OLD TRAPS FOR NEW WEEVILS: NEW RECORDS FOR CURCULIONIDS (COLEOPTERA: CURCULIONIDAE), BRENTIDS (COLEOPTERA: BRENTIDAE) AND ANTHRIBIDS (COLEOPTERA: ANTHRIBIDAE) FROM JEFFERSON CO., FLORIDA

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OLD TRAPS FOR NEW WEEVILS: NEW RECORDS FOR CURCULIONIDS (COLEOPTERA: CURCULIONIDAE), BRENTIDS (COLEOPTERA: BRENTIDAE) AND ANTHRIBIDS (COLEOPTERA: ANTHRIBIDAE) FROM JEFFERSON CO., FLORIDA

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ABSTRACT

Trapping studies using three different types of traps placed in several wild and cultivated habitats in North Florida (Jefferson Co.) produced 97 different species of adult weevils in the family Curculionidae and the closely related primitive families Anthribidae, Brentidae and Ithyceridae. Sixty-one of 97 species trapped have not been reported previously from Jefferson Co. Furthermore, seven species of Curculionidae are first records for the state, with four of these being important agricultural pests (*Hypera meles*, *H. nigrirostris*, *H. punctata* and *Sitona lineatus*). In addition, some weevils taken in our traps represent undescribed species of *Apteromechus*, *Cercopeus* and *Conotrachelus*. Herein we include: (1) an alphabetical listing of species collected in these traps, (2) a description and illustration of the traps used, and (3) months of the year and generalized habitats where traps were placed and specimens were collected. Information on host associations is provided for many species.

Key Words: Tedders trap, Stinkbug trap, Circle trap, Florida, invasive weevils

RESUMEN

Estudios de trampeo utilizando tres diferentes tipos de trampas colocadas en áreas cultivadas y silvestres en el norte de Florida (Jefferson Co.) resultaron en la colecta de 97 diferentes especies de curculiónidos pertenecientes a la familia Curculionidae y a las familias primitivas de curculiónidos Anthribidae, Brentidae e Ithyceridae. Sesenta y una de las 97 especies capturadas constituyen primeros reportes para estas especies en el condado de Jefferson. Asimismo, siete de las especies capturadas nunca habian sido reportadas en el estado de Florida y cuatro de ellas son plagas agriculturales de suma importancia (*Hypera meles*, *H. nigrirostris*, *H. punctata* y *Sitona lineatus*). Adicionalmente, algunas de las especies capturadas representan nuevas especies pertenecientes a los géneros *Apteromechus*, *Cercopeus* y *Conotrachelus*. En este artículo incluimos: (1) un listado alfabético de las especies capturadas en las trampas, (2) la descripción e ilustración de las trampas utilizadas, y (3) los meses del año y descripción de las áreas donde las trampas fueron colocadas y los especimenes colectados. También hemos incluido información sobre las plantas hospederas para muchas de las especies capturadas.
Translation provided by author.

Weevils (Coleoptera: Curculionidae) are extremely important insects as plant pests and as beneficial biological control agents for noxious weeds. More than 863 genera and 7,000 species currently are recognized in North America (O'Brien & Wibmer 1982). Native species such as the plum curculio, *Conotrachelus nenuphar* (Herbst), and the cosmopolitan maize weevil, *Sitophilus zeamais* (Motschulsky), feed on everything from agronomic and fruit crops to stored products. Thousands of foreign species, particularly from the Caribbean and southeast Asia, are potential invaders of the United States, following the pattern of such destructive exotic pests as the boll weevil, *Anthonomus grandis grandis* Boheman, and the recently detected *Myllocerus undatus* Marshall in Florida (C. W. O., unpublished data).

The Florida beetle fauna is one of the most diverse in North America, given the many tropical species entering south Florida from the West Indies (Peck & Thomas 1998). In the most recent distributional checklist for the Coleoptera of Florida (Peck & Thomas 1998) the authors indicate

that close to 18% (or ≈ 825 species) belong to the superfamily Curculionoidea (as defined in Alonso-Zarazaga & Lyal 1999). Some of the species can be very abundant at particular sites and times of the year and, as such, can be collected with relative ease. An example of this is the Fuller rose beetle, *Naupactus cervinus* (Boheman) (R. F. M., unpublished data). However, many Curculionoidea are cryptic and nocturnally active, and collecting them can prove difficult. As a result, exotic pest weevils entering the state may remain undetected for many years until their population builds-up to economically important levels.

We conducted a series of trapping studies over a period of nine years (1993-2001) in several wild and cultivated habitats in North Florida near the town of Monticello. Three different types of traps previously reported as effective for capturing a variety of economically important weevils (Tedders & Wood 1994, Mizell & Tedders 1999) were tested for their ability to capture other species. Ninety-seven different species of adult weevils, Curculionidae, and the closely related primitive families Anthribidae, Brentidae and Ithyceridae (as treated in Alonso-Zarazaga & Lyal 1999) were collected. In this paper we include: (1) a table with information on all of the species collected, (2) months of the year when specimens were collected, (3) descriptions and photographs of the traps used, and (4) information on host associations for most species. Our results are discussed in the context of the importance of visual cues for weevils and the use of traps in early detection of pest weevil introductions.

Materials and Methods

Sites

Traps were placed in various wild and cultivated habitats on the grounds of the University of Florida, North Florida Research and Education Center in Monticello, FL, which is located in Jefferson County about 16 km S of the Florida-Georgia state line. Different traps or trap combinations were placed in pecan (PCN) (*Carya illinoiensis*) and peach (PCH) (*Prunus persica*) orchards and in small plantings of Japanese persimmon (PSN) (*Diospyros kaki*) (Table 1). These cultivated areas are interspersed with several wet woodland sites (WD) containing tree species that are typical for North Florida, including slash pine (*Pinus elliottii*), loblolly pine (*P. taeda*), longleaf pine (*P. palustris*), tupelo or black gum (*Nyssa sylvatica*), sweet gum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), red oak (*Quercus rubra*) and shagbark hickory (*Carya ovata*) (USDA 1989). In addition, other weedy, forage and ornamental plant species were present in the surrounding habitats. Among these were mixed bahia-grass (*Paspalum notatum*), vetch (*Vicia sativa*), red clover (*Trifolium pratense*), rabbit-eye blueberries (*Vaccinium ashei*), *Lantana camara*, and *Sesbania* spp.

Traps. Three types of traps were tested for their ability to capture weevils. We used two active pyramidal-shaped traps (Figs. 1a and 1b) similar (equal dimensions) to those described in Tedders and Wood (1994) and Mizell and Tedders (1999). Trap bodies were manufactured from 1.3 cm thick masonite and painted black (Ace® acrylic flat latex house paint #103A105) or safety yellow (Glidden® alkyd industrial formula #4540). The screen cone and collecting cylinder components of the boll weevil trap (Anonymous 1990) were used to capture the adult weevils in the black traps, while the window screen top collection device described by Mizell and Tedders (1995) was used to capture the weevils in the yellow pyramidal trap. In this manuscript we refer to the black pyramidal trap as a Tedders trap (T in Table 1) and the yellow pyramidal trap as a Stinkbug trap (SB) (after Mizell & Tedders 1995). The third trap used was a passive Circle trap (C) (Fig. 1c), made of aluminum insect screening, similar to the one described by Mulder et al. (2000) to capture the pecan weevil and the plum curculio in Oklahoma. As above for the Tedders trap, a boll weevil trap top was modified to fit the top of the circle trap to capture adult weevils.

The total number of traps of each type varied from year to year, but at no time were fewer than 20 traps of each type present in the field. Tedders, Stinkbug and Circle traps were placed in all habitats except for peach orchards, which did not receive Circle traps. All traps were unbaited and were serviced 1-3 times per week throughout the course of the study. Trap tops were emptied, cleaned of debris and replaced. Captured insects were preserved in 95% ethyl alcohol and brought back to the laboratory, where a representative series of all weevils from each trap were mounted and labeled. Taxonomic determinations to species were made by C.W.O. Trap(s), habitat(s) and month(s) of the year when each species of weevil was collected were summarized, and the information is presented in Table 1. Species for which host associations are provided in the text are indicated in Table 1, as are the species that have been introduced into North America.

Results and Discussion

Ninety-seven species of adult Curculionidae and the closely related primitive families Anthribidae, Brentidae and Ithyceridae were collected in our traps from 1993-2001 (Table 1). The preponderance of species collected was advanced weevils (89 species), with only six species of Anthibidae, one species of Brentidae and the one species of Ithyceridae being captured. Table 1 indicates the species for which host associations are provided in

TABLE 1. SUMMARY OF TRAPPING RESULTS IN JEFFERSON COUNTY, FLORIDA WHERE THREE DIFFERENT TYPES OF TRAPS WERE EVALUATED FOR THEIR ABILITY TO CAPTURE WEEVILS IN SEVERAL WILD AND CULTIVATED HABITATS FROM 1993-2001. THE TRAPS USED WERE BLACK TEDDERS TRAPS (T), YELLOW STINKBUG TRAPS (SB) AND CIRCLE TRAPS (C). THE FIRST COLUMN INDICATES THE FAMILY (F) TO WHICH EACH SPECIES BELONGS (ANTHRIBIDAE (A), BRENTIDAE (B), ITHYCERIDAE (I) OR CURCULIONIADE (C)) AND WHETHER THE CAPTURE REPRESENTS A NEW RECORD FOR JEFFERSON COUNTY (*) OR FOR THE STATE OF FLORIDA (**). INTRO ? INDICATES WHETHER OR NOT THE SPECIES IS EXOTIC TO NORTH AMERICA. AN "X" IN THE COLUMN FOR HOST INFO ? INDICATES WHETHER ADDITIONAL HOST ASSOCIATION INFORMATION IS PROVIDED IN THE TEXT.

F	*Genus, species* and author	Habitat(s) where traps were placed[1]	Type of trap			Month(s) when captures occurred	common name (ESA 1997)[2]	Intro?	Host info?
			T	SB	C				
A	*Araecerus coffeae* (Fabricius)	PCH		x		V	(coffee bean weevil)	no	x
A*	*Brachycorynus rectus* (LeConte)	PCN, PSN	x		x	VIII		no	x
A	*Euparius marmoreus* (Olivier)	PCH, PCN	x	x	x	I-IV, VI		no	x
A*	*Goniocloeus bimaculatus* (Olivier)	WD			x	III		no	x
A*	*Piesocorynus mixtus* LeConte	WD	x			III		no	x
A	*Toxonotus cornutus* (Say)	PCH	x			II, IV		no	x
B*	*Arrenodes minutus* (Drury)	WD			x	V, XII	oak timberworm	no	x
I*	*Ithycerus noveboracensis* (Forster)	WD, PSN			x	IV, V	the New York weevil	no	x
C*	*Acalles porosus* Blatchley	PCH, PCN, PSN	x			IV-V, VIII		no	no
C**	*Acanthoscelidius curtus* (Say)	PCH		x		V		no	x
C*	*Anthonomus quadrigibbus* Say	PCH, WD	x			III-IV	apple curculio	no	x
C*	*Aphrastus griseus* Blatchley	PCH, PCN, PSN, WD	x	x	x	V-IX, XI		no	no
C	*Apinocis* sp. 1	WD	x			?		no	no
C	*Apteromechus ferratus* (Say)	PCH, WD	x			III, VIII		no	x
C	*Apteromechus* new species 1	PCH	x			III		no	no
C*	*Atrichonotus taeniatulus* (Berg)	PCH		x		VI-IX		yes	x
C	*Bagous magister* LeConte	PCH, PSN	x			II		no	x
C**	*Brachystylus acutus* (Say)	PCH, PCN, PSN, WD	x		x	IV-VI	(grey persimmon weevil)	no	x
C	*Baris* sp. 1	WD	x			?		no	no
C*	*Chalcodermus aeneus* Boheman	PCH, PSN, WD	x	x	x	V, VII-IX	cowpea curculio	no	x
C*	*Chalcodermus collaris* Horn	PCH		x		V, VIII		no	no
C	*Cercopeus* new sp. # 18	PCH	x			II		no	no
C*	*Conotrachelus affinis* Boheman	PCN	x			?		no	x
C*	*Conotrachelus anaglypticus* (Say)	PCH, PCN, PSN	x	x		II-VIII		no	x
C*	*Conotrachelus aratus* (Germar)	PCH		x		IV		no	x
C*	*Conotrachelus carolinensis* Schoof	PCH, PSN, WD	x	x	x	III-VI, VIII		no	x
C*	*Conotrachelus elegans* (Say)	PCH, PCN, WD	x	x	x	III-VI		no	x
C	Conotrachelus geminatus LeConte	PCN		x		VI		no	x

[1]PCN = pecan, PCH = peach, PSN = Japanese persimmon, WD = wet woodland.
[2]names in parenthesis are common names not accepted by ESA (1997).

TABLE 1. (CONTINUED) SUMMARY OF TRAPPING RESULTS IN JEFFERSON COUNTY, FLORIDA WHERE THREE DIFFERENT TYPES OF TRAPS WERE EVALUATED FOR THEIR ABILITY TO CAPTURE WEEVILS IN SEVERAL WILD AND CULTIVATED HABITATS FROM 1993-2001. THE TRAPS USED WERE BLACK TEDDERS TRAPS (T), YELLOW STINKBUG TRAPS (SB) AND CIRCLE TRAPS (C). THE FIRST COLUMN INDICATES THE FAMILY (F) TO WHICH EACH SPECIES BELONGS (ANTHRIBIDAE (A), BRENTIDAE (B), ITHYCERIDAE (I) OR CURCULIONIADE (C)) AND WHETHER THE CAPTURE REPRESENTS A NEW RECORD FOR JEFFERSON COUNTY (*) OR FOR THE STATE OF FLORIDA (**). INTRO ? INDICATES WHETHER OR NOT THE SPECIES IS EXOTIC TO NORTH AMERICA. AN "X" IN THE COLUMN FOR HOST INFO ? INDICATES WHETHER ADDITIONAL HOST ASSOCIATION INFORMATION IS PROVIDED IN THE TEXT.

F	*Genus, species* and author	Habitat(s) where traps were placed[1]	Type of trap			Month(s) when captures occurred	common name (ESA 1997)[2]	Intro?	Host info?
			T	SB	C				
C*	*Conotrachelus hicoriae* Schoof	PCH, PCN, PSN, WD	x	x	x	IV, VI-IX		no	x
C	*Conotrachelus naso* LeConte	PCH, PCN, PSN, WD	x	x	x	IV-IX, XII		no	x
C	*Conotrachelus nenuphar* (Herbst)	PCH, PCN, WD	x	x		II-VIII, XI	plum curculio	no	x
C	*Conotrachelus posticatus* Boheman	PCH, PCN, PSN, WD	x	x	x	III-XI		no	x
C*	*Conotrachelus similis* Boheman	PCH, PSN, WD	x		x	VI		no	x
C	*Conotrachelus* new sp. # 9	PCH	x	x		VIII-IX		no	no
C	*Conotrachelus* new sp. # 12	PCH		x		IV		no	no
C*	*Cophes fallax* (LeConte)	PCH, PCN, PSN, WD	x	x	x	II-VI, VII-XII		no	x
C*	*Cophes oblongus* (LeConte)	PCH, PCN, PSN, WD	x		x	V-VI, VIII		no	no
C*	*Cophes obtentus* (Herbst)	PCH, PCN, PSN, WD	x		x	IV-VI, VIII-X		no	no
C	*Cossonus corticola* Say	WD	x			VII		no	x
C	*Cossonus impressifrons* Boheman	WD	x			VII		no	x
C*	*Cryptorhynchus fuscatus* LeConte	PCN, PSN, WD	x		x	I, III-VI, VIII-X, XII		no	x
C*	*Cryptorhynchus helvus* LeConte	PCH, PCN, PSN, WD	x	x	x	VI-VII		no	no
C*	*Cryptorhynchus minutissimus* LeConte	PCN, PSN, WD	x		x	I, V		no	x
C**	*Cryptorhynchus woodruffi* Sleeper	PCH, PCN, PSN, WD	x		x	III-X		no	no
C	*Curculio caryae* (Horn)	PCN, PSN, WD	x		x	IX-XI	pecan weevil	no	x
C*	*Curculio fulvus* Chittenden	PCN, PSN	x			X		no	x
C*	*Curculio humeralis* (Casey)	WD			x	IX		no	x
C*	*Curculio longidens* Chittenden	PCN		x		IX		no	x
C*	*Curculio pardalis* (Chittenden)	PCN, PSN	x			X		no	x
C*	*Curculio proboscideus* (Fabricius)	PCN, PSN, WD			x	X-XII		no	x
C*	*Curculio sulcatulus* (Casey)	PCH, PCN, PSN, WD		x	x	I, VI, IX-XII		no	x
C*	*Cyrtepistomus castaneus* (Roelofs)	PCH, PCN, PSN, WD	x	x	x	I-XII	Asiatic oak weevil	yes	x
C	*Eubulus bisignatus* (Say)	PCH	x			III, V		no	x
C	*Eubulus parochus* (Herbst)	PCH	x			III		no	x
C*	*Eudiagogus maryae* Warner	PCH, WD	x	x		VI-VIII		no	x
C*	*Eudiagogus rosenschoeldi* Fahraeus	PCH, PSN, SES	x	x		VII-IX		no	x
C*	*Geraeus penicilla* (Herbst)	PCH, WD	x	x		III, VI		no	no

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F	*Genus, species* and author	Habitat(s) where traps were placed[1]	Type of trap			Month(s) when captures occurred	common name (ESA 1997)[2]	Intro?	Host info?
			T	SB	C				
C	*Geraeus* sp. 1 (female)	PCN	x			?		no	no
C	*Geraeus* sp. 2 (male)	PCH	x			?		no	no
C	*Hylobius pales* (Herbst)	PCH, PCN, PSN, WD	x		x	I-V, VII, XI	pales weevil	no	x
C**	*Hypera meles* (Fabricius)	PCN	x			IX	clover head weevil	yes	x
C**	*Hypera nigrirostris* (Fabricius)	PCH, PCN, WD	x	x		V, VII	lesser clover leaf weevil	yes	x
C*	*Hypera postica* (Gyllenhal)	PCH, PCN, PSN,	x	x		V, VIII, IX	alfalfa weevil	yes	x
C**	*Hypera punctata* (Fabricius)	PCH, PCN	x	x		VI, VIII, IX, XI	clover leaf weevil	yes	x
C*	*Listroderes apicalis* Waterhouse	PCH, PCN, PSN,	x			VI, VIII, IX, XI		yes	x
C	*Listroderes difficilis* Germain	PCH, PCN	x	x		II-X	vegetable weevil	yes	x
C*	*Madarellus undulatus* (Say)	PCH,PCN, PSN	x			IV, XI		no	x
C*	*Myrmex dichrous* (LeConte)	WD	x			?		no	x
C*	*Myrmex floridanus* (Casey)	PCN, PSN	x		x	V-VI		no	x
C	*Naupactus cervinus* (Boheman)	PCH, PCN, PSN,	x	x	x	II-VIII, XII	Fuller rose beetle	yes	x
C	*Naupactus peregrinus* (Buchanan)	PCH, PCN, PSN, WD	x	x		VI-IX	(white-fringed beetle)	yes	x
C*	*Ochyromera ligustri* Warner	PCH, PCN	x	x		III, IX-X		yes	x
C*	*Odontocorynus salebrosus* (Casey)	PCH		x		V		no	x
C	*Odontocorynus* sp. 1	PCH, PSN	x	x		VII		no	no
C	*Odontocorynus* sp. 2	PCH	x			VII		no	no
C	*Odontocorynus* sp. 3 (female)	PCN	x			VII		no	no
C*	*Odontopus calceatus* (Say)	PCH, PCN	x			IV		no	x
C	*Pachnaeus opalus* (Olivier)	PCH, PCN,PSN	x	x	x	V-VIII, X-XI		no	x
C	*Pachylobius picivorus* (Germar)	PCH, PCN, PSN, WD	x		x	III-VIII	pitch-eating weevil	no	x
C*	*Pandeleteius hilaris* (Herbst)	PCH, PCN, PSN, WD	x	x	x	I-III, V-VI, VIII-XII		no	x
C*	*Pheloconus cribricollis* (Say)	WD	x			IV		no	x
C*	*Phyrdenus divergens* (Germar)	WD	x			VIII		no	x
C*	*Pissodes nemorensis* Germar	WD	x			XII	Eastern pine weevil	no	x
C*	*Pseudomus sedentarius* (Say)	WD	x		x	II, V		no	no
C	*Sitona californius* Fahraeus	PCH, PCN	x	x		III-VI, VIII		no	x
C*	*Sitona hispidulus* (Fabricius)	PCN	x			IX	clover root curculio	yes	x

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F	*Genus, species* and author	Habitat(s) where traps were placed[1]	Type of trap			Month(s) when captures occurred	common name (ESA 1997)[2]	Intro?	Host info?
			T	SB	C				
C**	*Sitona lineatus* (Linneaus)	PCH, PCN, PSN	x	x	x	II-VI, IX, XII	pea leaf weevil	yes	x
C*	*Sitona lineellus* (Bonsdorff)	PCN, PSN	x	x	x	VI-IX		yes	x
C	*Sitophilus oryzae* (Linnaeus)	PCN, PSN	x	x	x	VIII	rice weevil	yes	x
C	*Sitophilus zeamais* Motschulsky	PCH, PCN	x	x		IV, VI-VII	maize weevil	yes	x
C	*Smicronyx* sp. 1	PSN	x			?		no	no
C	*Sphenophorus cariosus* (Olivier)	PCH, WD	x	x		IX		no	x
C*	*Sphenophorus coesifrons* Gyllenhal	PCH, PCN, PSN, WD	x	x		VI-VIII, X-XI		no	x
C*	*Sphenophorus inaequalis* (Say)	PCH, PCN	x	x		V, VII		no	x
C*	*Tanymecus lacaena* (Herbst)	PCH, PCN, PSN		x		II-III, VI, IX		no	x
C*	*Tyloderma foveolatum* (Say)	PCH	x	x		IV-VI		no	x
C*	*Tyloderma variegatum* (Horn)	PCN, PSN, WD			x	VI		no	x

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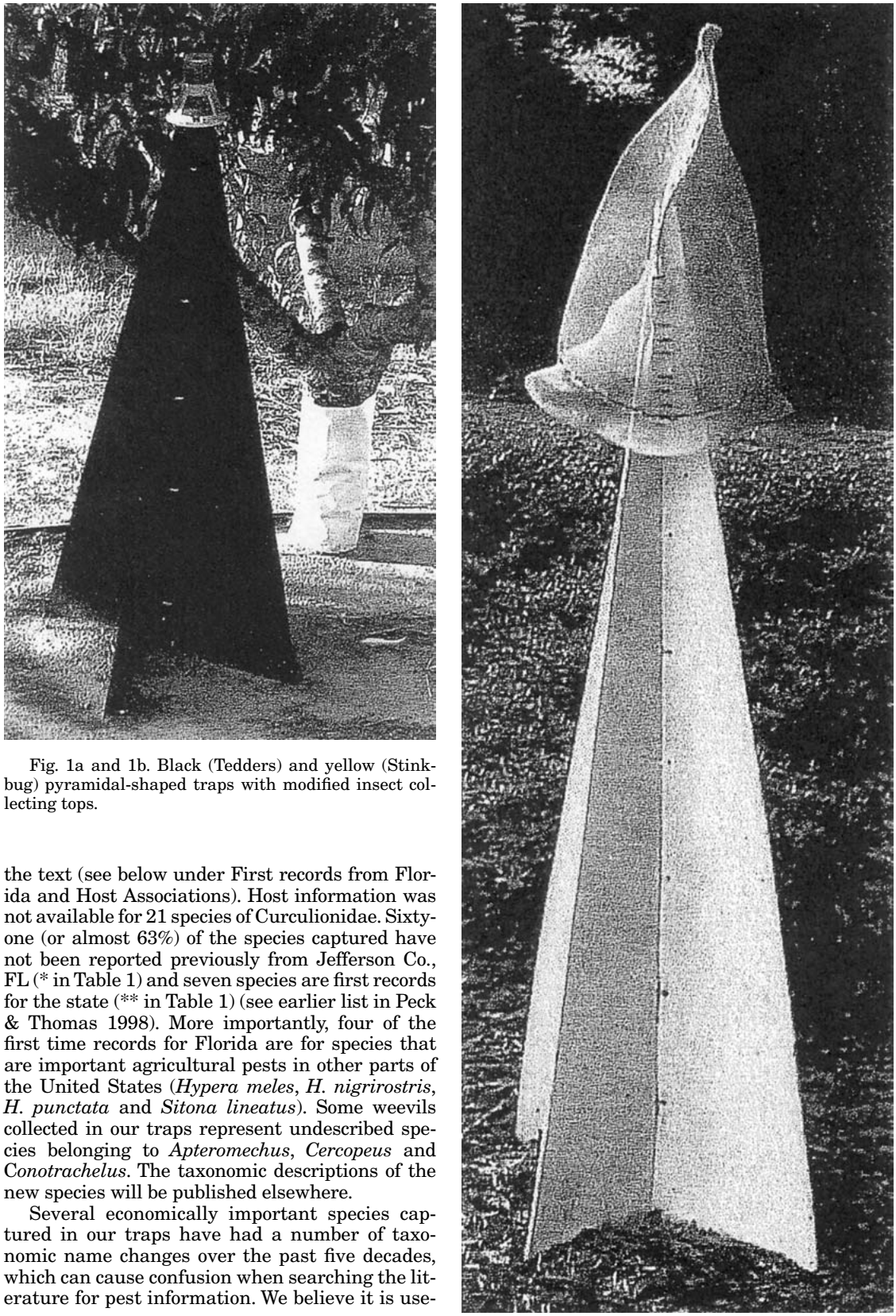

Fig. 1a and 1b. Black (Tedders) and yellow (Stinkbug) pyramidal-shaped traps with modified insect collecting tops.

the text (see below under First records from Florida and Host Associations). Host information was not available for 21 species of Curculionidae. Sixty-one (or almost 63%) of the species captured have not been reported previously from Jefferson Co., FL (* in Table 1) and seven species are first records for the state (** in Table 1) (see earlier list in Peck & Thomas 1998). More importantly, four of the first time records for Florida are for species that are important agricultural pests in other parts of the United States (*Hypera meles*, *H. nigrirostris*, *H. punctata* and *Sitona lineatus*). Some weevils collected in our traps represent undescribed species belonging to *Apteromechus*, *Cercopeus* and C*onotrachelus*. The taxonomic descriptions of the new species will be published elsewhere.

Several economically important species captured in our traps have had a number of taxonomic name changes over the past five decades, which can cause confusion when searching the literature for pest information. We believe it is use-

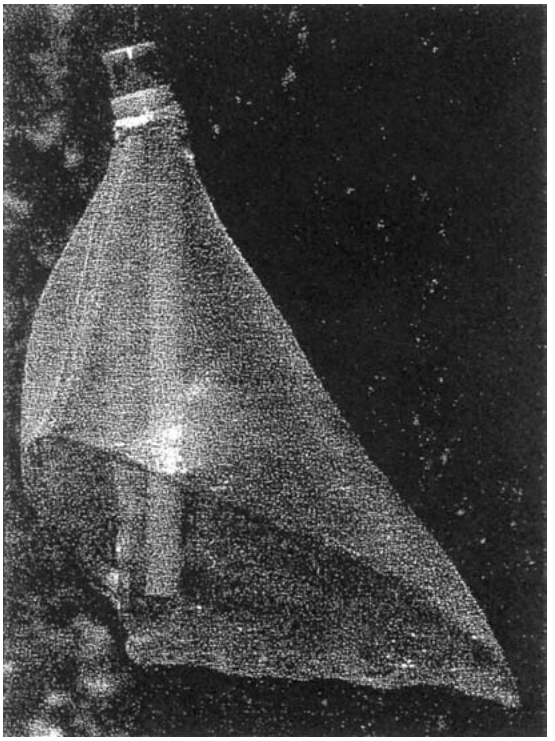

Fig. 1c. Circle trap.

ful to list some of these names here in order to aid researchers in their studies of these weevils. The anthribid weevil, *Araecerus coffeae* (Fabricius), was known as *A. fasciculatus* DeGeer until 1994, when Zimmerman published notes on the long ignored synonymy of this widespread stored product pest (Zimmerman 1994). However, there is controversy over this synonymy and, as such, the name changes may continue for this important pest species. The vegetable weevil, *Listroderes difficilis* Germain, has been called *L. costirostris* Schoenherr, which is actually a distinct Argentine species known in the United States only from California and Arizona (O'Brien & Wibmer 1982). The Fuller rose beetle, *Naupactus cervinus* (Boheman), has been introduced into many countries from its home in Argentina, including into the United States (Lanteri et al. 2002). It has been placed in and referred to as belonging to the genera *Aramigus*, *Asynonychus*, *Pantomorus* and *Naupactus*, the latter in which it is currently placed (Alonso-Zarazaga & Lyal 1999). In addition, its specific name has several junior synonyms that have been used in older literature, including *Aramigus fulleri* (Horn), *Asynonychus godmanni* (Crotch), *Pantomorus olindae* (Perkins) and *Naupactus simplex* Pascoe. Finally, *Naupactus peregrinus* (Buchanan) is another species still referred to under several different genera including *Graphognathus* and *Pantomorus*. It is important that researchers be aware of all names used for the species they investigate if they wish to make use of earlier research studies regarding life history, distribution, control options or information on natural enemies. Sources of such names are found most often in catalogs or checklists, as well as in revisions and monographs of many groups of economically important insects.

First records for Florida

1) A single adult of *Acanthoscelidius curtus* (Say) was found on 19 May 1995 in a Stinkbug trap placed in a peach orchard. We continued to have Stinkbug traps at this location, however, no other specimens of this species were collected. Blatchley and Leng (1916) report it as occurring on *Polygonum* sp. in swamps in New York. *Polygonum* spp. (Polygonaceae) are commonly known as knotweeds and grow in marshes, swamps, wet forests and ditches. *Acanthoscelidius curtus* is found in South Carolina, Kentucky, Virginia and North Carolina, as well as in the north eastern and north central United States (O'Brien & Wibmer 1982). Two other species of *Acanthoscelidius*, *A. acephalus* (Say) and *A. mendicus* (Dietz), are listed as occurring in north Florida (Peck & Thomas 1998) but were not collected in our study. Most *Acanthoscelidius* species breed in evening primrose (*Oenothera* spp.) (C. W. O., unpublished data).

2) We collected specimens of *Brachystylus acutus* (Say) in Tedders and Circle traps placed in pecan and Japanese persimmon orchards. Very few specimens were obtained (8 total) and these collections occurred from April to June in 2000 and in June 2001. Blatchley and Leng (1916) call this species the gray persimmon weevil (although this is not an approved ESA common name, ESA 1997) and report that it has been collected from hickory and persimmon and swept from low herbage. They suggest that it probably is found wherever persimmon is grown. *Brachystylus acutus* is found in Georgia, Alabama, Kentucky, Mississippi, North Carolina, South Carolina, the northeastern states, and Missouri. No other species of *Brachystylus* are reported to occur in the United States (O'Brien & Wibmer 1982).

3) We collected 40 adults of *Cryptorhynchus woodruffi* Sleeper mostly from woodland habitats in Tedders and Circle traps. Two adults were captured in traps placed in pecan orchards and one in a peach orchard. The first specimen was found in May 1999 and additional collections were made in 2000 and 2001. Sleeper (1955) described the male and female of *C. woodruffi* collected at Cranberry Bog, Buckeye Lake, Ohio in June 1953, however, no information on host associations were provided for the species.

4-6) Three of the new Florida records that are important agricultural pests belong to the genus

Hypera, and include *Hypera meles* (Fabricius) (the clover head weevil), *H. nigrirostri*s (F.) (the lesser clover weevil) and *H. punctata* (F.) (the clover leaf weevil). These species are native to the Old World but have been reported from the southeastern United States (O'Brien & Wibmer 1982). *Hypera meles* has been reported to feed on alfalfa (= lucerne), red, zigzag and crimson clovers and black medik. *Hypera nigrirostris* feeds on alsike, white, red, crimson and zigzag clovers, alfalfa and black medik, while *H. punctata* feeds on red, crimson and white clovers, alfalfa and Jerusalem artichoke (*Helianthus tuberosus*) in Europe (Titus 1911). We collected ten *H. meles* from Tedders traps placed in a pecan orchard in September 1993. Specimens of *H. nigrirostris* were found in both Tedders and Stinkbug traps placed in pecan and peach orchards, respectively. A few specimens also were collected in Tedders traps located in forested habitats adjacent to the orchards. These weevils were collected in July 1993 and May 1995. Adults of *H. punctata* were taken from the same traps and habitats as *H. nigrirostris*, but were collected during September and November 1993, August and November of 1994 and in June 2001. The genus *Hypera* is primarily Palearctic in distribution (Puttler et al. 1973), although seventeen species are listed as occurring in North America, six of which are introduced from Europe (O'Brien & Wibmer 1982). Until now, only two species of *Hypera*, *H. postica* (Gyllenhal) and *H. compta* (Say), were listed as occurring in Florida (Peck & Thomas 1998). *Hypera postica*, the alfalfa weevil, is an immigrant from Europe and a major pest of alfalfa and other legumes (Puttler et al. 1973), and *H. compta* is semiaquatic and breeds externally on leaves of *Polygonum* in Florida (C.W.O., unpublished data).

7) Nineteen *Sitona lineatus* (Linneaus), the pea leaf weevil, adults were collected in Tedders (11 specimens), Stinkbug (4) and in Circle traps (4) placed in pecan, peach and Japanese persimmon orchards. Specimens were collected from February-June and in September and December from 1996-2001. This is the first record for *S. lineatus* in the southeastern United States. C. W. O. has since collected additional specimens in Tallahassee, FL. It previously had been reported to occur in Idaho, Oregon, Washington and in British Columbia, Canada, where it is a serious pest of edible legumes, especially peas, *Pisum sativum* (Schotzko & Quisenberry 1999). Hoebeke and Wheeler (1985) also collected it in coastal areas of Virginia. Bright (1994) reports it as occurring on peas, beans, sweet peas, alfalfa, various varieties of clover, bird's foot trefoil, wild and cultivated vetch, chickpea (*Cicer arietinum*) and thrashed oats. Of the twenty species of *Sitona* present in North America, four are reported to occur in the southeastern United States. With this new state record for *S. lineatus*, all four species are now reported as occurring in Florida (O'Brien & Wibmer 1982, Peck & Thomas 1998).

First records for Jefferson County

Fifty-four species trapped during this study are first records for Jefferson County (designated with * in Table 1). When the seven new weevil records for the state are included, the number of species new to Jefferson County increases to 61. The list includes seven species of *Conotrachelus*, six *Curculio*, three each of *Cryptorhynchus* and *Cophes*, two each of *Chalcodermus, Eudiagogus, Myrmex, Sitona*, *Sphenophorus,* and *Tyloderma*, and one species each of *Acalles, Anthonomus, Aphrastus, Atrichonotus, Cyrtepistomus, Geraeus, Hypera, Listroderes, Madarellus, Ochyromera, Odontocorynus, Odontopus, Pandeleteius, Pheloconus, Phyrdenus, Pissodes, Pseudomus,* and *Tanymecus*. Three species of Anthribidae and one each of Brentidae and Ithyceridae are also new records for Jefferson Co.

Host associations for weevils collected during this study (see above for 1st state records)

Anthribidae. *Araecerus coffeae* (F.), the coffee bean weevil, is a well-known pest of coffee beans, but larvae can develop in seeds of many kinds of plants (Zimmerman 1994). *Brachycorynus rectus* (LeConte) has been reared from *Celtis laevigatus*, black locust and dead wood of sugar maple (Valentine 1998). *Euparius marmoreus* (Olivier) feeds on several species of polypore fungi (*Trametes hirsutus*, *T. versicolor*, *Megasporoporia setulosa*, *Trichaptum biforme*, *T. abietinus*, *T. sector*, *Phlebia hydnoides*, *Panis rudis* and *Pereniporia medulla-panis*) (Valentine 1998). *Goniocloeus bimaculatus* (Olivier) has been collected on *Biscogniauxia* sp. fungus on winter-killed sugar maple, on *Xylaria* sp. and *Diatrype* sp. fungi and has been also been found under bark of dead oaks (Valentine 1998). Adults and larvae of *Piesocorynus mixtus* LeConte eat pyrenomycete fungi of the order Sphaeriales, families Zylariaceae and Diatrypaceae (Valentine 1998). *Toxonotus cornutus* (Say) has been found boring in persimmon (*Diospyrus* sp.), and has been collected from *Prosopis* and oak seedlings (Valentine 1998).

Brentidae. *Arrenodes minutus* (Drury) occurs beneath the bark of recently felled or dying oak, poplar and beech trees (Blatchley & Leng 1916).

Ithyceridae. *Ithycerus noveboracensis* (Forster) is associated with trees from the families Betulaceae (*Carpinus caroliniana*, *Betula populifolia*), Juglandaceae (*Juglans cinerea*, *Carya cordiformis*, *C. ovata*) and Fagaceae (*Fagus grandifolia*, *Castanea dentata*, *Quercus alba*, *Q. macrocarpa*, *Q. bicolor*, *Q. coccinea*, *Q. prinus*, *Q. ellipsoids* & *Q. borealis*). Large numbers of adults occasionally are taken from fruit trees in the family Rosaceae,

such as apple (*Malus sylvestris*), plum (*Prunus americana*) and peach (Sanborne 1981).

Curculionidae. The larvae of *Anthonomus quadrigibbus* Say feed around the core of apple, pear and haw (*Crataegus* sp.) but are rarely very injurious. They have also been collected from flowers of red haw, *Crataegus*, and hazel, shadebush (*Amelanchier*), and various fruit trees (Blatchley & Leng 1916). *Apteromechus ferratus* (Say), as well as other species of *Apteromechus*, breed in twigs and branches of many hardwood trees and shrubs (C. W. O., unpublished data). *Atrichonotus taeniatulus* (Berg) feeds on a variety of plants, with a preference for Leguminosae. Host plants for this species include lucern, subterranean clover, bean, hibiscus, dahlia, rose, eucalyptus, sunflower and roots of grasses (Lanteri & O'Brien 1990). *Bagous magister* LeConte is commonly collected feeding on water lily (*Nymphaea odorata*) (C. W. O., unpublished data). *Chalcodermus aeneu*s Boheman, the cowpea curculio, infests field peas, string beans, soybean, lima bean, cotton and strawberry. Several leguminous weeds, including vetch, also are hosts (Blatchley & Leng 1916).

Schoof (1942) and references cited therein, report that larvae of *Conotrachelus affinis* Boheman attack nuts of Juglandaceae (pignut, shagbark, mockernut and bitternut hickory). *Conotrachelus anaglypticus* (Say) is considered an economic pest of peach and larvae have been reported to attack cotton bolls (*Gossypium hirsutum*), and the cambium and inner bark of several fruit and shade trees (apple, pear, pignut hickory, American hornbeam, sweet birch, American beech, American chestnut, white, chestnut, and red oak, tulip tree, service berry, red maple, tupelo, flowering dogwood and sourwood), as well as columbine (*Aquilegia*), cowpea, Japanese plum, mulberry elm and *Crataegus*. *Conotrachelus aratus* (Germar) attack several species of Juglandaceae (pecan, bitternut, shagbark and pignut hickory), while *C. carolinensis* Schoof attacks peaches and has been collected in cotton fields. *Pheloconus cribicollis* (Say), formerly in the genus *Conotrachelus*, have been collected on *Pinus palustris*, cotton, *Ambrosia* and peach while *C. elegans* (Say) has been reported on *Pinus rigida*, and feeding on leaves and nuts of various species of Juglandaceae (pecan, mockernut and pignut hickory) as well as on plum and cotton. They have been found breeding in galls caused by *Phylloxera* on leaves of hickory and pecan. *Conotrachelus geminatus* LeConte have been bred from flowerheads of beggar-tick (*Bidens*) and giant ragweed (*Ambrosia trifida*). *Conotrachelus hicoriae* Schoof attack the nuts of pecan and peach. *Conotrachleus naso* LeConte breed in the fruit of hawthorn (*Crataegus* sp.), and in acorns of post, live, white and chestnut oaks and other species of Fagaceae, and on cotton and on dogwood. *Conotrachelus nenuphar* (Herbst), the plum curculio, has been reported from plum, cherry, peach, nectarine, apple, wild crabapple, pear and quince. In addition, huckleberry, grape, strawberry, currant, gooseberry and persimmon are listed as occasional hosts. *Conotrachelus posticatus* Boheman breeds in acorns of various species of *Quercus* (Schoof 1942). *Conotrachelus similis* Boheman breeds in the berries of wooly buckthorn (*Bumelia lanuginosa*) (Blatchley & Leng 1916).

Cophes fallax (LeConte) can be found when sifting the soil under beech logs, and it breeds in dead limbs of hickory and dead stems of *Cassia* (Blatchley & Leng 1916). *Cossonus corticola* Say occurs under the bark of pine and is reported to feed on pine, while *C. impressifrons* Boheman occurs under bark of butternut, sycamore, oak, chestnut and other hardwood trees (Blatchley & Leng 1916). *Cryptorhynchus fuscatus* LeConte breeds in dead branches of hardwood trees, while *C. minutissimus* LeConte has been extracted from dead branches of pecan (C. W. O., unpublished data).

Seven species of *Curculio* were captured in our traps. Gibson (1969) reports that the pecan weevil, *Curculio caryae* (Horn) breeds in most species of the genus *Carya* (pecan, hickory). *Curculio fulvus* Chittenden has been found breeding exclusively in live oak (*Q. virginiana*). *Curculio sulcatulus* (Casey) has been found breeding in 29 species of oaks (*Quercus*), preferring the acorns of the red oak group of species, and is the only *Curculio* reported infesting *Q. mohriana*. *Curculio proboscideus* (Fabricius) attacks 21 species of oaks, while *C. pardalis* (Chittenden) has been reported from 18, *C. longidens* Chittenden from 11 and *C. humeralis* (Casey) from 13 *Quercus* species. In addition, *C. pardalis* is the only *Curculio* found attacking *Quercus robur* and *Q. chapmani*, while *C. humeralis* is the only *Curculio* listed as attacking *Quercus margaretta* (Gibson 1969).

Cyrtepistomus castaneus (Roelofs), the Asiatic oak weevil, attacks many species of woody plants but seems to prefer oak and chestnut. The larval stage is a root feeder, while the adults attack the leaves. *Eubulus bisignatus* (Say) breeds in twigs and branches of many hardwood trees and shrubs (C. W. O., unpublished data). *Eubulus parochus* Herbst was reportedly beaten from elm and found under the bark of butternut. Larvae mine the inner bark and wood of weakened and decayed walnut (Blatchley & Leng 1916). *Eudiagogus maryae* Warner has been found feeding on and defoliating species of *Sesbania*, *Cassia* and *Daubentonia*, while *E. rosenschoeldi* Fahraeus are associated almost exclusively with three species of *Sesbania*, *S. vesicaria* (bagpod sesbania), *S. drummondii* (Drummond rattlebox) and *S. exaltata* (hemp sesbania) (Warner 1979). *Hylobius pales* (Herbst), the pales weevil, is an important pest of new pine and Christmas tree plantations throughout eastern North America (Fettig & Salom 1998). *Listroderes apicalis* Waterhouse is a pest of beets (*Beta*

vulgaris), sunflower (*Helianthus annus*) and wheat (*Triticum aestivum*) (Lanteri et al. 2002). The host list for *Listroderes difficilis* Germain, the vegetable weevil, includes bean, beet, burdock, cabbage, carrot, cauliflower, celery, chard, Chinese cabbage, garlic, head cabbage, kale, lettuce, mustard, mustard cabbage, onion, pepper, peanut, potato, radish, rape, spinach, tomato, turnip and sweet potato. Cultivated flowers attacked include pansy, petunia, poppy, phlox and verbena. The principal weed hosts include dandelion, mallow, milk thistle, mustard, wild aster, wild radish and wild parsnip (High 1939). *Madarellus undulatus* (Say) occurs on wild grape, poison ivy and Virginia creeper and bores in the latter (Blatchley & Leng 1916). *Myrmex dichrous* (LeConte) breeds in dead fronds of palmetto and Sabal palms (C. W. O., unpublished data), while *M. floridanus* (Casey) has been collected from oak and *Bumelia* (Peck & Thomas 1998). *Naupactus cervinus* (Boheman), the Fuller rose beetle, is injurious to citrus trees and ornamentals such as rose and geranium (Lanteri et al. 2002). The larvae of *Naupactus peregrinus* (Buchanan) are serious pests of many crops and ornamental plants in the southeastern United States. *Ochyromera ligustri* Warner breeds in fruits of *Ligustrum* (C. W. O., unpublished data). *Odontocorynus salebrosus* (Casey) has been swept from huckleberry and collected from *Asclepias* and *Achillea lanulosa* (Blatchley & Leng 1916). The larvae of *Odontopus calceatus* (Say) mine the leaves of sassafras and *Liriodendron* (Blatchley & Leng 1916). *Pachnaeus opalus* (Olivier) has been collected from crabapple and on Irish juniper (C. W. O., unpublished data). Like the pales weevil, *Pachylobius picivorus* (Germar), the pitch-eating weevil, is an important pest of new pine and Christmas tree plantations throughout eastern North America (Fettig & Salom 1998). *Pandeleteius hilaris* (Herbst) has been reported from the leaves of oak, hickory and chestnut as well as from beech, smart-weed and *Ceanothus* (Howden 1959). *Phyrdenus divergens* (Germar) occurs on black night-shade (*Solanum nigrum*) (Blatchley & Leng 1916). *Pissodes nemorensis* Germar, the Eastern pine weevil, attacks the trunks of young trees of Virginia pine, *Pinus virginiana*.

Sitona californius Fahraeus has been recorded from native lupine (*Lupinus polyphyllus*), *Ceanothus divaricata* and from a variety of plants including plum, peach, crabapple, alfalfa, apple, wild sunflower, *Lotus scoparius* and *Eleocharis macrostachya* (Bright 1994). *Sitona hispidulus* (F.) occurs on various forage legumes, alfalfa and varieties of clover (Bright 1994). *Sitona lineellus* (Bonsdorff) occurs mainly on alfalfa but also can be found on vetch, several varieties of clover, peas, alsike and many garden plants (Bright 1994). The rice weevil, *Sitophilus oryzae* (L.), and the maize weevil, *S. zeamais* Motschulsky are cosmopolitan pests of wheat, maize, oats, barley, sorghum, buckwheat, rye, rice, stored cotton, table beans and cashew nuts. Adults are reported to burrow into grapes, apples, and pears (Lanteri et al. 2002). The rice weevil is so called only because rice is the food on which it was first described. *Sphenophorus cariosus* (Olivier) generally feeds on rushes and sedges but has proven destructive to corn. The horned or beaked rush (*Rhynchospora corniculata*) is the preferred host, although it occurs in several species of *Cyperus* and *Scirpus* (Vaurie 1951). *Sphenophorus coesifrons* Gyllenhal has been collected from centipede grass (C.W.O., unpublished data), and adults can damage corn and are injurious to rice (Vaurie 1951). *Sphenophorus inaequalis* (Say) is reported from Bermuda grass (*Cynodon dactylon*) (Vaurie 1951). *Tanymecus lacaena* (Herbst) feeds on ragweed (*Ambrosia artemisiifolia*) (C.W.O., unpublished data). *Tyloderma foveolatum* (Say) breeds in the stems of evening primrose (*Oenothera biennis*) and the cut-leaved primrose (*O. laciniata*); it has also been reported as feeding on corn stalks and ripe strawberries (Wibmer 1981). Several life stages of *T. variegatum* (Horn) were collected from lizard's tail (*Saururus cernuus*) by Wibmer (1981).

Trap Mode of Action

Active Tedders and Stinkbug traps and passive Circle traps have been used previously to capture many economically important weevils (Sherman & Mizell 1995, Tedders & Wood 1995, Tedders et al. 1996, Stansly et al. 1997, Prokopy & Wright 1998), as well as other selected Coleoptera (Braman et al. 2002). However, we know of no earlier study where these traps have captured as many species of weevils as we report herein. Furthermore, Mizell and Tedders (1999) and Mizell et al. (2002) used baited Tedders traps to study the behavioral response to visual and olfactory cues in *H. pales* and *Pachylobius picivorus*, two pests of Christmas trees in Florida. Unlike the Tedders and Stinkbug traps, which function as silhouette mimicking structures when placed on the ground, the Circle trap is normally attached to the tree bole where it acts as a passive funnel that captures insects walking up the bole of the tree.

Raney and Eikenbary (1968) reported that 60-80% of pecan weevil adults emerging from their pupal cells (in the soil under pecan trees) reach the tree bole by walking rather than flying. Similar behavior has been observed in many weevils that attack fruit trees or that feed on the tender new growth of their host trees (e. g., *Diaprepes abbreviatus* (L.) on citrus). Availability of all of these food resources (young nuts, fruits and tender foliage) is highly variable in time and space (Hunter & Lechowicz 1992). Yields in fruit and nut trees and the timing of citrus growth flushes are genetically programmed but are highly plastic, allowing

for modification in their expression through interaction with the environment. For example, pecan is an alternate bearing nut tree with cycles of high and low nut production, which vary for individual trees (Wood & McMeans 1981, Sparks 1991).

Presumably in response to the unpredictability in the nut resource, the pecan weevil has evolved a two and partial three-year life cycle, and adults tend to aggregate year after year on those trees with the highest yield of nuts. We hypothesize that the walking behavior exhibited by the pecan weevil is an adaptation that enhances the probability that emerging adults will return to the tree of their larval development, which over evolutionary time would be those trees with the highest yield of nuts. As such, we would expect the pecan weevil, as well as other weevils that use the bole as a visual cue to locate host trees after emergence, to be captured in either the silhouette mimicking traps or in traps attached to the tree trunk. Our examination of the host associations for the weevils captured during our study suggests that the preponderance of species captured are associated with tree species found in the study area. However, this hypothesis does not explain the capture of species that breed in weedy hosts or that pupate in their host plant. Nevertheless, we have demonstrated that active pyramidal (Tedders & Stinkbug) and passive Circle traps are valuable tools for capturing rare weevils and to monitor for economically important weevil immigrants.

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