NEW DISTRIBUTIONAL RECORDS FOR *PLATYSTETHUS* (COLEOPTERA: STAPHYLINIDAE: OXYTELINAE) WITH NOTES ON THE BIOLOGY OF *P. AMERICANUS*

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ABSTRACT

A survey of the fauna of cattle dung dropped naturally on pasture in Alachua County, Florida, revealed several species of Staphylinidae, including two species of *Platystethus*. Adult *Platystethus spiculus* Erichson were collected only in July 1991. Adult *Platystethus americanus* Erichson were collected from March to June 1993. In the laboratory, immature stages of *P. americanus* took 18-22 days to develop at 27°C (2-3, 10-12, and 7 days for the egg, larval, and pupal stage, respectively). Some adults were offered cattle dung alone as diet in which the females deposited eggs in chambers. Some larvae were offered cattle dung and horn fly [*Haematobia irritans* (L.)] larvae as diet, and the beetle larvae pupated successfully in chambers or partial chambers under the dung. Adults and larvae held without cattle dung ate horn fly larvae, but females did not oviposit and beetle larvae did not pupate, most likely because they require dung or a similar substrate in which to make chambers. New distributional records are Florida and New Mexico for *P. americanus*, and St. Croix (U.S. Virgin Islands) and New Mexico for *P. spiculus*.

Key words: *Platystethus americanus*, *Platystethus spiculus*, Florida, predation, horn fly, cattle dung.

RESUMEN

Una investigación de la fauna que habita las deposiciones del ganado en pastos del condado de Alachua, Florida, reveló la presencia de varias especies de Staphylinidae, incluyendo dos especies de *Platystethus*. Los adultos de *Platystethus spiculus* Erichson se colectaron sólo en julio de 1991. Los adultos de *Platystethus americanus* Erichson fueron colectados desde marzo hasta junio de 1993. En el laboratorio, los estadios inmaduros de *P. americanus* tardaron 18-22 días para desarrollarse a 27°C (2-3, 10-12, y 7 días para los huevos, larvas y pupas, respectivamente). A un grupo de adultos se les ofreció deposición de ganado como dieta solamente, sobre la cual las hembras depositaron sus huevos en cámaras. A un grupo de larvas se les ofreció deposición de ganado y larvas de la mosca *Haematobia irritans* (L.) como alimento, y como resultado las larvas de los escarabajos puparon exitosamente en cámaras, total o parcialmente construidas debajo de la deposición. Los grupos de adultos y larvas de los escarabajos mantenidos sin deposiciones de ganado comieron las larvas de moscas ofrecidas, pero las hembras no depositaron huevos y las larvas no puparon, posiblemente debido a la falta del material de la deposición o de otro parecido para construir sus cámaras. Se lograron nuevos registros de distribución de *P. americanus* para la Florida y Nuevo México, y de *P. spiculus* para Santa Cruz (St. Croix, Islas Vírgenes Norteamericanas) y Nuevo México.

Results reported herein are part of a study on the arthropod community associated with cattle dung in Florida. No comprehensive study of the fauna of cattle dung has yet been reported for Florida. The doctoral dissertation of the senior author will, when

completed, document many components of the fauna and their interactions; this paper deals only with the genus *Platystethus* and its role. The presence of certain arthropods, especially predatory Staphylinidae, in cattle dung has been shown elsewhere to reduce populations of the horn fly, *Haematobia irritans* (L.) (Blume et al. 1970, Thomas & Morgan 1972, Macqueen & Beirne 1975). We view an understanding of the fauna and the interactions in cattle dung in Florida as a necessary background to implementing biological control of horn fly.

Materials and Methods

A survey of the arthropod community associated with cattle dung was conducted on pasture in July 1991 and from June 1992 to December 1993. The pasture is 16 km (10 miles) northeast of Gainesville, Alachua County, Florida, and had approximately 250 beef cattle at the time of the study. Two methods of collection were used: pitfall traps baited with fresh cattle dung, and emergence boxes that held entire dung pads and trapped all emerging arthropods. A dilute soap solution was added to the pitfall traps to drown trapped arthropods and keep them clean and flexible for subsequent processing. Ten to 15 pitfall traps were set twice each month from May to October, and once each month from November to April. Arthropods captured in the traps were collected after 24 hours and preserved in 70% alcohol for identification.

Between December 1992 and December 1993, cattle dung pads about 24 hours old were collected from the pasture and carried to the laboratory to extract the dung-associated arthropods. Five dung pads were sampled twice a month from May to October and once a month from November to April. The pads were placed individually into emergence boxes of a type described to us by G. T. Fincher (USDA-ARS, College Station, Texas). Each box was a gray plastic kitchen box 46 cm long x 33 cm wide x 18 cm high. A 30 x 20 cm^2 section was cut from each lid and replaced with a piece of black cotton cloth to provide ventilation. A circular hole (4 cm diam) was cut through one end of the box. The lid for a 7.5 cm high $\times$ 4 cm diam vial was perforated, then glued and riveted to the box over the hole. When the vial was screwed onto the cap, it served as a collection device to collect arthropods that attempted to escape the emergence box by flight. In a similar manner, a 10 cm diam hole was cut through the bottom of the box. The lid of a 12.7 cm deep $\times$ 12.7 cm diam plastic jar was perforated and glued and riveted over the hole in the box and then the jar screwed onto the jar lid. This device collected arthropods walking and falling into it. The mouth of the vial and the cup were each fitted with a hardware cloth funnel to prevent insects from escaping back to the box. The vial and the cup collected adult arthropods that left the dung in the emergence box. These arthropods either were in the adult stage when the dung was collected, or had developed from immature stages within the dung.

Adult *Platystethus americanus* Erichson from dung were confined in Petri dishes (5.08 cm diam x 1.27 cm high) to study their biology and predation behavior. Moist paper towel was placed on the bottom of each Petri dish. A water-soaked cotton ball was provided for humidity, and cattle dung and/or horn fly eggs or first instar larvae were provided for food. An observation cage as described by Hinton (1944) was also made for rearing *P. americanus* in the laboratory. The cage consisted of a well cut in a piece of styrofoam. The well was covered by a piece of microscope slide. The reproduction and development of the beetle at successive stages were recorded daily.

Results and Discussion

Field Collections of Adults

In July 1991, six cattle dung pads (<2 hours old) were collected from the pasture and placed into emergence cages. Three pads were collected on grass and three on

bare soil. Fifty-seven *P. spiculus* Erichson were extracted from two of the three pads on grass. Most *P. spiculus* were extracted within the first 48 hours after the dung pads were collected, and the last specimen was collected on the 19th day after the dung was sampled (Fig. 1).

Beginning in June 1992, Staphylinidae and other arthropods were captured in pitfall traps also. The first *P. americanus* specimens were trapped on 23 March 1993; more were collected in April-June, and none thereafter (Fig. 2). Fourteen *P. americanus* were captured in 9 of 60 traps (15% positive) from March to June 1993.

Extractions from dung pads provided one *P. americanus* from dung collected on 23 March 1993. The numbers increased in April and May, peaked in June, then declined quickly. Only one specimen was extracted from the pads collected on 30 June. No additional *P. americanus* specimens were found (Fig. 2). In total, 109 *P. americanus* were extracted from 15 of 30 (50%) dung pads during March through June 1993. As with *P. spiculus*, most of the *P. americanus* were extracted within the first 48 hours after the dung was sampled. Perhaps this indicates loss of attraction of the dung to the beetles as it decomposed.

Platystethus spiculus was collected only in July 1991, and *P. americanus* only in March-June 1993. We do not know the habitats of these species during the rest of the year. In a study conducted during June-September in Indiana, *P. americanus* was collected in each of those months, but less frequently in July (Sanders & Dobson 1966). In a study conducted in June-September in Nebraska, *P. americanus* was collected most frequently in early July (Schreiber et al. 1987). In a study conducted in Texas from March 1979 to December 1980, *P. americanus* adults were trapped in 1979 in April-October with peak numbers in July, and in 1980 in February-June with peak numbers in June (Hunter et al. 1991); the data for 1980 are similar to ours.

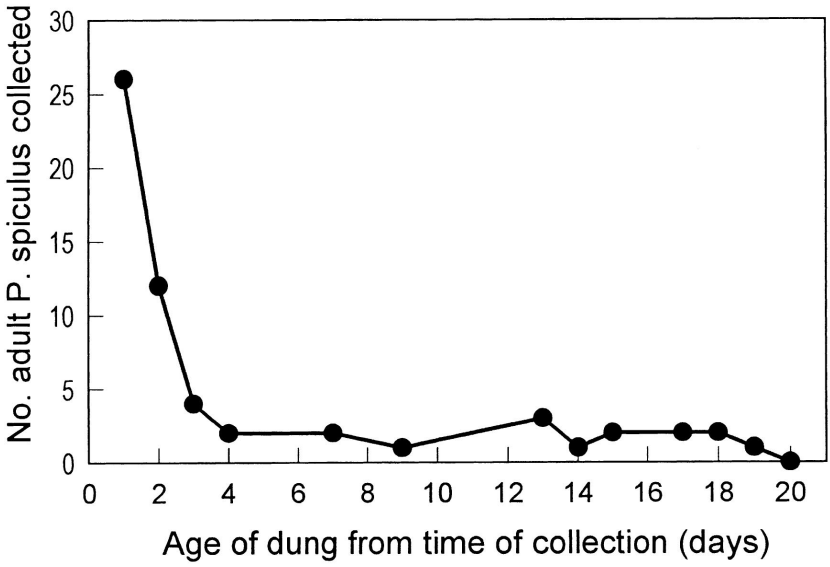

Fig. 1. Numbers of *Platystethus spiculus* adults extracted from 24-hr-old cattle dung placed into emergence boxes (n = 6) by day from date of collection. Most of these insects emerged from the dung in the first 48 hours.

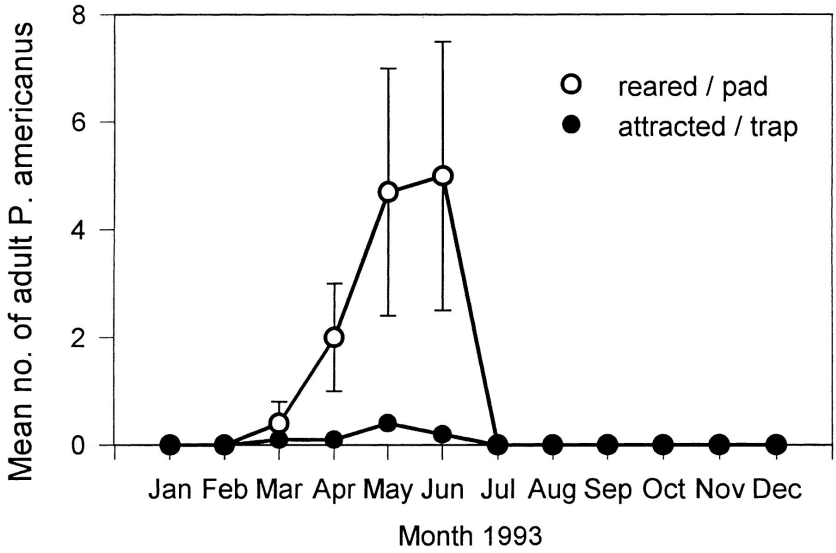

Fig. 2. Mean numbers of adult *Platystethus americanus* collected (a) by dung-baited pitfall traps in the field (n = 10 × 2 in May-October, 10 for the remaining months) and (b) from emergence boxes containing 24-hr-old cattle dung (n = 5 × 2 in May-October, 5 for the remaining months) by month.

Mating and Behavior of Female *Platystethus*

Two pairs of adult *P. americanus* were observed mating on the second and third day, respectively, after confinement in a Petri dish. One mating lasted 65 seconds and the other 80 seconds. The male at first was on the back of the female and twisted his abdomen back and forth about once per second. Then he moved until the two adults faced in opposite directions with tail to tail attachment for 10 to 20 seconds more until they separated.

Hinton (1944) described sub-social behavior by *P. arenarius* females. He observed that the female constructed a brood chamber in cattle dung, remained inside throughout the incubation of the eggs and, during the first few days of the life of the young larvae, she attacked other insects entering the chamber and protected her young against fungi. We observed that female *P. americanus* made two chambers, about 1 cm apart, connected by a gallery. One was a brood chamber with 3-5 eggs; it was about 5-7 mm in diam and about 5 mm deep. The female spent most of her time in the other chamber, or in the connecting gallery. We did not observe defensive or chamber-repairing behavior.

Eggs, Larvae, and Pupae of *Platystethus americanus*

The development time of the immature stages, from oviposition to adult emergence, was 18-22 days at 27°C. The egg is oval, colorless, and transparent. Its surface is smooth and without sculpture and measures approximately 0.48 x 0.24 mm. Incubation lasted 2-3 days. At 24 hours, two black (eye) spots could be seen near one end of the egg, and an embryo was visible. Three pairs of adults were reared in separate cages containing cattle dung.

First instar larvae of *P. americanus* were 1.5 x 0.26 mm in size and developed in 2-3 days. The second instar was 1.85 x 0.48 mm and developed in 2-3 days. The third was 2.71 x 0.57 mm (Fig. 3) and developed in 5-6 days.

The larva of *P. americanus* was described by Paulian (1941). The larva of *P. spiculus* was described by Legner & Moore (1977), and more completely, with the pupa, by Palomino & Dale (1989). These larvae are campodeiform, pale with the integument mostly transparent. The head and mouthparts are tinged with brown. In all members of the subfamily Oxytelinae the antenna has 3 segments, and the 2nd segment has a sensory appendage (Frank 1991) on the apico-medial aspect. In the larva of *P. americanus*, this appendage is only half as long as the 3rd segment. Legner & Moore (1977) and Palomino & Dale (1989) describe this appendage in *P. spiculus* as being as long as the 3rd antennal segment, making this a useful character to distinguish between the 2 species.

The pupa (Fig. 3) is exarate, 2.0 x 0.7 mm, yellowish-white, and very similar to the pupa of *P. spiculus* as described by Palomino & Dale (1989). This stage lasted 7 days, including a 1-day prepupal stage.

Food of *Platystethus*

The food range of *Platystethus* adults and larvae is unclear. Mohr (1943) assumed that *P. americanus* is a predator because it is a staphylinid, and Cervenka & Moon (1991), without providing evidence, considered it to be predatory. However, the family Staphylinidae includes fungivores as well as predators. *Platystethus arenarius* (Fourcroy) adults and larvae were observed by Hinton (1944) to ingest cattle dung, and were stated by Skidmore (1991) to feed exclusively on cattle dung. Larvae of *P. spiculus* were reported from cattle dung by Legner & Moore (1977). Frank (1976) found

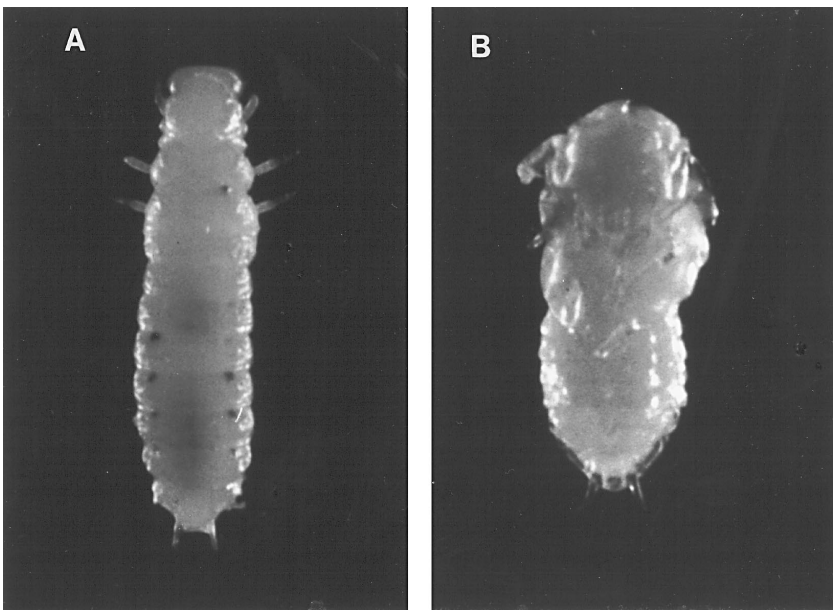

Fig. 3. Photographs of *Platystethus americanus*: (A) dorsal view of a third instar larva and (B) dorsal view of a pupa.

adult *P. spiculus* in horse dung, but many were discovered feeding on a slime mold [*Fuligo septica* (L.) Wigger]. Palomino & Dale (1989) reported collecting *P. spiculus* adults from cattle dung, obtaining eggs, and rearing larvae on a diet of house fly [*Musca domestica* (L.)] eggs (killed in hot water) in small Petri dishes; those authors provided wadded soft paper as substrate in the dishes (Palomino & Dale 1989) without any cattle dung (W. E. Dale pers. comm.).

We confined 10 adult *P. americanus* individually in Petri dishes and provided them with horn fly eggs and first instar larvae for food, without dung. Each beetle consumed 1.5 ± 1.02 (SD) first instar larvae of the horn fly per day (range 0-4 per day), leaving only the pharyngeal sclerites of the larvae in the dish; but we found no beetle eggs in the dishes. Horn fly eggs were not eaten. However, when adults were offered only cattle dung, they survived and the females made chambers in the dung and oviposited in these. This shows that dung (or fungi growing in the dung) provides an adequate diet, but does not prove that fly larvae are an inadequate diet; the failure of females to lay eggs probably was because we failed to provide a substrate in which the females could form chambers for oviposition.

When five *P. americanus* larvae were placed in Petri dishes with horn fly eggs and larvae but no cattle dung, feeding on first instar fly larvae occurred, and the beetle larvae developed but did not pupate. Horn fly eggs were not eaten. However, when beetle larvae were reared with cattle dung and horn fly eggs and larvae, they pupated successfully in chambers or partial chambers under the dung. This suggests only that larvae will not pupate unless provided with an appropriate substrate in which to form pupation chambers.

The trichotomy of coprophagy-mycophagy-predation has not been resolved experimentally in any *Platystethus* species, nor yet by us. However, the coprophagy may be only apparent, for while the insects may ingest dung, they may be digesting fungus, for which the dung provides a substrate. We now believe that oviposition and pupation in chambers, formed by the adult females and prepupae respectively, are obligate behaviors in *P. americanus*. Palomino & Dale (1989) showed that *P. spiculus* will accept a paper substrate in place of dung in which to make these chambers. We believe that the paper towel we placed in Petri dishes was not of suitable texture or bulk, and could not be excavated to form chambers.

Finally, the lack of *Platystethus* adults (and larvae) in cattle dung throughout the year at the study site suggests that dung is not the principal habitat, but is merely an additional habitat which is used in seasons of higher temperature and humidity when dispersal flight by adults occurs.

Geographical Distribution

The world fauna contains 48 species of *Platystethus* (Herman 1970), of which 3 now occur in the USA. *Platystethus americanus* has a Nearctic distribution, ranging as far north as British Columbia and Quebec. Earlier records are summarized by Blume (1985). Our finding of it in Alachua County is the first record for Florida. Three specimens sent to J. H. Frank for identification in 1988 seem to be the first record of *P. americanus* for New Mexico; they were labelled: New Mexico, Dona Ana County, 30-V-1987, dairy, coll. T. Carrillo.

Platystethus cornutus Gravenhorst is a Palearctic species whose discovery in Nebraska by Moore & Legner (1971) was the first record for the USA. It was reported from Ohio by Moore (1976).

Platystethus spiculus is widely distributed in Neotropical countries (Blackwelder 1943). It was identified from Bermuda by J. H. Frank, reported by Hilburn & Gordon (1989). Two specimens collected at a U.V. light trap give the first records for the US

Virgin Islands: St. Croix, Northside A, Sprat Hall, 23-VI-1991, and Westend, Brooks Hill, 24-VI-1991, coll. J. H. Frank (the specimens are in the collection of J. H. Frank). It seems to reach the northern limit of its range in the southern tier of states in the USA. It has been reported from Texas (Casey 1886), California and Arizona (Moore & Legner 1971), and Florida (Frank 1976). A specimen sent to J. H. Frank for identification in 1986 by G. H. Kinzer (New Mexico State University) seems to be the first record of *P. spiculus* for New Mexico: it was collected in cattle dung on the Jornada Experimental Range in Dona Ana County (the date of collection was not given). Moore & Legner (1971) provided a key to the adults of these 3 species. Frank (1976) supplemented that key by noting sexual dimorphism in the characters of the head.

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