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The Siricidae (Hymenoptera: Symphyta) of Florida

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The Siricidae (Hymenoptera: Symphyta) of Florida

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Abstract. The six species of Siricidae (Hymenoptera: Symphyta) occurring in Florida and one species of regulatory concern introduced to North America are reviewed. Included are diagnoses of *Eriotremex formosanus* (Matsumura), *Sirex areolatus* (Cresson), *Sirex nigricornis* Fabricius, *Tremex columba* (Linnaeus), *Urocerus cressoni* Norton, *Urocerus taxodii* (Ashmead) and *Sirex noctilio* (Fabricius). A key to species, photographs of morphological features, biological notes and distribution data are provided. For the species *T. columba*, *S. nigricornis*, *U. taxodii*, and *U. cressoni*, a total of eight new state records are presented.

Introduction

Florida's forest industry contributes \$16.6 billion to the state's economy annually and encompasses almost 16 million acres (Florida Forestry Association 2008). Florida's forests are unique and are home to plants and animals found nowhere else in the world. Not only do the public forests of Florida provide habitat for its many endemic animal and plant species, but with a relatively mild climate state and national forests are a major draw for campers year round.

Florida is also a major trade hub and receives material from all over the world. The State of Florida has 12 international airports and 14 deep water maritime ports. Therefore, Florida is a high-risk state for the introduction and establishment of exotic wood-boring insects. Early detection of invasive wood-boring insects is critical to successful implementation of response actions. Recent discoveries of established populations of *Sirex noctilio* Fabricius in New York, Pennsylvania, Michigan, Vermont, Ontario and Quebec, and the subsequent damage caused by this pest underscores the importance of this type of survey (Dodds et al. 2010).

To this end, the Florida Department of Agriculture and Consumer Services (FDACS), Division of Plant Industry's (DPI) Cooperative Agricultural Pest Survey (CAPS) program, began surveying for *S. noctilio* in 2006. It quickly became apparent that there was a need for a diagnostic treatment of the family Siricidae in Florida.

The family Siricidae, commonly referred to as woodwasps or horntails, consists of 10 extant genera and 122 species worldwide (Schiff et al. 2012; Smith and Schiff 2002; Morgan 1968; Benson 1950). Of the 10 known genera Florida has four (representing six species): *Eriotremex* Benson, *Sirex* Linnaeus, *Tremex* Jurine and *Urocerus* Geoffroy. This family largely occurs in the Northern Hemisphere, rarely being found south of the Tropic of Cancer, the exceptions being two species of Afrotropical distribution (Smith and Schiff 2002) and the Palearctic *Sirex noctilio* is invasive in Australia, New Zealand, South Africa, and South America (Morgan 1968). Even with this wide geographic range relatively little is known about their habits and taxonomy.

This family is distinguished by its fairly large size (usually >20 mm) and the cylindrical body of the adults. Long filiform antennae with 14 to 30 segments are another diagnostic feature. The most striking diagnostic feature is the large hornlike projection, called the cornus, on the last abdominal segment of the females. Males are generally smaller and the last segment of their abdomen has a smaller pointed

projection. The larvae are cylindrical, cream-colored, have no prolegs, vestigial thoracic legs and a spine at the end of the abdomen.

The Siricidae are wood-boring insects with larvae that feed on the cambium of trees. Angiosperms seem to be the preferred host plants of the subfamily Tremicinae while the subfamily Siricinae prefers gymnosperms. A female woodwasp inserts a symbiotic wood-decaying fungus into a plant along with the egg. Upon eclosion, the larval woodwasp feeds on the hyphae of the fungus as it is unable to digest cellulose (Buchner 1965; Gilbertson 1984). While some woodwasps are polyphagous, most are highly specialized to a specific plant and often to a certain part of that plant (Benson 1950). Larvae will feed within the host plant for one or more years before emerging as adults.

In most species, the adult females seek out weak or dying trees for oviposition sites. However, *S. noctilio* will readily attack stressed trees in healthy pine stands inserting a toxic mucus along with a wood-decaying fungus (*Amylostereum* sp.) during oviposition which will kill the tree (Haugen and Hoebeke 2005). While Middlekauff (1960) reported that larvae of *S. noctilio* bore into these trees and take several years to complete their life cycle, Zylstra et al. (2010) reported the life cycle as typically one year, sometimes taking longer to develop. Dodds (personal communication) reported that a portion of the population emerges in one year while the rest remain in the tree until the next year. Most noteworthy of Florida's fauna is that adult flight activity tends to occur over more of the year than indicated in Schiff et al. (2012), likely due to warmer winters.

Because these organisms take so long to emerge from wood they are often transported by commerce over large distances. This has certainly been the case with *S. noctilio*. *Sirex noctilio*, a native of Eurasia and North Africa, is adventive in Australia where it quickly became a pest of the Monterey pine (*Pinus radiata* D. Don) plantations in the eastern portions of the country causing millions of dollars' worth of damage. This pest has been known to cause as much as 80% mortality in these exotic pine plantations (Haugen and Hoebeke 2005). *Sirex noctilio* was first trapped in North America on 7 September 2004, in Fulton, New York, in a CAPS EBB trap, and was found infesting trees in Spring 2005 (Dodds and de Groot 2012). Later, *S. noctilio* was detected in Ontario (2005), Pennsylvania (2006), Michigan (2007), Vermont (2007), Quebec (2008) and Ohio (2009) (Dodds and de Groot 2012). Populations have become established in each of these regions except for Ohio (Dodds et al. 2010). Because *S. noctilio* has economic importance and may spread farther south, we include it in the key to the Siricidae of Florida. With the threat of new introductions and the continued spread of *S. noctilio*, it is imperative that a clear and concise form of identification be devised. More thorough taxonomic treatment of the family and natural history overview are presented in Schiff et al. (2012), in which all New World taxa are revised.

The objectives of this study are to **1)** develop a taxonomic key for the identification of the Siricidae of Florida and **2)** provide a brief description of each Floridian species.

Materials and Methods

For this study, 447 specimens belonging to the genera *Eriotremex*, *Sirex*, *Tremex* and *Urocercus* were examined. Specimens examined and other records were from the Florida State Collection of Arthropods (FSCA), FDACS-DPI, Gainesville, FL; John L. Foltz Collection (JLFC), Gainesville, FL; University of Central Florida Collection (UCFC), Orlando, FL; and the Florida Cooperative Agricultural Pest Survey (CAPS), Gainesville, FL. Specimen records presented were copied from label data. Specimens from JLFC and CAPS will be donated to the FSCA. Not all data from CAPS are represented by voucher specimens, but are all recorded in the Solid Wood Packing Material database (SWPM). Some data included abbreviations of localities which could not be deciphered. Such data was presented as it was written. Host records should be considered plant associations only because authors often list hosts as plants on which the insect was collected but not necessarily feeding.

All images were photographed by Natasha Wright (FDACS-DPI) using the Syncroscopy AutoMontage® system attached to a Leica Z16 APO microscope located at the Division of Plant Industry in Gainesville, Florida. Images were then edited using PhotoShop®. All specimens photographed were from the FSCA except for those of *S. noctilio*, which were on loan from David Smith (United States National Museum of Natural History, Smithsonian Institute, Washington, D.C.).

Key to the Adult Siricidae of Florida

Below is a dichotomous key to the known Siricidae of Florida and *S. noctilio*. The only North American genus not represented in the key is *Xeris*, which is distinguished by having only one apical metatibial spur and at least 22 antennal segments. Specimens of *S. behrensii* (Cresson 1880) emerged from imported wood in Florida (Smith and Schiff 2002). However, this species is not considered to be among the Florida fauna since the authors are not aware of any natural collection records. For specimens collected outside of Florida, refer to the revision of the New World Siricidae by Schiff et al. (2012).

1. **Both sexes** with two apical metatibial spurs (Fig. 1); antennae with 18 or more segments, often exceeding 22 segments **2**
 - **Both sexes** with only one apical metatibial spur (Fig. 2); antennae with fewer than 22 segments **3**
- 2(1). **Both sexes** often with a large white spot behind each eye (Fig. 3); **female** cornus long and slender, basally constricted (Fig. 4); forewing with crossvein Cu_1 absent (Fig. 30, 31); **male** metatarsus slender, with the 1st segment at least 4 times as long as it is broad, commonly up to 5-6 times longer, and 2nd and 3rd segments at least 2 times as long as they are broad **4 (*Urocerus*)**
 - **Both sexes** with head entirely black (Fig. 5); **female** cornus short and triangular (Fig. 6), without a basal constriction (except slightly in *S. longicauda*); forewing with at least basal half of Cu_1 present (Fig. 16, 19, 24); **male** metatarsus stout and laterally flattened, with the 1st segment no more than 4 times as long as it is broad, and 2nd and 3rd segments triangular and as long or longer than broad (Fig. 20, 26) **7 (*Sirex*)**



Figures 1-6. 1) Apical metatibial spur, female *Sirex noctilio*. 2) Apical metatibial spur, male *Tremex columba*. 3) Head of female *Urocerus taxodii*. 4) Cornus of female *U. cressoni*. 5) Head of female *S. areolatus*. 6) Cornus of female *S. areolatus*.

- 3(1). **Both sexes** with antennae having 14-15 segments; body without long golden hairs (Fig. 10-13) *Tremex columba* (Linnaeus)
 — **Both sexes** with antennae having 20-21 segments; body with long golden hairs (Fig. 7-9) *Eriotremex formosanus* (Matsumura)
- 4(2). Ovipositor and cornus present (Fig. 4, 6) (**female**) 5
 — Ovipositor and cornus absent (Fig. 10, 20, 25) (**male**) 6
- 5(4). Abdomen mostly reddish-orange, sometimes with basal and/or apical segments blackish (Fig. 28-30) *Urocerus cressoni* Norton
 — Abdomen black, but cornus orangish (Fig. 31-32) *Urocerus taxodii* (Ashmead)
- 6(4). Legs entirely black *Urocerus cressoni* Norton
 — Meso- and metatibiae and tarsi dark orange, basal third of metatibia and basal half of metabasitarsus white *Urocerus taxodii* (Ashmead)
- 7(2). Ovipositor and cornus present (Fig. 4, 6) (**female**) 8
 — Ovipositor and cornus absent (Fig. 10, 20, 25) (**male**) 10
- 8(7). Ovipositor longer than width of forewing (Fig. 14-16) *Sirex areolatus* (Cresson)
 — Ovipositor shorter than width of forewing 9
- 9(8). Abdomen mostly red, but sometimes basally infuscated or black (Fig. 17-19) *Sirex nigricornis* (Fabricius)
 — Abdomen entirely black or bluish-black (Fig. 22-24) *Sirex noctilio* (Fabricius)
- 10(8). Abdomen red, with only basal 1 or 2 segments black (Fig. 20-21) *Sirex nigricornis* (Fabricius)
 — Abdomen black at both base and apex, black at apex may only be on dorsum or venter of apical segment 11
- 11(10). Legs entirely black; wings hyaline *Sirex areolatus* (Cresson)
 — Legs mostly to entirely reddish-brown to yellow; wings not significantly infuscated or hyaline (Fig. 25-27) *Sirex noctilio* (Fabricius)

***Eriotremex formosanus* (Matsumura), 1912**

(Fig. 7-9)

Diagnosis. Males and females have 20-21 black antennal segments (sometimes paler at the base and apex), two-segmented labial palpi, and the metatibiae with only one apical spur. The abdomen in males is black with yellow markings on most segments in a pattern resembling two stripes running the length of much of the abdomen. The abdomens of females have black segments, some of which have yellow bands. The anterior thorax is black in males and yellow in females. They differ from *Tremex columba* by having more antennomeres and the body clothed with long golden hairs.

Previously, Stange (1996) stated that no males of this species have ever been collected. However, males are now known.

Biology. The known hosts for *E. formosanus* include *Quercus nigra* Linnaeus, *Quercus phellos* Linnaeus, *Quercus alba* Linnaeus (Fagaceae), and hickory (Juglandaceae: *Carya*). They have also emerged from firewood of *Liquidambar styraciflua* Linnaeus (Hamamelidaceae), hickory and *Quercus nigra*. Other collection records include *Quercus laurifolia* Michaux, *L. styraciflua*, *Pinus palustris* Miller, *Pinus taeda* Linnaeus, and ovipositing in *Pinus elliottii* Engelm (Pinaceae) (Stange 1996; Smith and Schiff 2002). They are frequently observed ovipositing on pine (Schiff et al. 2006).



Figures 7-13. 7-9) *Eriotremex formosanus* female. 7) Dorsal habitus. 8) Wings. 9) Lateral habitus. 10-13) *Tremex columba*. 10) Dorsal habitus, male. 11) Lateral habitus, male. 12) Lateral habitus, female. 13) Wings, female.

Adults have been collected during all months of the year (Smith and Schiff 2002). Some specimens were collected at UV light. According to Smith (1996) this is the most common species in Florida. All FSCA specimens are female.

Distribution. This species is adventive in the southeastern United States and probably arrived as a contaminant from Southeast Asia (Japan, Laos, Taiwan, and Vietnam) in the 1970s (Smith and Schiff 2002). In North America it occupies Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Utah and Virginia (Stange 1996; Smith and Schiff 2002; Schiff et al. 2006, 2012). In Florida it has been collected in Alachua, Baker, Bradford, Calhoun, Clay, Columbia, Dixie, Gulf, Hernando, Hillsborough, Lee, Leon, Liberty, Marion, Nassau, Okaloosa, Polk, Saint Lucie, Taylor and Union Counties (Stange 1996 *in part*).

Specimens. USA: Alabama: Macon County: 1.5 miles east of CR 13, 26-V-1985, R.D. Cave (FSCA; 1); **Florida:** Alachua County: Gainesville, in firewood, 19-V-1983, O. Hawkins (FSCA; 5 pre-emergent in vial with alcohol, 2 larvae in vial with alcohol); Gainesville, in swimming pool, 3-V-1976, R.P. Esser (JLFC; 1); Gainesville, on laurel oak, 1-V-1980, 3-V-1980, 15-V-1980, 21-V-1980, 29-V-1983, L.A. Hetrick (FSCA; 6); Gainesville, on pine, 11-XI-1987, H. Denmark (FSCA; 1); Gainesville, 4-VII-1986, 22-IX-1991, L.R. Davis, Jr. (FSCA; 2); Gainesville, 19-IX-1978, H.A. Denmark (FSCA; 1); Gainesville, 18-IV-1982, L.A. Hetrick (FSCA; 1); Gainesville, 10-IX-1990, P.J. Landolt (FSCA; 2); Gainesville, 20-X-1996, L.A. Stange (FSCA; 1); Gainesville, 19-V-1983, O. Hawkins (FSCA; 1); Gainesville Airport, 27-VI-1987, P.E. Skelley (FSCA; 1); Gainesville, Beville Heights, blacklight trap, 8-XII-1979, L.A. Stange (FSCA; 5); Gainesville, Doyle Conner Building, blacklight trap, 2-XI-1975 (FSCA; 1); Gainesville, NW 54th Terrace, 15-VIII-1996, L.A. Stange (FSCA; 1); SE Gainesville, 1 mile north of Payne's Prairie on Kincaid Road, malaise trap, 28-IV-1998, 4-V-1998, 11-V-1998, B.D. Sutton (FSCA; 3); University of Florida, Gainesville, VI-1980, M.S. Fontaine (JLFC; 2); ex. *Liquidambar styraciflua* L., 19-V-1983, O. Hawkins (FSCA; 12); Baker County: Columbia County line, Osceola National Forest, malaise trap, 17-V-1977, J.R. Wiley (FSCA; 1); Bradford County: SR 100, 8 km west of Starke, window trap in crown layer of a disturbed pondcypress hammock, 23-30-VI-1980, A. Wilkening (JLFC; 1); Calhoun County: Neil Lumber Company, on longleaf pine, 12-IX-1974, G.D. Hertel (FSCA; 1); Clay County: Goldhead Branch State Park, 4-V-1995, C. Porter & L. Stange (FSCA; 1); Orange Park, 17-IX-1977, A. Semago (FSCA; 1); Columbia County: Osceola National Forest, Route 90, malaise trap, 20-X-1976, J.R. Wiley (FSCA; 1); Dixie County: 3 miles north of Old Town, 10-V-1979, P.M. Choate, Jr. (FSCA; 11); 3 miles North of Old Town, 10-V-1979, L.A. Stange (FSCA; 16); 3.5 miles north of Old Town on Route 349, 17-V-1978, P.M. Choate, Jr. (FSCA; 3); 3.8 miles north of Old Town, 20-V-1978, H. Greenbaum (FSCA; 23); Old Town, 20-V-1978, G.B. Edwards (FSCA; 3); Old Town, 29-IV-1989, C.W. Mills, III (FSCA; 1); 5-VIII-1977, (FSCA; 1); 5-VIII-1977 (FSCA; 1); Gulf County: Wewahitchka, 8-V-1987, L. Stange & J. Wiley (FSCA; 1); Hernando County: Brooksville, 17-V-1978, D.P. Hertel (FSCA; 4); Chinsegut Hill, 12-V-1978, 19-V-1978, J.V. Miller (FSCA; 33); Hillsborough County: Tampa, USF Campus, 20-VI-1980, 10-V-1979, 13-V-1979, L. Brown (FSCA; 3); Tampa, USF Campus, III-1977 (FSCA; 2); Lee County: Buckingham, V-1984, Dieter & Radtke (FSCA; 1); Leon County: Tallahassee, 28-VI-2002, C.W. O'Brien (FSCA; 1); Liberty County: Torreya State Park, 21-IX-1978, H.V. Weems, Jr. (FSCA; 1); Torreya State Park, 20-VIII-1987, C. Porter & L. Stange (FSCA; 1); Torreya State Park, 13-VI-1974, Q. Anglin (FSCA; 1); Torreya State Park, 28-V-1988, R. Gillmore (FSCA; 1); Marion County: Citra, NW 24th Avenue, on dead oak, 1-IX-1993, 26-IX-1993, F.W. Skillman, Jr. (FSCA; 2); on *Pinus taeda*, 25-VIII-1977, E.E. Banks (FSCA; 1); Nassau County: Fort Clinch State Park, 29-X-1983, C. Porter & L. Stange (FSCA; 1); Okaloosa County: Blackwater River State Forest, Lee Canoes, 22-IX-1987, L. Stange & J. Wiley (FSCA; 1); Orange County: Orlando, UCF Campus, long leaf and sand pine-turkey oak habitat, Malaise Trap, 31-V-1996, 30-VIII-1996, 2-X-1997, S. M. Fullerton (UCFC; 3); Walt Disney World, 18-I-1996, D. Hanf (UCFC; 1); Orlando, 22-X-2000, T. McIlleath (UCFC; 1); Lake Buena Vista, Ready Creek, floodplain swamp, on rotten log, 12-VII-1995, D. Hanf (UCFC; 1); Polk County: Haines City, on pine, 7-XI-1979, H. Gillis & V.G. Brown (FSCA; 1); Saint Lucie County: Fort Pierce, 8-X-1978, Campbell (FSCA; 1); Union County: Highway 241 at the Santa Fe River, 23-IV-1989, 8-V-1985, C.W. Mills, III (FSCA; 3); **Louisiana:** Saint Tammany Parish County: St. Tammany Parish, 4.2 miles northeast of Abita Springs, 16-IX-2003, V.A. Brou (FSCA; 1); **North Carolina:** Carteret County: 13-VI-1990 (FSCA; 1); **South Carolina:** Pickens County: 7 miles northeast of Pickens, 21-VIII-1986, 10-IX-1985, 11-XI-1986, 17-IX-1985, 17-XI-1986, 20-XI-1986, 20-XI-1991, H.L. Dozier (FSCA; 12); **[probably Florida]** ex. oak, 6-VIII-1996, Slumsky (JLFC; 1).

***Tremex columba* (Linnaeus), 1763**

(Fig. 10-13)

Diagnosis. Males and females have antennae with 14-15 brown segments (often paler basally and apically), two-segmented labial palpi, metatibia with only one apical spur, and wings with crossveins C_1 and 2 RM absent and cell 2A of forewing with base of 3A present. Females typically have yellow-banded abdominal segments and yellow heads. It is distinguished from *Eriotremex formosanus* by the lack of long golden hairs clothing the body and having significantly fewer antennomeres.

Bradley (1913) offered a key to the races of *T. columba*.

Natural history. The known hosts of *T. columba* include *Acer saccharum* Marsh. (Aceraceae), *Ulmus* spp. (Ulmaceae), *Quercus* spp., *Fagus grandifolia* Ehrh. (Fagaceae), *Carya* spp. (Juglandaceae), *Celtis laevigata* Willd. (Celtidaceae), *Carpinus* sp. (Betulaceae), apple, beech, birch, box elder, hackberry, maple, pear, poplar and sycamore (Middlekauff 1960; Smith and Schiff 2002; Schiff et al. 2006).

Tremex columba is known to harbor the fungal symbiont *Cerrena (Daedalea) unicolor* Bull. ex Fries which is associated with every stage of female development (Smith and Schiff 2002). *Ibalia maculipennis* Haldeman, *Ibalia anceps* Say (Hymenoptera: Ibalidae), *Megarhyssa atrata* (Fabricius), *Megarhyssa greenei* Viereck and *Megarhyssa macrurus macrurus* (Linnaeus) (Hymenoptera: Ichneumonidae) have been recorded as parasites of this species (Middlekauff 1960; Smith and Schiff 2002).

Adults have been collected from February to November. One FSCA specimen label read "ex. orange tree." Another was collected from a frontal and turpentine-baited Lindgren funnel trap. Several specimens were collected at UV lights.

Distribution. Alabama, Arkansas, California, Colorado, Connecticut, Delaware (**new state record**), District of Columbia, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma (**new state record**), Pennsylvania, Rhode Island, South Carolina (**new state record**), Tennessee, Texas, Utah, Vermont, Virginia, West Virginia, Wisconsin, Wyoming, Canada and Mexico (Bradley 1913; Middlekauff 1960; Stange 1996; Smith and Schiff 2002; Schiff et al. 2006, 2012). Specimens have also been collected from elm timber in New Zealand (Morgan 1968). In Florida specimens have been collected in Alachua, Leon, Marion, Miami-Dade, Orange and Pinellas Counties.

Specimens. USA: Colorado: Denver County: Denver, 19-VIII-1969 (FSCA; 1); Jefferson County: south end of Route 121, Martin Marietta Plant, 16-IX-1992, L.R. Davis, Jr. (FSCA; 18); **Delaware:** Kent County: Woodland Beach, 3-VIII-1972, J.T. Hance (FSCA; 1); **Florida:** Alachua County: 1 mile southeast of I-75, on FL 23-A, 18-V-1972, T. Neal (FSCA; 1); 2 miles north of Gainesville, ramp trap, 12-VI-1975, H. Davis (FSCA; 1); Foltz's backyard, frontal/turpentine Lindgren funnel trap, 8-XI-1999, J.L. Foltz (JLFC; 1); Gainesville, 18-X-1964, 10-XI-1964, G. Rankin (FSCA; 4); Gainesville, 9-XI-1975, D.M. LaBella (FSCA; 1); Gainesville, 9-V-1981, T. Wolfe (JLFC; 1); Gainesville, Doyle Conner Building, blacklight trap, 2-XI-1975, F.W. Mead (FSCA; 1); Gainesville, University of Florida, Natural Area Teaching Lab, Surge/Natural Area Drive, 1-XI-1995, J.L. Foltz (JLFC; 1); Leon County: Tallahassee, blacklight trap, 22-X-1975, E. Curlee (FSCA; 1); Marion County: Citra, ex. Orange tree, 22-XI-1946, J.C. Bell (FSCA; 1); Miami-Dade County: Miami, University of Miami, 26-IX-1978 (FSCA; 1); Orange County: Walt Disney World, CDC Trap/CO₂ gas, 16-II-1996, Z. Prusak (FSCA; 1); Pinellas County: Dunedin, 12-V-1985, L.C. Dow (FSCA; 1); Saint Petersburg, 25-VI-1995, C. Smith (JLFC; 1); [county unknown] Florida Agricultural Exp. Station, 25-IV-1928, A.N. Tissot (FSCA; 1); **Georgia:** Fulton County: Atlanta, 2-VIII-1947, 22-VIII-1947, F.W. Fattig (FSCA; 2); **Illinois:** Champaign County: Urbana (FSCA; 1); **Indiana:** Brown County: north of Belmont, blacklight trap, 18-VIII-1984, C.W. Hagen, Jr. (FSCA; 1); north of Belmont, blacklight trap, 28-VIII-1984, C.W. Hagen, Jr. (FSCA; 1); Knox County: Vincennes, 24-VII-1978, M. Minno (FSCA; 1); Monroe County: Bloomington, 22-X-1974, J. Crider (FSCA; 1); [county unknown] Ames, 23-IX-1891, (FSCA; 1); **Kansas:** Atchison County: Atchison, 15-X-1957, J.W. McReynolds (FSCA; 1); Douglas County: 3/4 miles west of Lawrence, 15-IX-1963, H.L. Willis (FSCA; 1); Douglas County: near Lawrence, 30-IX-1966, an entomology class (FSCA; 1); Riley Pottawatomie County: Manhattan, X-1954, V.E. Adler (FSCA;

1); **Kentucky**: Lyon County: Golden Pond, VII-1964, M.A. Tidwell (FSCA; 1); **Louisiana**: West Feliciana Parish: 2 miles northeast of Tunica, 1-XI-1964, G.N. Ross (FSCA; 1); **Maine**: Penobscot County: Orono, 25-VI-1965, P.V. Perkins (FSCA; 1); **Maryland**: Anne Arundel County: Edgewater, blacklight, 16-IX-1991, C.L. Staines (FSCA; 1); **Missouri**: Blanco County: Columbia, 27-IX-1966, S. Poe (FSCA; 2); Columbia, 18-VII-1966, J.C. Peters (FSCA; 1); Jackson County: Independence, 1969, R.L. Heitzman (FSCA; 1); Wayne County: Sam A. Baker State Park, Ozark Plateau Flora, 26-VI-1986, H.M. Webber (FSCA; 1); **New Jersey**: Bergen County: Ramsey, 7-VIII-1936, E.J. Gerberg (FSCA; 1); Middlesex County: New Brunswick, Malaise Trap, 29-IX-1953, W. E. Collins (UCFC; 1); Metuchen, Brother' Pond, 9-VII-1961, C.C. Porter (FSCA; 1); **New York**: Albany County: Albany, 26-VI-1941, E.J. Gerberg (FSCA; 1); **North Carolina**: Swain County: Great Smoky Mountains National Park, old field, 4-VII-2004, G. Steck, B. Sutton & Super (UCFC; 2); Wake County: Falls, 1-XI-1971, M.A. Tidwell (FSCA; 1); **Ohio**: Butler County: Oxford, Main Street, 26-XI-1979, K. Manley (FSCA; 1); Champaign County: Westville, on *Celtis occidentalis* L., 6-VII-1962, R.E. Woodruff (FSCA; 1); Coshocton County: Cavallo, 10-VIII-1942 (FSCA; 1); Fairfield County: 1-X-1950, H.V. Weems, Jr. (FSCA; 1); Franklin County: Columbus, VII-1951, 26-VIII-1952, 9-IX-1952, F.W. Mead (FSCA; 5); 18-X-1950, H.V. Weems, Jr. (FSCA; 1); Knox County: 1-X-1942, H.F. Stohecker (FSCA; 1); **Oklahoma**: Latimer County: 5 miles west of Red Oak, 28-V-1977, 4-VI-1977, K. Stephan (FSCA; 2); VII-1987, X-1985, X-1988, XI-1982, XI-1987, K. Stephan (FSCA; 9); **Pennsylvania**: Berks County: Douglasville, 8-VII-1983, F.W. Skillman, Jr. (FSCA; 1); Delaware County: Wallingford, 13-VII-1962, F.W. Skillman, Jr. (FSCA; 1); Fulton County: 2 miles north of Cowan's Gap State Park, 11-VII-1988, E. Giesbert (FSCA; 1); **South Carolina**: Chas'n. Hts., 13-X-1970, D.R. Estes (FSCA; 1); **Tennessee**: Benton County: 13-VII-1950, T.J. Walker, Jr. (FSCA; 1); Blount County: Great Smoky Mountains National Park, Cades Cove, old field, gallery forest edge, Malaise Trap, 28-VIII-2003, G. Steck and B. Sutton (UCFC; 1); **Texas**: Blanco County: Johnson City, 20-V-1970, G.N. Ross (FSCA; 1); Crosby County: White River Lake, 1-X-1990, J. Huether (FSCA; 1); Lubbock County: Lubbock, on oak tree, X-1986, J.C. Cokendolpher (FSCA; 1); Uvalde County: Garner State Park, 18-VI-1968, G.H. Nelson (FSCA; 1); **Wisconsin**: Grant County: Platteville, 5-X-1970 (FSCA; 1).

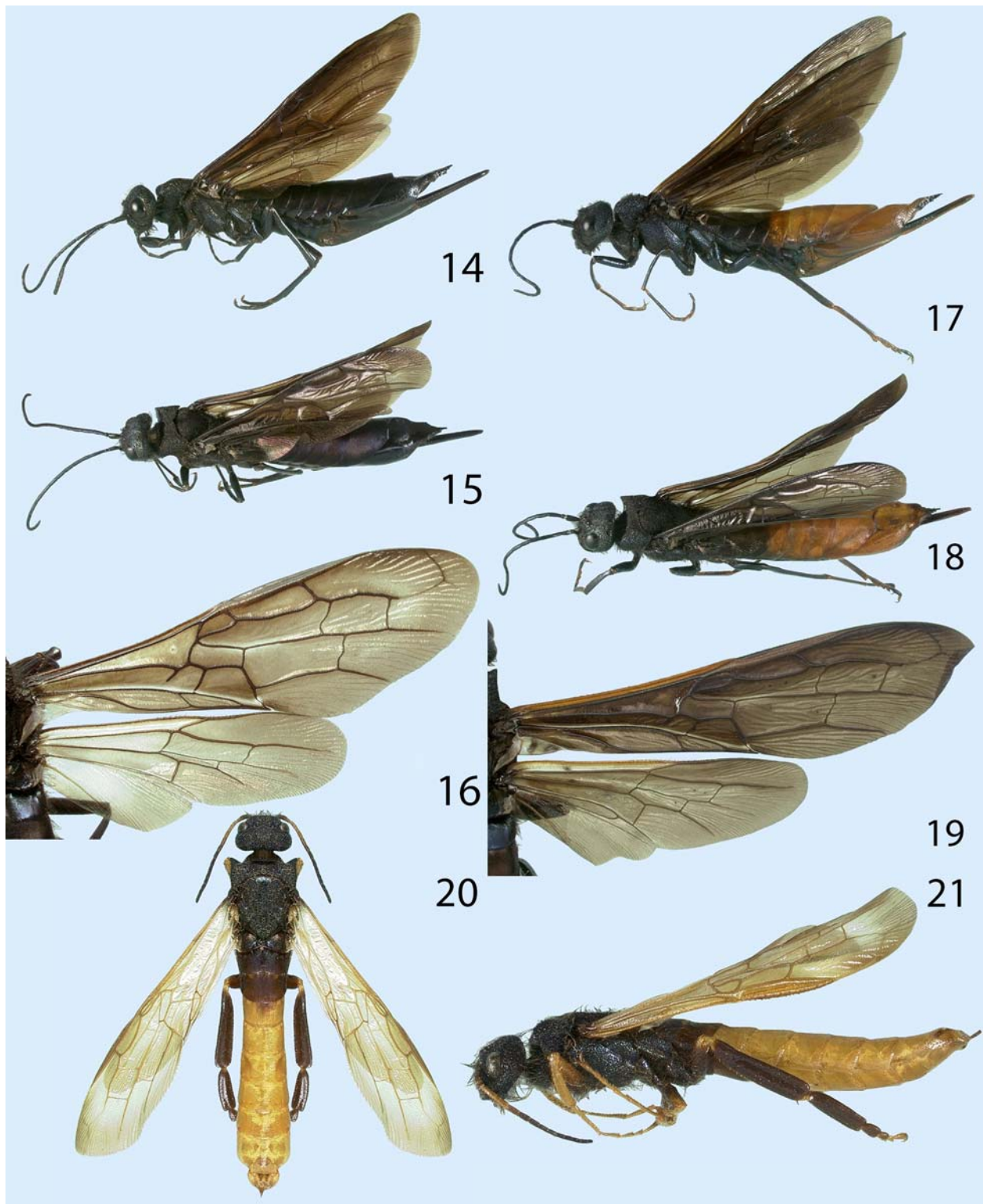
***Sirex areolatus* (Cresson), 1867**, the Western horntail (Middlekauff 1960)
(Fig. 14-16)

Diagnosis. Females of *S. areolatus* have a bluish-black body and legs and an ovipositor which is longer than the forewing. The length of the ovipositor distinguishes it from other Florida species and all other North American *Sirex* except for *Sirex longicauda* Middlekauff, which differs by having a slightly basally constricted cornus, red tibiae and tarsi, and a longer ovipositor. The males have entirely bluish-black legs, clear-hyaline wings with a black stigma, and abdominal segments II-VII orange (basal and apical segments bluish-black). The black on the abdominal apex may be restricted to the dorsal or ventral abdomen. Males of *S. nigricornis*, *S. behrensii* (Cresson), and *S. cyaneus* Fabricius have only the basal most abdominal segments black and have reddish or red and black legs. Males of *S. edwardsii* Brulle, *S. longicauda*, *S. varipes* Walker, *S. juvencus* (Linnaeus), and *S. noctilio* have similar abdominal coloration, but their legs have variable red coloration. Bradley (1913) differentiated the races of *S. areolatus*.

Natural history. The known hosts of *S. areolatus* include *Libocedrus decurrens* (Torr.) Florin, *Juniperus occidentalis* Hook., *Juniperus scopulorum* Sarg., *Thuja* sp., *Cupressus macrocarpa* (Hartw.) (Cupressaceae), *Pinus contorta* Dougl., *Pinus jeffreyi* (Murray), *Pinus lambertiana* Dougl., *Pinus radiata* Don, *Pseudotsuga taxifolia* Britton, *Pseudotsuga menziesii* (Mirbel) Franco (Pinaceae), *Taxodium distichum* (Linnaeus) Rich., and *Sequoia sempervirens* (Lamb. ex D. Don) Endl. (Taxodiaceae) (Middlekauff 1960; Stange 1996; Smith and Schiff 2002). Smith and Schiff (2002) suggested that it may have established itself in the eastern states in baldcypress.

Ibalia ensiger Norton (Hymenoptera: Ibalidae) has been reared from *S. areolatus* (Middlekauff 1960).

Adults of *S. areolatus* have been collected in the wild (i.e., not reared) from June to December in Florida. All but two of the Florida specimens were collected in Lindgren funnel traps baited with alpha-beta pinene, ethanol, or frontalol and turpentine. The other two emerged from the walls of residences,



Figures 14-21. 14-16) *Sirex areolatus* female. 14) Lateral habitus. 15) Dorsolateral habitus. 16) Wings. 17-19) *Sirex nigricornis* female. 17) Lateral habitus. 18) Dorsolateral habitus. 19) Wings. 20-21) *Sirex nigricornis* male. 20) Dorsal habitus. 21) Lateral habitus.

one of which was collected after it emerged through a plastered wall from fir lumber. Discussing these specimens, Smith and Schiff (2002) described *S. areolatus* as adventive in the eastern United States.

Distribution. Alabama, Arizona, Arkansas, California, Colorado, Florida, Hawaii, Idaho, New Mexico, Oregon, Utah, Virginia, Washington, Canada, Honduras and Europe (Bradley 1913; Middlekauff 1960; Morgan 1968; Stange 1996; Smith and Schiff 2002; Schiff et al. 2006, 2012). A specimen from Kauai, Hawaii was collected after it emerged from a “cedar wall” (Smith and Schiff 2002). In Florida specimens have been collected in Alachua, Collier, Duval, Leon, Orange and Santa Rosa Counties. Schiff et al. (2012) indicated that two Florida records are outside the normal distribution and are adventives. However, our presented data (*below*) indicate that, while perhaps new to Florida as of the last half century, it is not limited to incidental interceptions.

Previously, Stange (1996) had recorded *S. areolatus* from Florida based on a single emergence record from imported wood in Collier County in 1963. Today, *S. areolatus* is established in Florida (based on numerous natural collections during the SWPM, CAPS, and JLFC surveys).

Specimens. USA: California: El Dorado County: 3 miles southwest of Somerset, VII-1978, R.R. Wharton (FSCA; 1); Ice House Rd, 3 miles north of Riverton, on pine, 22-X-1965, C.W. O’Brien (FSCA; 4); Los Angeles County: Azusa, 17-VII-1950, D.R. Estes (FSCA; 1); Palos Verdes, 27-IX-1963, D.R. Estes (FSCA; 1); **Florida:** Alachua County: Foltz’s backyard, frontalinalin/turpentine Lindgren funnel trap, 22-XI-1999, J.L. Foltz (JLFC; 1); Gainesville, frontalinalin/turpentine Lindgren funnel trap, 17-XI-1994, J.L. Foltz & L. Pirozzoli (JLFC; 3); Gainesville, University of Florida, Natural Area Teaching Lab, Surge/Natural Area Drive, frontalinalin/turpentine Lindgren funnel trap, 9-X-1997, D. Yow (JLFC; 1); Collier County: Naples, emerged from plastered wall over fir from western US, IV-1962, H.V. Weems, Jr. (FSCA; 1); Duval County: Jacksonville, east of New Berlin Road, alpha-beta pinene-baited Lindgren funnel trap, 20-XII-2006, A. Silagyi (CAPS; 5); Jacksonville, on Dames Point Drive, alpha-beta pinene-baited Lindgren funnel trap, 29-XI-2006, A. Silagyi (CAPS; 1); Jacksonville, on Yellow Bluff Road, ethanol-baited Lindgren funnel trap, 20-XII-2006, A. Silagyi (CAPS; 1); Leon County: Tallahassee, 4.8 miles south of Capitol Circle, on CR 373, ethanol-baited Lindgren funnel trap, 7-XII-2006, M. Bentley (CAPS; 1); Orange County: Orlando, emerged from living room wall, 15-IX-1964, J.S. Flood (FSCA; 1 in vial with alcohol); Santa Rosa County: Gulf Breeze, Gulf Islands National Seashore on Gulf Breeze Parkway, alpha-beta pinene-baited Lindgren funnel trap, 15-XII-2006, C. Street (CAPS; 1).

***Sirex nigricornis* Fabricius, 1781**

(Fig. 17-21)

Diagnosis. Females of *S. nigricornis* have black legs with reddish tarsi, an ovipositor which is shorter than the forewing, and the abdomen is mostly reddish-orange except for the black basal segments. *Sirex behrensii* is similar, but has, sometimes subtly, black-banded forewings. *Sirex longicauda* and *S. areolatus* both have longer ovipositors. The other North American females of *Sirex* are separated by having entirely bluish-black abdomens. The males of *S. nigricornis* are best distinguished by the apical two segments of the metatarsi being reddish-yellow while the basal segments are black, the basally black but otherwise reddish abdomen, and black antennae. *Sirex cyaneus* is separated by its entirely black metatarsi. The antennae of *S. behrensii* differ, being basally pale. The other males of North American *Sirex* have reddish abdomens which are both basally and apically black, the apical portion often reduced to only dorsal or ventral expression. Males of *Sirex varipes* are best separated by association with females.

Bradley (1913) differentiates the races of *S. nigricornis*.

Natural history. The known hosts of *S. nigricornis* include *Picea* sp., *Pinus clausa* (Chapman ex Engelm.) Vasey ex Sarg., *Pinus echinata* Miller, *Pinus palustris* Miller, *Pinus taeda* Linnaeus, *Pinus rigida* Miller, *Pinus strobes* Linnaeus, and *Pinus virginiana* Miller (Pinaceae) (Smith and Schiff 2002; Schiff et al. 2006).

Ibalia leucospoides (Hochworth) (Hymenoptera: Ibalidae) has been collected from trees infested with *S. nigricornis* and *S. edwardsii* and may be a parasitoid of either of them (Smith and Schiff 2002). *Sirex nigricornis* also harbors the fungal symbiont *Amylostereum chailletii* (Pers.) Boidin, as do many other species of *Sirex* and *Urocerus* (Smith and Schiff 2002).

All but four of the Florida specimens were collected in Lindgren funnel traps baited with alpha-beta pinene, ethanol, or frontalin and turpentine. Adults have been collected in January, March, June and September to December. Florida specimens have been collected nearly throughout the year, contrary to July to October (Schiff et al. 2012), likely referring to more northern latitudes.

Distribution. Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Indiana, Louisiana, Maryland, Massachusetts, Mississippi, New York, North Carolina, Ohio, Oklahoma (**new state record**), Pennsylvania, South Carolina, Tennessee, Texas, Virginia, West Virginia, Wisconsin and Canada (Bradley 1913; Stange 1996; Smith and Schiff 2002; Schiff et al. 2006, 2012). In Florida specimens have been collected in Alachua, Bay, Columbia, Duval, Escambia, Leon, and Santa Rosa Counties.

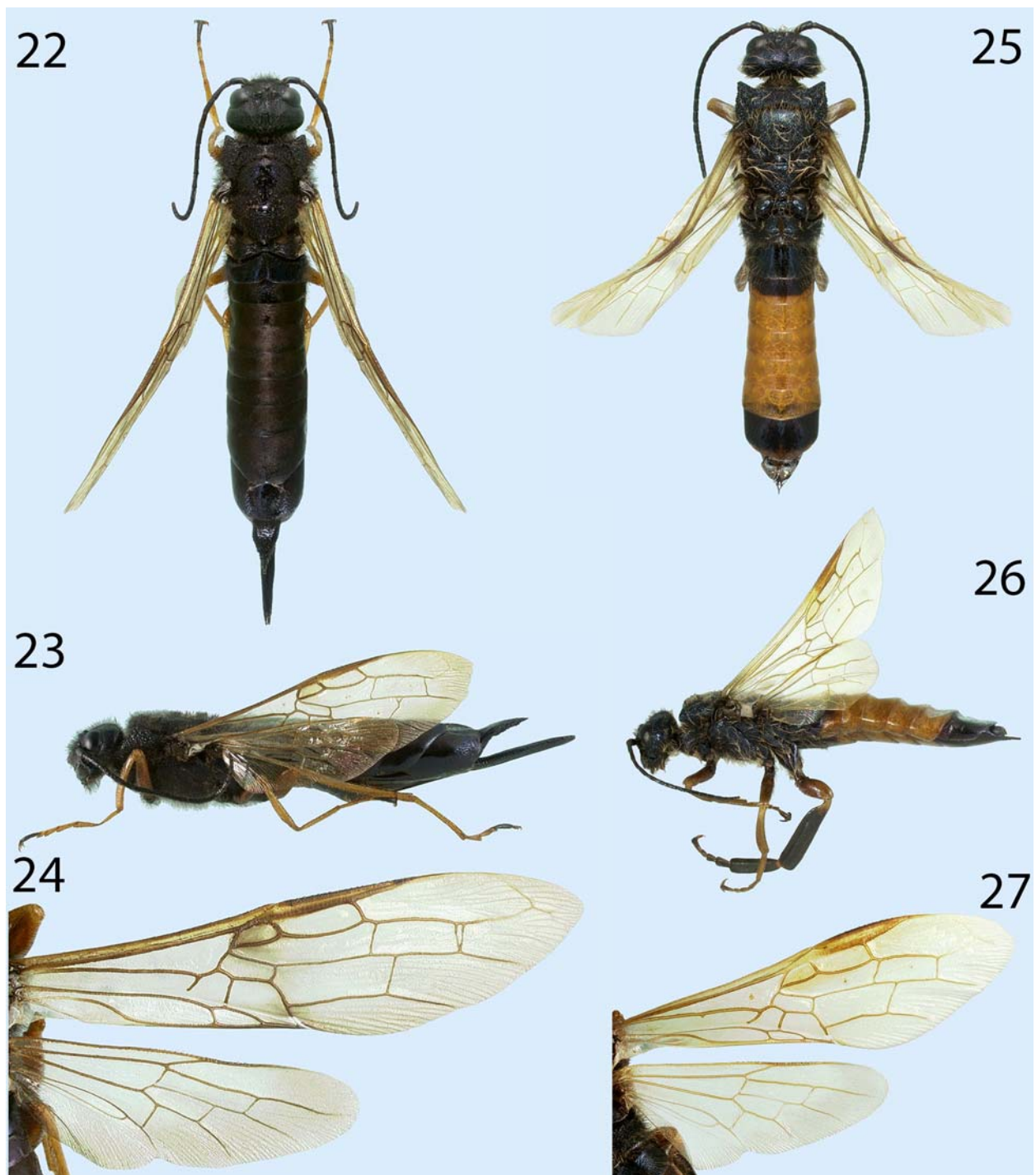
Specimens. USA: Arkansas: Nevada County: Bluff City seed orchard, ex. *Pinus taeda*, 16-XI-1976, 17-XI-1976, 24-XI-1976, 14-X-1976, H.N. Greenbaum (FSCA; 8); **Florida:** [probably Alachua County: Gainesville], frontalin/turpentine Lindgren funnel trap, X-1997 or XI-1997 (JLFC; 1); Alachua County: Gainesville, ex. *Pinus elliottii* bolt, 25-XI-1974, R.C. Wilkinson (FSCA; 1); X-1950, R.E. Sher (FSCA; 1); Gainesville, Farmer's Market, 19-III-1998, C. Chu (JLFC; 1); Gainesville, University of Florida, Natural Area Teaching Lab, Surge/Natural Area Drive, frontalin/turpentine Lindgren funnel trap, 15-XI-1999, J.L. Foltz (JLFC; 1); Bay County: Panama City, Division of Forestry Office, on Highway 98, alpha-beta pinene-baited Lindgren funnel trap, 19-XII-2006, L. Smith (CAPS; 1); Panama City, FSU Panama City Campus, ethanol-baited Lindgren funnel trap, 28-XI-2006, L. Smith (CAPS; 1); Columbia County: Lake City, 5 miles northeast of Osceola National Forest, 30-XI-1968, L. O'Berry (FSCA; 1); Duval County: Jacksonville, Fort George Island, alpha-beta pinene-baited Lindgren funnel trap, 5-XII-2006, J. Eickwort (CAPS; 2); Jacksonville, on Heckscher Drive, alpha-beta pinene-baited Lindgren funnel trap, 29-XI-2006, 20-XII-2006, A. Silagyi (CAPS; 2); Jacksonville, on Yellow Bluff Road, ethanol-baited Lindgren funnel trap, 20-XII-2006, A. Silagyi (CAPS; 1); Escambia County: Pensacola, at Boardwalk Park near Bayview Cemetery, alpha-beta pinene-baited Lindgren funnel trap, 19-XI-2006, 28-XI-2006, 15-XII-2006, C. Street (CAPS; 3); Leon County: Tallahassee, 1/4 mile south of SR 20, alpha-beta pinene-baited Lindgren funnel trap, 26-I-2007, M. Bentley (CAPS; 1); Tallahassee, 1/4 mile south of SR 20, ethanol-baited Lindgren funnel trap, 17-XI-2006, M. Bentley (CAPS; 1); Tallahassee, 4.8 miles south of Capitol Circle, on CR 373, alpha-beta pinene-baited Lindgren funnel trap, 7-XII-2006, M. Bentley (CAPS; 1); Santa Rosa County: Gulf Breeze, Gulf Islands National Seashore on Gulf Breeze Parkway, alpha-beta pinene-baited Lindgren funnel trap, 15-XII-2006, C. Street (CAPS; 2); **Oklahoma:** Latimer County: X-1986, XI-1992, XI-1987, K. Stephan (FSCA; 3); **Pennsylvania:** Berks County: Douglasville, 14-VI-1982, F.W. Skillman, Jr. (FSCA; 1).

***Sirex noctilio* Fabricius, 1793**

(Fig. 22-27)

Diagnosis. Females of *S. noctilio* have an entirely bluish-black abdomen, entirely reddish-yellow legs, an ovipositor which is shorter than the forewing, and black antennae. *Sirex longicauda* and *S. areolatus* are separated by having longer ovipositors. *Sirex edwardsii* has black legs while *S. juvencus* and *S. cyaneus* have orangish tarsi. *Sirex behrensii* and *S. nigricornis* are distinguished by the presence of orange on the abdomen. *Sirex varipes* is quite similar, but has more clear wings and the orange legs often seem to have an "additional" surfacing of blue on some segments. Males of *S. noctilio* have black antennae, entirely orange front and middle legs, orange metafemora (the rest of the hind leg black), and the abdomen mostly orange with black basal and apical segments (the apical black often reduced to only dorsal or ventral expression). *Sirex juvencus* is distinguished by its basally pale antennae. *Sirex edwardsii*, *S. areolatus* and *S. longicauda* have entirely black hind legs. *Sirex cyaneus*, *S. nigricornis*, *S. varipes* and *S. behrensii* are separated by their abdomens, which are only basally black.

Natural history. Various *Pinus* species (e.g., white, red, jack, Scots, lodgepole, ponderosa) are hosts for *S. noctilio* (Dodds and de Groot 2012). Some rare host records include *Abies*, *Larix*, and *Pseudotsuga menziesii* (Mirbel) Franco (Pinaceae) (Smith and Schiff 2002; Schiff et al. 2006), but emergence from



Figures 22-27. 22-24) *Sirex noctilio* female. 22) dorsal habitus. 23) Lateral habitus. 24) Wings. 25-27) *Sirex noctilio* male. 25) Dorsal habitus. 26) Lateral habitus. 27) Wings.

non-pine hosts is not expected. *Sirex noctilio* is a major pest of *P. radiata* in New Zealand and Australia and is now a threat to this species in South Africa and South America. The major (threatened) pine plantations in South America are Loblolly Pine (*Pinus taeda*) and Mexican Weeping Pine (*Pinus patula*) in South Africa (Dodds et al. 2010; Dodds and de Groot 2012).

Adults and larvae harbor *Amylostereum areolatum*, a fungal symbiont (Smith and Schiff 2002).

Distribution. While there are no specimens of *S. noctilio* in the FSCA, nor any intercepted in Florida ports, this species has been included due to its invasiveness and recent detection in North America.

Sirex noctilio is native to Asia, northern Africa, and Europe. It is adventive in Australia, New Zealand, South Africa, South America and North America (Morgan 1968). In North America it occurs in Michigan, New York, Ohio, Pennsylvania, Vermont, Quebec and Ontario (Dodds and de Groot 2012; Schiff et al. 2006; USDA 2010). No specimens have been collected in Florida.

***Urocerus cressoni* Norton, 1864**

(Fig. 28-30)

Diagnosis. Females have abdomen basally black and apically orange, the cornus also orange, black wings, the black head with a pale spot behind each eye and the antennal flagellum partly white with some basal and/or apical segments black. The females of other species have either clear to yellow wings (perhaps with blackish margins) or an entirely black abdomen (although the cornus is orangish in *U. taxodii*). Males have entirely black legs, reddish abdomens (sometimes basally black), black wings and a black head with a pale spot behind each eye. The males of other North American *Urocerus* have clear to yellow wings and/or the presence of both black and yellow on the legs.

Bradley (1913) provided a key to the varieties of *U. cressoni*.

Natural history. The known hosts of *U. cressoni* include *Abies balsamea* Linnaeus, *Abies fraseri* (Pursh) Poir, *Picea* sp., *Pinus taeda* Linnaeus, and *Pinus rigida* Miller (Pinaceae) (Stange 1996; Smith and Schiff 2002; Schiff et al. 2006). Literature records indicate that it has been reared from Fraser fir.

Adults have been collected from July to November.

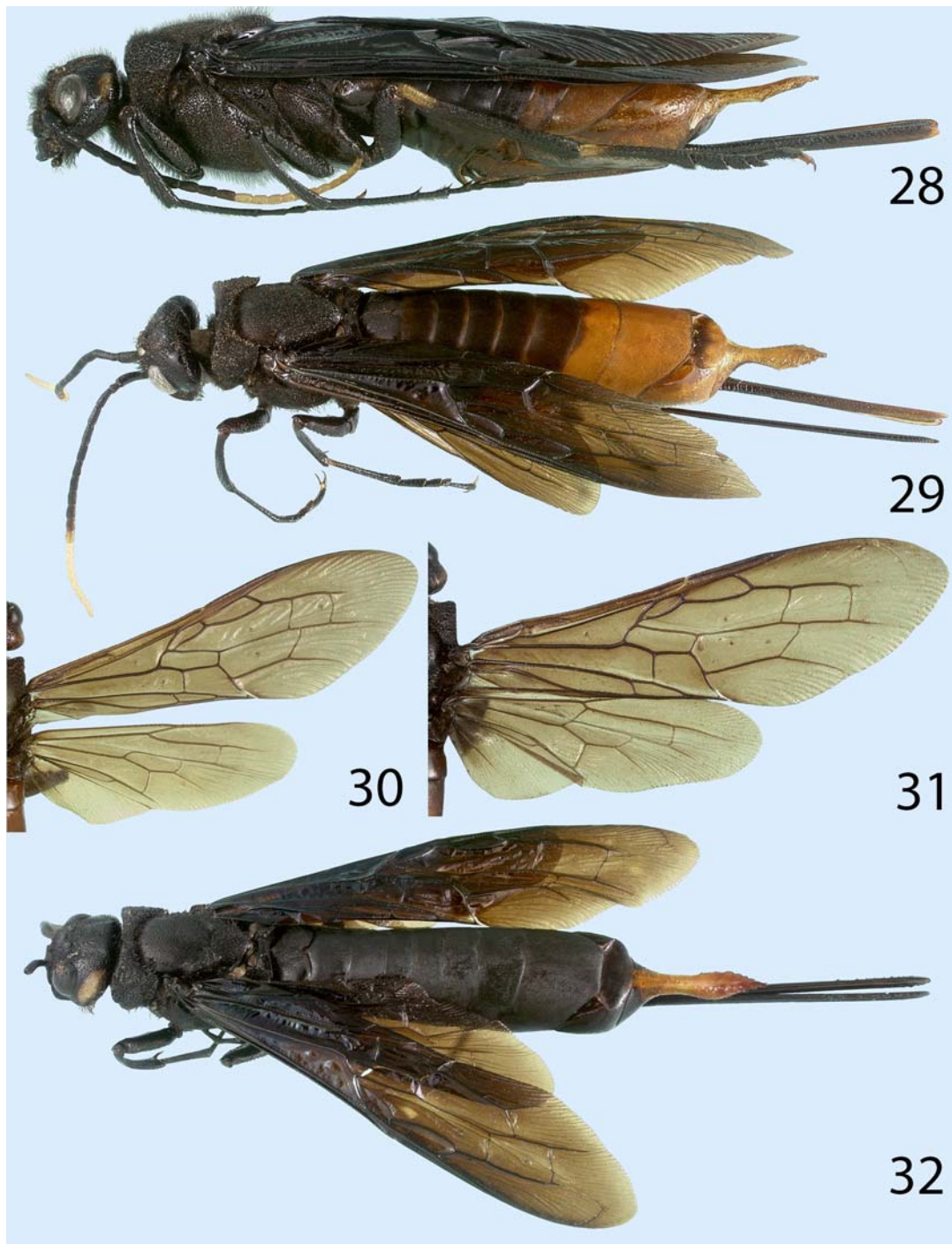
Distribution. Arkansas (**new state record**), Colorado, Connecticut, District of Columbia, Florida, Georgia, Indiana, Iowa, Maine (**new state record**), Maryland, Massachusetts, Michigan (**new state record**), Minnesota, Nebraska, New Jersey, New York, North Carolina, Ohio, Oklahoma (**new state record**), Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia, Wisconsin and Canada (Bradley 1913; Stange 1996; Smith and Schiff 2002; Schiff et al. 2006, 2012). Maine and Michigan are indicated on distribution maps in Schiff et al. (2012), however these states are not listed in the written distribution. In Florida a specimen was collected in Orange County.

Specimens. Canada: Nova Scotia: Victoria: Baddeck: Beinn Bhreagh, insect flight trap, 27-VII-1979, G.B. Fairchild (FSCA; 1); **USA: Arkansas:** Nevada County: Bluff City seed orchard, ex. *Pinus taeda*, 16-XI-1976, H.N. Greenbaum (FSCA; 1); **Florida:** Orange County: Orlando, UCF Campus, sand pine-rosemary scrub, Malaise Trap, 13-VII-1993, S. M. Fullerton (UCFC; 1); **Georgia:** Madison County: Danielsville, 11-X-1972, R. White (FSCA; 1); **Maine:** Penobscot County: Township A Range 7 [ca. Medway and East Millinocket (Llyod Davis, personal communication), Me., 30-VII-1966, L.R. Davis, Jr. (FSCA; 1); **Michigan:** Ingham County: Lansing (FSCA; 1); **New Jersey:** Bergen County: Ramsey, 12-VII-1935, W.J. Gertsch (FSCA; 1); **Ohio:** Hocking County: Neotoma, 10-VIII-1946 (FSCA; 1); **Oklahoma:** Latimer County: VII-1988, VIII-1990, K. Stephan (FSCA; 2); **South Carolina:** Pickens County: 7 miles northeast of Pickens, 22-IX-1995, H.L. Dozier (FSCA; 1); **Tennessee:** Blount County: Great Smoky Mountains National Park, Cades Cove, old field, gallery forest edge, Malaise Trap, 19-VIII-2004, G. Steck and B. Sutton (UCFC; 1).

***Urocerus taxodii* (Ashmead), 1904**

(Fig. 31-32)

Diagnosis. Females have a black abdomen, except for the orangish cornus, a black head with a pale spot behind each eye, black legs with some white markings on the basal metatibiae and metabasitarsi, black wings and antennae which are basally black and apically white. *Urocerus sah* (Mocsáry) and *U. gigas flavicornis* (Fabricius) differ in having yellowish wings. The abdomen of *U. cressoni* is basally black and apically orange. *Urocerus albicornis* (Fabricius) is separated by its black cornus. The males have a black



Figures 28-32. *Urocerus* species. **28)** Lateral habitus, female *U. cressoni*. **29)** Dorsolateral habitus, female *U. cressoni*. **30)** Wings of male *U. cressoni*. **31)** Wings of male *U. taxodii*. **32)** Dorsolateral habitus, female *U. taxodii*.

head with a pale spot behind each eye, black wings, antennae that are apically pale and basally black, and entirely yellowish to reddish abdomen, and the bases of the metatibiae and metabasitarsi much paler. The legs of *U. cressoni* are entirely black. *Urocerus gigas flavicornis* and *U. albicornis* are distinguished by their bicolored abdomens. *Urocerus sah* has a mostly yellow head with no discernable pale spots behind the eyes and entirely yellow antennae.

Natural history. *Taxodium distichum* (Linnaeus) Rich. (Taxodiaceae), from which adults have been reared, is the only known host (Bradley 1913; Stange 1996; Schiff et al. 2006).

Adults have been collected in April to June, August, October and November (Bradley 1913; Smith and Schiff 2002). One FSCA specimen was collected in a frontal and turpentine-baited Lindgren funnel trap.

Distribution. District of Columbia, Florida, Georgia, Maryland (**new state record**), Mississippi, Missouri, Montana, New York, North Carolina, Virginia and Canada (Bradley 1913; Stange 1996; Smith and Schiff 2002; Schiff et al. 2006). In Florida specimens have been collected from Alachua, Collier and Hillsborough Counties.

Specimens. USA: Florida: Alachua County: Gainesville, NW 42nd Terrace, frontal/turpentine Lindgren funnel trap, 28-XI-1997, J.L. Foltz (FSCA; 1); Collier County: Corkscrew Swamp, 9-IV-1958, H.V. Weems, Jr. (FSCA; 1); Hillsborough County: Tampa, 8-XI-1986, J.E. Eger (FSCA; 1); **Maryland:** Dorchester County: Hudson, 5-VIII-1965 (FSCA; 1).

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