Historical and recent investigations on the bee fauna of Taiwan (Hymenoptera, Apoidea)

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Abstract: The bee fauna of Taiwan was studied intensively in the first half of last century and was based in large parts on the extensive material collected by Hans Sauter between 1902 and 1914. Subsequent studies on bees of Taiwan have only been sporadic. Within a cooperation between the above mentioned institutions the bee fauna was reinvestigated. It was shown how insufficiently the bee fauna of Taiwan had been investigated so far, in particular, the higher mountain regions. Now about 150 species of bees, belonging to 32 different genera, are known from Taiwan, ten of which have been described or recognized as new for science by the recent cooperation.

Key words: Apidae, Andrenidae; Colletidae, Megachilidae, Colletidae, Halictidae, Taiwan, biogeography

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The island Taiwan (or Formosa), which is located on the tropic of cancer, is separated from mainland China by the Taiwan strait, which is about 140 km wide. Almost two thirds of its total area of 36000 km² are mountainous, reaching up to 3997 m above sea level (Mount Yushan), which is the highest mountain peak in East Asia east of the Himalayans. The central mountain range, with 62 mountains over 3000 m above sea level, forms the dominant geological structure of the island of about 350 km length in North-South extension. The climatic conditions of high mountain regions (over about 2000 m above sea level) are temperate, with snow in winter months, while in the lowlands of Taiwan the conditions are subtropical to tropical.

The bee fauna of Taiwan was studied intensively in the first half of last century (Cockerell 1911a, b, c, 1912, 1927; Friese 1911, 1914; Hedicke 1925; Strand 1913, 1914a, b) and was based in large parts on the extensive material collected by Hans Sauter during the years 1902 to 1914 (Chen 2002). Subsequent studies of bees of Taiwan have been sporadic (e.g. Shiokawa 1999, 2002; Starr 1992; Yasumatsu & Hirashima 1965).

Material and methods

During the course of three expeditions to Taiwan within a research cooperation between the Zoologische Staatssammlung München, Germany and the Department of Entomology of the National Chung Hsing University, (Taichung, Taiwan) in the years 2000-2002, the authors had the opportunity to collect bees at various sites on the island and to study the bee material housed in following local institutions and collections: National Chung Hsing University (ENTU), Taichung; National Museum of Natural Science (NMNS), Taichung; Taiwan Agricultural Research Institute (TARI), Wufeng.

Results and discussion

The results of these expeditions show how insufficiently the bee fauna of Taiwan had been investigated up to now (Dubitzky 2002, 2005, 2006; Dubitzky & Kuhlmann 2004; Dubitzky & al., 2006). In particular, the higher mountain regions were poorly collected by Sauter, partly because of traffic problems, but mainly because of the danger of local head hunting rituals still practised at that time. Recent expeditions to the

mountain regions therefore harvested valuable material and furnished interesting results, for example the first record of the genus *Colletes* on Taiwan (Dubitzky & Kuhlmann 2004). A key to the genera of the bees known from Taiwan was presented recently (Dubitzky & al. 2006).

To date about 150 species of bees, belonging to 32 different genera, are known from Taiwan (Tab. 1). While seven of these genera are mainly distributed in the Palearctic region, 11 of them are typical for the Oriental as well as for Palearctic region and 11 genera are primarily found in the Oriental region. The genera *Bathanthidium*, *Elaphropoda* and *Tetralonioidella* are restricted to the Oriental region.

Family	Genus	biogeographic region
Colletidae	*Colletes* Latreille (*C. taiwanensis* Dubitzky & Kuhlmann)	P
	Hylaeus Fabricius (3)	P
Andrenidae	*Andrena* Fabricius (6)	P
Halictidae	*Halictus* Latreille (*H. aerarius* Smith)	O/P
	Lasioglossum Curtis (25)	O/P
	Lipotriches Gerstaecker (2)	O
	Nomia Latreille (12)	O
	Nomioides Schenck (2)	P
	Patellapis Friese (*P. formosicola* Blüthgen)	O
	Sphecodes Latreille (3)	P
	Steganomus Ritsema (*S. taiwana* Hirashima)	O
Megachilidae	*Bathanthidium* Alfken (*B. bifoveolatum* (Alfken))	O*
	Coelioxys Latreille (6)	O/P
	Euaspis Gerstaecker (2)	O
	Heriades Spinola (*H. sauteri* Cockerell)	O/P
	Lithurgus Berthold (*L. collaris* Smith)	P
	Megachile Latreille (25)	O/P
	Trachusa Panzer (2)	O/P
Apidae	*Amegilla* Friese (6)	O/P
	Apis Linnaeus (2)	O
	Bombus Latreille (9)	O/P
	Braunsapis Michener (*B. marginata* (Smith))	O
	Ceratina Latreille (10)	O/P
	Ctenoplectra Kirby (2)	O
	Elaphropoda Lieftinck (*E. taiwanica* Wu)	O*
	Habropoda Smith (4)	O
	Nomada Scopoli (4)	P
	Tetralonia Spinola (3)	O/P
	Tetralonioidella Strand (3)	O*
	Thyreus Panzer (3)	O/P
	Trigona Jurine (*T. ventralis* Smith)	O
	Xylocopa Latreille (7)	O

Tab.1: Bee families and genera recorded on Taiwan with number of species given in parentheses or with name of species if only one species occurs in Taiwan. Genera are listed in alphabetically order which does not reflect the systematic position of the genera within each family. The main distribution of the genus (biogeographic region) is given in consideration of the Old World without Africa as follows: O: genus with predominantly Oriental distribution; O*: occurring in oriental region only; O/P: genus with Oriental and Palearctic distribution; P: genus with predominantly Palearctic distribution.

Ten species of bees have been described or recognized as new for science by the recent research cooperation. Concerning the genus *Andrena*, of which only one species was recorded for Taiwan, the total number of species increased up to six in the course of this study with four species being new to science (Dubitzky 2002, 2006). The nearest relatives of these new species are interestingly found in the Palearctic and not in the Oriental region. This is because the new species are predominantly inhabiting the higher regions of Taiwan, which are generally more similar to the Palearctic region than the lower, more tropical parts of the island. The great differences in altitude found on Taiwan also seem to be important for speciation processes within other bee genera as shown e. g. for *Habropoda* and *Tetralonioidella* (Dubitzky 2005).

Several species were described within the genus *Halictus*, but there is actually to date only one species known of this genus (s. l. as seen by Michener and Ebmer) from Taiwan, *Halictus (Seladonia) aerarius* Smith, 1873 which was described under the synonym *Halictus leucopogon* Strand (Ebmer 2006 and personal communication). Thanks to informations provided by Ebmer (pers. com.) the list of halictide genera recorded for Taiwan could be completed by the genus *Patellapis*, which is represented by the subgenus *Pachyhalictus* Cockerell on Taiwan. Unfortunately this genus was not included in the key of bee genera of Taiwan which has been presented recently (Dubitzky & al. 2006).

Although the fauna of Taiwan is mostly assigned to the Oriental region, the results of this investigation clearly support that the insects of the higher mountainous parts resemble more strongly the Eastern Palearctic region. It is suggested that additional species and genera will be found in further investigations, especially in the mountainous parts of the island.

Acknowledgement

This investigation was supported by DAAD and NSF (PPP Project D/0039914). Furthermore we thank to May-Ling Chan, National Museum of Natural Science, Taichung and Hsien-Tzung Shih, Taiwan Agricultural Research Institute, Council of Agriculture, Wufeng, Taichung, for good cooperation and the possibility to lend material. We also thank to A. W. Ebmer, Puchenau, Austria, for very helpful information and literature on Halictinae as well as for the information on the existence of the genus *Patellapis* on Taiwan.

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