus*-Unterzweig, die mit südöstlicher Verbreitung (*argentatus*-, *singaporensis*- und *mulu*-Gruppe) einen zweiten (Bayer und Schönhofer 2012, Abb. 2–4). Aufgrund der beobachteten, kleinräumigen Verbreitungsmuster von *Psechrus* ist es unwahrscheinlich, dass „Ballooning", also die Verdriftung durch vom Wind erfasste Spinnfäden, in dieser Gattung eine Rolle spielt. Dies wurde auch bislang noch nie beobachtet. Daher sollte *Psechrus* ein wohl nur geringes Ausbreitungspotential haben. Daher ist die beobachtete Aufspaltung nach geographischer Verbreitung durchaus nachvollziehbar. Auch andere Autoren konnten phylogenetisch basale Aufspaltungen, welche sich geographisch „ablesen" lassen, nachweisen (Su et al. 2011; Crews und Gillespie 2010). Eine klare morphologische Abgrenzung der o.g. beiden Stammlinien durch rein somatische Merkmale ist jedoch nicht möglich, allenfalls tendenziell: Die südlich verbreiteten Arten haben im Verhältnis zum Prosoma etwas längere Beine als die nördlich verbreiteten und besitzen breitere, dunkle Lateralbänder dorsal auf dem Prosoma (Es gibt jedoch einige Ausnahmen; Was die Lateralbänder auf dem Prosoma anbelangt, sind z. B. auch die von *P. crepido* sowie der Vertreter der *torvus*-Gruppe sehr breit, zum Teil sogar noch etwas breiter als bei denen der südlich verbreiteten Artengruppen).

D) Phylogenetische Beziehungen der Arten innerhalb der Gattung *Fecenia*:

In der Gattung *Fecenia* gab es in allen Auswertungen (Bayer und Schönhofer 2012, Abb. 1–6) gleichermaßen eine Aufspaltung, welche *F. protensa* und *F. travancoria* von *F. cylindrata* und *F. ochracea* abtrennte. *F. protensa* und *F. travancoria* sind definitiv sehr nahe verwandt (Bayer 2011), für *F. cylindrata* und *F. ochracea* wurden in Bayer (2011) hingegen keine ausdrücklichen Gemeinsamkeiten der Kopulationsorgane festgestellt, so dass dieses Schwestergruppenverhältnis etwas überrascht. Auch liegen die Verbreitungsgebiete dieser beiden Arten weit auseinander (Bayer und Schönhofer 2012, Abb. 7). Es bleibt abzuwarten, wie sich die Topologie in *Fecenia* noch ändern wird, falls die in der vorliegenden Untersuchung fehlende *F. macilenta* zukünftig noch mit einbezogen wird.

E) Überprüfung der Arthypothesen in *Psechrus* und *Fecenia*

Die Stammbäume mit dem COI Datensatz als Grundlage (Bayer und Schönhofer 2012, Abb. 5–6) wiesen alle Exemplare der einzelnen *Psechrus* Arten jeweils als Monophyla aus. Zudem waren die Astlängen zwischen Exemplaren derselben Art i.d.R. kurz (Sequenz-Distanzunterschiede also gering, bei den meisten *Psechrus*-Arten unter 2%), die zwischen Exemplaren unterschiedlicher Arten deutlich länger. Demnach konnten die Arthypothesen (Bayer 2012) aller in der molekularen Analyse inkludierten *Psechrus* Arten grundsätzlich bestätigt werden. Eine Ausnahme stellte *P. ancoralis* dar, bei welcher auch intraspezifisch beachtliche Astlängen zu verzeichnen waren. Diese lagen teilweise sogar bei 13% Sequenzdistanz (Bayer und Schönhofer 2012, Abb. 6). Diese Art weist auch morphologisch eine recht deutliche Variabilität auf, die allerdings klar als intraspezifisch erkannt wurde (Bayer 2012) und nur die Kopulationsorgane der Weibchen betrifft; die der Männchen weisen keine nennenswerte Variation auf. Zudem konnte keine geographische Abhängigkeit von bestimmten Formen festgestellt und zwischen den verschiedenen Formen viele Übergangsformen erkannt werden. Diese außerordentlich großen intraspezifischen Sequenzdistanzen zwischen fast allen untersuchten *P. ancoralis*-Individuen sind daher schwierig zu erklären. Es wäre denkbar, dass bei dieser Art die Evolutionsrate des COI-Gens aus noch unbekannten Gründen höher als bei anderen *Psechrus* Arten ist. In Astrin et al. (2006) und Barrett und Hebert (2005) wurde bei einigen untersuchten Arten ebenfalls eine auffallend hohe intraspezifische Sequenzdistanz festgestellt. Eine Ausnahme bezüglich der normalerweise beobachteten, mit mindestens ca. 6,5% recht großen interspezifischen Sequenzdistanzen, war mit *P. torvus* und *P. hartmanni* gegeben (lediglich 2,2%). Diese sind zwar tatsächlich recht ähnliche Arten, sind aber anhand ihrer Kopulationsorgane deutlich abgrenzbar (Bayer 2012, Abb. 69a–e, 70a–d cf. Abb. 71a–e, 72a–d). Eine eindeutige Erklärung für die geringe COI-Sequenzdistanz kann momentan nicht geliefert werden. Von beiden Arten stand jeweils nur ein Exemplar für die molekulare Untersuchung zur Verfügung, d.h. es konnte z.B. nicht überprüft werden, wie groß intraspezifische Distanzen in beiden Arten bzw. wie hoch die jeweiligen interspezifischen Distanzen zwischen anderen Individuen von *P. torvus* und *P. hartmanni* sind. Es ist nicht auszuschließen, dass das vorliegende Ergebnis möglicherweise artifiziell zustande gekommen ist. Eine andere mögliche Erklärung könnte aber sein, dass die Evolution der Kopulationsorgane in der *torvus*-Gruppe aus noch unbekannten Gründen schneller abläuft als bei anderen *Psechrus*-Artengruppen.

Auch die *Fecenia*-Arten wurden generell als Monophyla mit geringen intraspezifischen Sequenzdistanzen erkannt. Die interspezifischen Distanzen hingegen waren generell deutlich höher, jedoch mit einer Ausnahme. Die interspezifische Sequenzdistanz zwischen *F. protensa* und *F. travancoria* war mit ca. 4,7% vergleichsweise gering. Das Männchen von *F. travancoria* ist nicht bekannt und aus der Typuslokalität von *F. travancoria* stand für die Untersuchungen in Bayer (2011) nur das eine Holotypus-Weibchen zur Verfügung. Die Kopulationsorgane der Weibchen von *F. protensa* und *F. travancoria* sind sehr ähnlich und eine Unterscheidung ist nur über die Vulva möglich (siehe Abschnitt 4.2). Diese geringen Unterschiede könnten möglicherweise doch nur intraspezifischer Natur sein, was die Synonymie beider nomineller Arten bedeuten würde. So ist also nicht auszuschließen, dass hier ein Artaufspaltungsprozess im Gange aber noch nicht abgeschlossen ist. Allerdings wurden, wie in 4.2 bereits erwähnt, bislang keine Zwischenformen gefunden. Eine eindeutige Bewertung des Artstatus von *F. travancoria* (jüngerer Name) kann nur nach Überprüfung von Männchen dieser Art bzw. weiterem, vor allem frischem, für DNA-Extraktion nutzbarem Material (möglichst aus der Typuslokalität) erfolgen.

Anhand der COI-Sequenzen war es auch möglich, juvenile Exemplare, die aufgrund fehlender diagnostischer Merkmale mit morphologischen Methoden zumeist nicht determinierbar gewesen wären, zu bestimmen. So clusterte z.B. eine juvenile *Fecenia* aus Brunei zusammen mit *F. protensa* Exemplaren. Somit war gleichzeitig der Erstnachweis von *F. protensa* für Brunei erbracht. Dies bestätigt die Aussagen in Hebert et al. (2003), dass Tierarten anhand der Barcoding Region ihrer COI Sequenz bestimmt werden können, zumindest einmal für die Spinnenfamilie Psechride.

4.4 Gesamtbetrachtungen

Um die Familie Psechridae gründlich zu revidieren und ihre phylogenetische Position im System der Webspinnen sowie die phylogenetischen Zusammenhänge innerhalb der Familie aufzuklären, war es zunächst nötig, Typus-Exemplare von allen bis dato beschriebenen validen als auch synonymisierten *Psechrus* und *Fecenia* Arten zu untersuchen. Dies konnte, von sehr wenigen Ausnahmen abgesehen, geleistet werden. In den Einzelfällen, in denen Typen nicht verfügbar waren, konnten anhand ausreichend detaillierter Illustrationen und Beschreibungen in den Originalpublikationen und/oder anhand Materials aus den jeweiligen Typuslokalitäten die jeweiligen Arten charakterisiert werden. So wurden alle bislang beschriebenen Arten klar diagnostiziert. Dies war die Grundlage für die ausführliche morphologische Bearbeitung des gesamten zur Verfügung stehenden *Psechrus* und *Fecenia* Materials. Diese lieferte neben überarbeiteten Diagnosen und Beschreibungen detaillierte Illustrationen —auch von intraspezifischer Variation— und zusätzliche Informationen zur Verbreitung der jeweiligen Arten. In den morphologischen Bearbeitungen wurde zusätzlich zu den bei Spinnen diagnostischen Merkmalen der Kopulationsorgane adulter Tiere auch ein Merkmal herausgestellt und eingehend untersucht, was bislang bei Spinnen nur wenig Beachtung gefunden hat: Die Prä-Epigyne subadulter Weibchen. Diese erwies sich bei *Psechrus* (Bayer 2012) und bei *Fecenia* (Bayer 2011) als taxonomisch relevant, konnte erstmals in einen Bestimmungsschlüssel integriert werden und hat mit ermöglicht, dass fehlerhafte Synonymien aufgedeckt und neue Synonymien erkannt werden konnten. Nach Untersuchung des zur Verfügung stehenden Materials stellte sich die Gattung *Psechrus*, entgegen Einschätzungen früherer Autoren (Levi 1982; Lehtinen 1967), als divers heraus. In Bayer (2012) konnten 23 neue Arten beschrieben werden (drei davon bereits in Bayer und Jäger [2010]). Alle bis auf drei Arten wurden anhand von Ähnlichkeiten der Kopulationsorgane in verschiedene Artengruppen eingeteilt. Mit diesen morphologischen Erkenntnissen, welche z.T. auch schon phylogenetische Hypothesen beinhalteten, war die Voraussetzung für die Untersuchung der phylogenetischen Verhältnisse innerhalb der Psechriden sowie deren Stellung im System der Araneomorphae mit Hilfe molekulargenetischer Methoden gegeben. Denn die hierfür verwendeten Exemplare konnten anhand der beiden morphologischen Arbeiten (Bayer 2011, 2012) eindeutig bestimmt werden (von ganz wenigen, entweder juvenilen Exemplaren oder von „taxonomischen Problemfällen“ abgesehen). Durch die molekularen Untersuchungen basierend auf den Sequenzen der Gene 28S rRNA, COI sowie beiden in Kombination mit den Auswertungsmethoden Maximum Likelihood, Bayesian Analysis sowie Neighbor Joining war es möglich, die Zugehörigkeit der Psechriden zur Überfamilie der Lycosoidea festzustellen, was aktuelle morphologisch-kladistische Untersuchungen verschiedener Autoren bestätigte. Auch wenn die Beziehungen zwischen *Psechrus* und *Fecenia*, und somit auch die Bewertung der Monophylie der Psechriden, ungeklärt blieben, konnte doch bestätigt werden, dass Gattungen, die früher zu den Psechriden gerechnet wurden, tatsächlich nur entfernt mit ihnen verwandt sind, so wie es auch neuere morphologische Revisionen aufzeigten, wonach die jeweiligen Gattungen bereits in andere Familien transferiert wurden. Bei der Untersuchung der Verwandtschaftsverhältnisse innerhalb der Psechridae lag ein großes Augenmerk auf der artenreichen Gattung *Psechrus*. Hier konnten grundsätzlich die Artengruppen, so wie in Bayer (2012) aufgestellt, bestätigt werden. Dies zeigt, dass die Struktur der Kopulationsorgane, zumindest auf niedriger, taxonomischer Ebene, wie Artengruppen oder Gattungen, wichtige phylogenetische Information enthält. Auch die in den morphologischen Arbeiten (Bayer 2011, 2012) aufgestellten Arthypothesen für alle *Fecenia* sowie *Psechrus*-Arten konnten durch die molekularen Untersuchungen bestätigt werden, da Exemplare gleicher Art Monophyla bildeten und sich durch geringe, intraspezifische Sequenzdistanzen auszeichneten, zu anderen Arten aber deutlich größere Distanzen aufwiesen. Schließlich war es durch die Analyse der Barcoding-Region des COI-Gens möglich, auch morphologisch nicht oder nur bedingt einzuordnende juvenile Tiere zu bestimmen.

Damit stellt die vorliegende Dissertation eine Fallstudie dar, wie durch eine methodisch integrative Bearbeitung wichtige phylogenetische sowie taxonomische Erkenntnisse in einer Organismengruppe, in diesem Falle der Spinnenfamilie Psechridae, gewonnen werden konnten. Und zwar wurden in den morphologisch-taxonomischen Untersuchungen, basierend auf gründlicher Merkmalsanalyse, nicht nur diagnostische Merkmalsunterschiede der einzelnen Arten der beiden Gattungen *Psechrus* und *Fecenia* herausgearbeitet, sondern auch phylogentische Vorüberlegungen —diese Gattungen betreffend— angestellt. Diese sowie auch alle aufgestellten Arthypothesen konnten anschließend mit molekularen Methoden bestätigt werden.

5. ZUSAMMENFASSUNG

Die vorliegende, publikationsbasierte Dissertation, bestehend aus den drei Einzelpublikationen Bayer (2011, 2012) und Bayer und Schönhofer (2012), verfolgte das Ziel, die Spinnenfamilie Psechridae zu revidieren. Weiterhin sollten die phylogenetische Position dieser Familie im System der höheren Webspinnen (Araneomorphae) sowie die phylogenetischen Beziehungen der einzelnen Arten innerhalb der beiden Gattungen der Psechridae untersucht werden. In Form von morphologisch-taxonomischen Bearbeitungen wurden die beiden die Psechridae bildenden Gattungen *Psechrus* und *Fecenia* revidiert, wobei sämtliches Typus-Material sowie reichhaltiges, weiteres Material eingehend beschrieben, illustriert und diagnostiziert wurde. Hierbei wurden auch intraspezifische Variabilität sowie die Prä-Epigynen subadulter Weibchen, die in taxonomischen Arbeiten bislang nur eine unwesentliche Rolle gespielt haben, beschrieben, illustriert und taxonomisch ausgewertet. Zudem wurden im Rahmen dieser Untersuchungen bereits Überlegungen über mögliche Verwandtschaftsbeziehungen innerhalb der beiden Gattungen angestellt.

In der *Fecenia*-Revision (Bayer 2011) wurden so, neben der ausführlichen Behandlung bereits beschriebener Arten, zwei fehlerhafte Synonymien erkannt, wobei eine Art revalidiert wurde, zwei Arten synonymisiert und ein Bestimmungsschlüssel erstellt, in den zum ersten Mal in der arachnologischen Forschung Merkmale der Prä-Epigynen integriert wurden. Die Charakteristika der Prä-Epigynen wurden in dieser Arbeit explizit herausgestellt und die taxonomische Bedeutung der Prä-Epigynen erkannt.

In der Gattung *Psechrus* konnten insgesamt 23 neue Arten beschrieben werden: Bereits in Bayer und Jäger (2010) wurden *Psechrus ancoralis*, *P. antraeus* und *P. steineri* neu beschrieben; die folgenden Arten wurden in Bayer (2012) neu beschrieben: *P. ulcus*, *P. aluco*, *P. decollatus*, *P. elachys*, *P. norops*, *P. arcuatus*, *P. laos*, *P. inflatus*, *P. pakawini*, *P. demiror*, *P. jaegeri*, *P. vivax*, *P. obtectus*, *P. fuscai*, *P. clavis*, *P. hartmanni*, *P. zygon*, *P. tauricornis*, *P. crepido* und *P. schwendingeri*.

Weiterhin wurden, neben der ausführlichen Behandlung bereits beschriebener Arten, zwei Arten revalidiert, eine synonymisiert, die Prä-Epigynen als taxonomisch relevant erkannt, ein ausführlicher Bestimmungsschlüssel erstellt und *Psechrus* in 8 Artengruppen aufgeteilt (Bayer 2012) basierend auf charakteristischen Merkmalsmustern der Kopulationsorgane der jeweiligen Vertreter.

Eine molekulargenetisch-phylogenetische Arbeit, in welcher die Gene 28S rRNA und COI sequenziert und analysiert wurden, hatte zum Ziel, die phylogenetische Position der Psechridae im System der Araneomorphae, die Stellung einiger früher zu dieser Familie gerechneten Gattungen, die Phylogenie innerhalb der Psechriden aufzuklären sowie die in den morphologischen Arbeiten aufgestellten Arthypothesen zu überprüfen. Für die ersten drei Aspekte waren der 28S- sowie der kombinierte Sequenz-Datensatz aus 28S und COI von großer Wichtigkeit und wurden jeweils mit Bayesian Analysis sowie Maximum Likelihood ausgewertet. Für den letztgenannten Aspekt (Arthypothesen) wurde der COI-Datensatz mit Neighbor Joining-Verfahren ausgewertet (zusätzlich Bayesian Analysis).

Die Ergebnisse aus der molekularen Studie ergaben die Zugehörigkeit der beiden Monophyla *Psechrus* und *Fecenia* zu der Überfamilie der Lycosoidea und bestätigten somit vorangegangene morphologisch-kladistische Studien verschiedener Autoren. Die Monophylie der Psechriden konnte aufgrund unzureichender Auflösung innerhalb der Lycosoidea weder bestätigt noch eindeutig widerlegt werden. Um dies aufzuklären, wäre es notwendig weitere Taxa aus der Überfamilie der Lycosoidea sowie weitere Gene in die Analysen miteinzubeziehen. Die Gattungen *Stiphidion*, *Poaka*, *Tengella* und *Themacrys* erwiesen sich als nur entfernt mit den Psechriden verwandt, so dass ihr Ausschluss aus dieser Familie gerechtfertigt ist. In der Gattung *Psechrus* war die Auflösung der Verwandtschaftsverhältnisse der Artengruppen untereinander zwar nur in Ansätzen möglich, allerdings wurden Arten, die laut Bayer (2012) zu bestimmten Artengruppen zählen, auch in den entsprechenden Stammbäumen der molekularen Studie generell als Monophyla ausgewiesen. In *Fecenia* wurden die Arten *F. travancoria* und *F. protensa* als Schwestergruppe dem zweiten Unterzweig mit *F. cylindrata* und *F. ochracea* gegenübergestellt. Durch die Analyse der Barcoding-Region der COI-Sequenz konnten alle in Bayer (2011, 2012) aufgestellten Arthypothesen bestätigt werden, da die verschiedenen Individuen der einzelnen Arten jeweils gut unterstützte Monophyla bildeten. Es wurden auch einige juvenile Tiere, die morphologisch nicht zur Art bestimmbar gewesen wären, in die Analyse mit einbezogen, die sich dann ebenfalls in die entsprechenden „Art-Monophyla“ einreihten. Dies zeigte, dass eine Art-Bestimmung durch COI-Barcoding bei Psechriden möglich ist.

Diese Dissertation stellt somit nicht zuletzt eine Fallstudie dar, wie durch integrative methodische Bearbeitung —also der morphologisch-taxonomischen sowie der molekularen— der phylogenetische als auch der taxonomische Kenntnisstand einer Tiergruppe (in diesem Falle jener der Gattungen *Psechrus* und *Fecenia*) erheblich erweitert wurde. Sie bestätigt damit auch den Wert der Morphologie der Kopulationsorgane für taxonomische und phylogenetische Entscheidungen. Zumindest auf Gattungs- und Artgruppenebene sind die phylogenetischen Einschätzungen basierend auf Merkmalsmustern der Kopulationsorgane im Falle der Forschung an Spinnen legitim.

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Fachbereich 15 Biowissenschaften

der

Johann Wolfgang Goethe – Universität

Der Bewerber **Steffen Bayer** hat heute das Promotionsverfahren im Fach

Biologie (Zoologie)

mit der Gesamtnote

abgeschlossen.

Die einzelnen Prüfungsleistungen wurden wie folgt bewertet :

Dissertation: ………..

Disputation: ……..

Das Recht zur Führung des Doktortitels wird nicht durch diese Bescheinigung, sondern erst durch die Aushändigung der Urkunde erworben.

Frankfurt am Main, den ……………

Der Dekan

Lebenslauf

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Frankfurt am Main, den 18.09.2012

Steffen Bayer