

OBSERVATIONS ON THE BEHAVIORS OF SOME SCOLIIDAE  
AND POMPILIDAE (HYMENOPTERA) IN FLORIDA

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## ABSTRACT

The first report of burrowing behavior in a male nearctic scoliid, *Campsomeris plumipes fossulana*, and the first description of the nesting behavior of the pompilid *Anoplius bequaerti* are presented. Observations on the nesting behaviors and nests of the spider wasps *Episyron conterminus posterus*, *Anoplius apiculatus pretiosus*, and *A. stenotus* are also given. New prey families for *Auplopus mellipes mellipes* and *Agenioideus birkmanni* are included. An emendation is made to an earlier paper (Kurczewski 1981) on nesting behavior of Florida Pompilidae.

## RESUMEN

Se presenta el primer reporte del comportamiento del barrenador de un macho scoliid neártico, *Campsomeris plumipes fossulana*, y la primera descripción del comportamiento de anidar del pompilid *Anoplius bequaerti*. También se reportan observaciones sobre el comportamiento de anidar y de nidos de la avispa-araña *Episyron conterminus*, *Anoplius apiculatus pretiosus*, y de *A. stenotus*. Se incluyen nuevas familias de presa de *Auplopus mellipes mellipes* y de *Agenioideus birkmanni*. Se hace una enmienda de una publicación previa (Kurczewski 1981) sobre el comportamiento de anidar de Pompilidae de la Florida.

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Little information exists on female behavior in the nearctic Scoliidae, and nothing is known about the behavior of the males (Krombein 1979). Much of the behavioral information reported for species of nearctic Pompilidae is fragmentary and slight because of the solitary nature of the females and their often cryptic nesting situations (see Evans and Yoshimoto 1962). Therefore, any information obtained on the behaviors of species in these 2 families of aculeate Hymenoptera should be reported to add to the knowledge about these incompletely studied groups.

With this goal in mind we present information on the burrowing behavior and resting "cell" of a male of the scoliid *Campsomeris plumipes fossulana* (Fabricius) and on the nesting behaviors and nests of the pompilids *Priocnemis cornica* (Say), *Episyron conterminus posterus* (Fox), *Anoplius apiculatus pretiosus* (Banks), *A. bequaerti* (Dreischbach), and *A. stenotus* (Banks). The observations were made on the sandy firetrails of the Archbold Biological Station (ABS), Lake Placid, Highlands County, and on the sand-flats beside the Peace River at Arcadia (Ar), DeSoto County, Florida. The species are treated in phylogenetic arrangement following Krombein (1979). The prey and wasp specimens have been deposited in the invertebrate and insect collections, respectively, of the S.U.N.Y. College of Environmental Science and Forestry. New prey records for the pompilids *Auplopus mellipes mellipes* (Say) and *Agenioideus birkmanni* (Banks) are included. These specimens are part of the insect collection of the Archbold Biological Station.

## Family SCOLIIDAE

*Campsomeris plumipes fossulana* (Fabricius)

ABS; 9 March 1986; 1430 (EST). One male flew from the vegetation bordering a firetrail, made 3 low circular flights, each ca. 2.5 m in diameter, and landed on sand near dried leaves and pine needles. He searched in a slight depression beneath this debris for 40 sec, and then began to burrow into the sand using the mandibles and forelegs. After 2 min his head and forelegs were buried from view. As the male dug deeper, he twisted his body back and forth, forming an arc of ca. 180°. When his head and thorax were below the sand surface, he began to push sand upward with the extended abdomen, and, as the anterior half of the abdomen disappeared from sight, his hindlegs and abdomen were both used to push the sand to the surface. After 9.5 min the wasp had disappeared from view, but every several sec his hindtarsi broke through the accumulation pushing damp sand upward. Thereafter, the only evidence of burrowing by the male was the occasional enlargement of the pile. No sand was pushed upward after 20 min. He never backed out to the surface to clear away the sand accumulation. This area was excavated 90 min later and a quiescent male in a position horizontal to the sand surface was located at a depth of 4.5 cm.

## Family POMPILIDAE

*Priocnemis cornica* (Say)

In 1981 one of us (FEK) described some aspects of nesting behavior and the nest of *Priocnemis* (*Priocnemis*) sp. in Florida (ABS). At that time it was believed that the observations pertained to an undescribed species of *Priocnemis*. However, M. S. Wasbauer (pers. comm.) has informed us that the specimen in question is probably a *P. cornica* with a red metasoma. He has examined other females similar to the Florida specimen with red metasoma and varying amounts of red on the posterior femora and tibiae from Turrialba, Costa Rica and Puerto Vallarta, Jalisco, Mexico and believes they are nothing more than color variants of the usually all-black *P. cornica*. Conspecificity is further suggested by the similarity in nesting behavior between the female observed in Florida and several all-black females of this species (see Evans and Yoshimoto 1962).

*Auplopus mellipes mellipes* (Say)

Collection data: ABS; 31 March 1983; A. Schreffler. "Flying across the Plaza."

Prey: ?*Aysha velox* (Becker), immature (Anyphaenidae), with all legs amputated at the coxal-trochanter joints.

*Agenioideus birkmanni* (Banks)

Collection data: ABS; 20 April 1983; M. Deyrup. "On bark of *Pinus elliottii*."

Prey: *Platycryptus undatus* (DeGeer), ♀ (Salticidae).

*Episyron conterminus posterus* (Fox)

Ar; 30 March 1972; 1126 (EST); ABS; 11, 16 March 1986; 1315, 1450 (EST). A wasp was observed digging a burrow with a 10° angle in a bare, white, sandy slope. She stopped, turned 180° in front of the entrance, cleaned, and flew to her cachement site,

a plant 2 m away. She apparently had lost or misplaced the spider because she searched on the plant and the adjacent hillside for 16 min. The female then returned to the burrow without the spider and began digging again. She dug for 5 additional min, backed out, turned 180°, cleaned, flew to the cachement site, and began searching on the plants in the area. She finally abandoned the 5.2 cm-long burrow and began digging 2 m to the east. She also abandoned her second burrow, only 1 cm long, flew back to the cachement site, searched on plants in the area, and then flew away. It is highly unusual for a pompilid to begin a 2nd excavation after abandoning an initial nearly completed one without first capturing, paralyzing, and caching another spider to replace the one that was stolen or misplaced.

Another female had cached her paralyzed spider on the leaf of a plant 5 cm above the sand surface and 60 cm from her nest entrance. She grasped the prey by a leg, flew with it, and released it on the sand, 30 cm to the opposite side of the entrance. She then pulled it backwards on the ground, grasping it with the mandibles by a leg, released it 5 cm from the entrance, walked to the opening, turned around, walked back to the prey, pulled it backwards by a leg, and released it beside the entrance. She grasped the prey by its spinnerets with the mandibles, and pulled it into the burrow.

The wasp appeared headfirst in her entrance 4 min after entering and began flinging sand alternately into the burrow with the forelegs and hammering this sand into place with the end of the abdomen. She came onto the sand surface to distances of 1-6 cm from the entrance to obtain loose sand for the fill, even though the tumulus was only 2.5 cm long. After filling the burrow and entrance, the female spent 2 min placing small twigs atop the fill. She eventually removed one of the several twigs placed on the filled entrance but left the others in place. Her final closure took 12 min to completion. A second wasp was collected as she closed her nest. She did not place debris atop the filled entrance.

The tumuli in front of the 0.7 and 0.6 cm-wide entrances were 2.0 cm wide and 2.5 cm long and 4.5 cm wide and 6.0 cm long, respectively. The straight burrows, 3.8 and 6.4 cm long, terminated in cells, 3.3 and 3.9 cm beneath the sand surface, respectively, (Figs. 1a,b). The cells, 0.5 cm high and wide and 0.6 and 0.9 cm long, respectively, contained a thoroughly paralyzed *Araneus bonsallae* (McCook), ♀, placed on its left side and a quiescent *Eriophora ravilla* (C. L. Koch), immature ♀, on its right side (both Araneidae), with the cephalothoraces placed toward the entrances. The eggs, 0.04 and 0.06 cm wide and 0.15 and 0.22 cm long, were placed obliquely on the right side of the spider's abdomen, nearly halfway from the base (Fig. 2a) and almost longitudinally on the left side of the spider's abdomen, nearly midway from its base (Fig. 2b). The wasps weighed 13 and 24 mg and the spiders, 18 and 54 mg.

*Anoplius apiculatus pretiosus* (Banks)

Ar; 29 March 1972; 12 March 1986; 1130 (EST). A female was observed constructing a burrow 16 cm from her prey, which lay dorsum upward on the sand. She pulled the spider on the ground into the opening, grasping it by its spinnerets, but it became wedged just inside. The wasp then spent 23 min digging around the spider, pulled it farther downward into the opening, and covered it nearly completely with loose sand, using the forelegs alternately. The resulting depression from which she took the sand measured 3.0 x 4.5 cm. The wasp then walked across the sand and began another burrow, 80 cm away. She periodically interrupted digging in her 2nd burrow, walked to the 1st excavation, examined the exposed parts of the spider with her antennae, walked back to the 2nd site, and resumed digging.

After digging in the 2nd excavation for 12 min, the wasp walked to the 1st site,

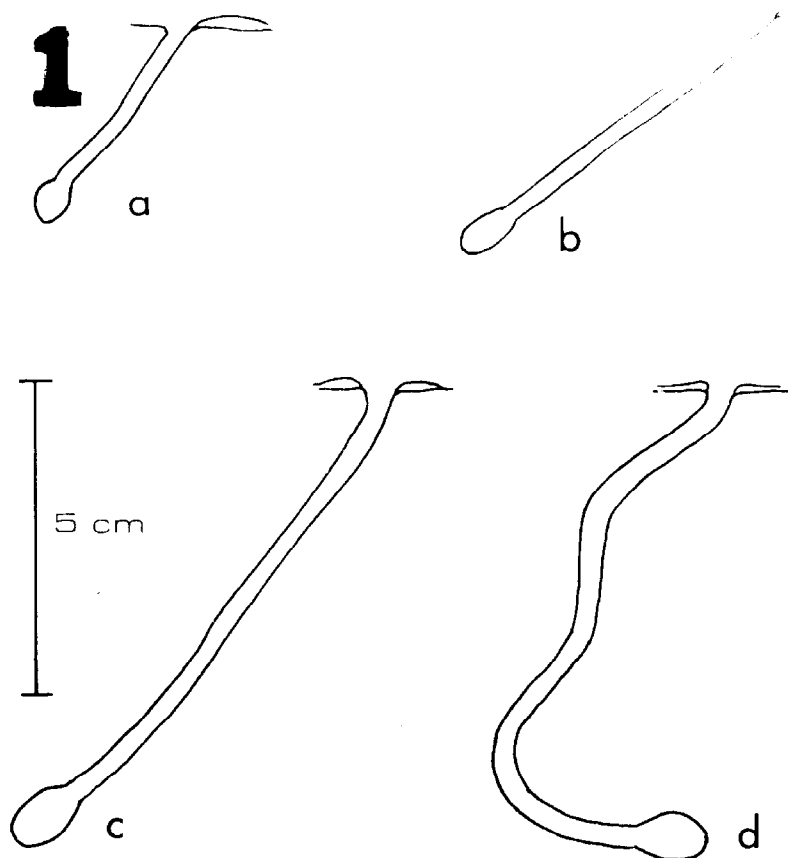


Fig. 1. Burrows and cells of species of Pompilidae, as viewed from the side: a, b, *Episyron conterminus posterus*; c, *Anoplius apiculatus pretiosus*; d, *A. bequaerti*.

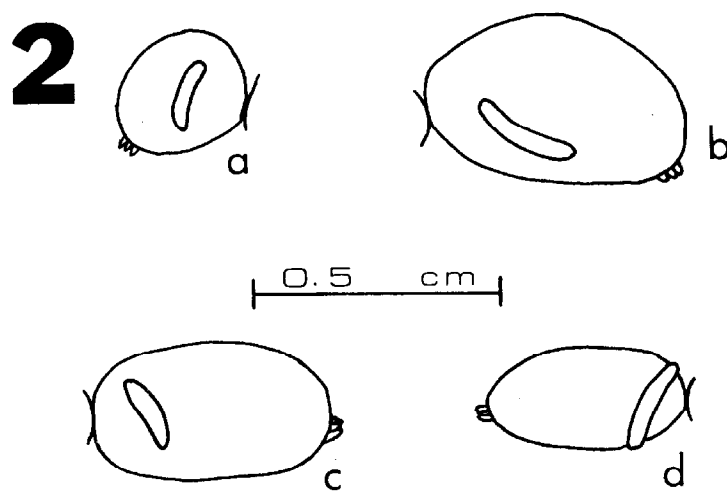


Fig. 2. Abdomens of prey spiders of species of Pompilidae, as seen in side view, showing placements of wasps' eggs: a, b, *Episyron conterminus posterus*; c, *Anoplius apiculatus pretiosus*; d, *A. bequaerti*.

grasped the spider by a leg with the mandibles, pulled the prey across the sand, released it, dorsal side upward, and started a 3rd excavation, 1.1 m from the prey. She stopped digging, walked to the spider, pulled it backwards, grasping it as before, and released it 1 cm from the opening. She then dug alternately with the forelegs, backed out periodically while removing sand, and occasionally walked to and examined the spider with her antennae. After 7 min of digging, the wasp grasped the spider by a hindleg with the mandibles, placed its abdomen inside the hole, pulled it out of the hole, put it dorsum up beside the entrance, and examined it for several sec. She then resumed digging and eventually covered the spider almost completely with sand except for the ends of its legs. After digging for 21 min, the wasp grasped the spider by a hindleg and, once again, placed its abdomen inside the entrance. She then dug beneath it, but had considerable difficulty attempting to pull the spider into the burrow by its spinnerets, using the mandibles. The prey became wedged in the opening and the wasp spent another 5 min alternating between digging around the spider with the forelegs and pulling it down the burrow by its spinnerets with the mandibles.

Two min after pulling the prey inside the female appeared headfirst in the entrance, closing the burrow. She came out, flung sand backward rapidly, using the forelegs alternately, and backed inside and hammered the sand into place with the end of the abdomen. After 9 min of closing, the wasp flew away but was captured. This closure was essentially identical to one observed 14 yr earlier at the same locality.

The entrances to the nests from 1972 and 1986, 0.9 and 1.0 cm wide, had not been filled flush. The rather straight burrows, 8.5 and 9.5 cm long, led to cells, 7.0 and 7.5 cm beneath the surface (Fig. 1c). The cells, 0.6 and 0.7 cm high and wide, respectively, and 0.8 and 1.0 cm long, contained rather lightly paralyzed *Arctosa* sp., immature and penultimate ♀ (Lycosidae) with the cephalothoraces positioned outward and dorsum upward. The eggs, 0.04 and 0.06 cm wide and 0.15 and 0.18 cm long, were both laid obliquely on the left sides of the spiders' abdomens near their bases (Fig. 2c). The wasps weighed 12 and 21 mg and the spiders, 26 and 88 mg.

*Anoplius bequaerti* (Dreisbach)

ABS; 11 March 1986; 1030-1210 (EST). Three females were observed walking on the sand, flicking their wings, and antennating the sand surface. Periodically, these wasps paused and dug briefly in the sand with the mandibles and forelegs, presumably searching for prey.

One wasp had captured a spider. After constructing her burrow, she dragged the prey on the sand by a hindleg with the mandibles and pulled it into her nest by its spinnerets, using the mandibles. The female appeared headfirst in her entrance, 23.5 min after entry with prey, and began shoving sand backward with the mid- and hindlegs while packing this sand into place with the end of the abdomen. She then came onto the surface and, bending the forelegs medially, raked sand backwards into the burrow, using the forelegs alternately. As she backed in and hammered the sand into the burrow with the end of the abdomen, her mid- and hindlegs continued to shove sand backward. During this behavior, the antennae were curled at the ends, the forelegs were held laterally, and the wings were held flat on the dorsum. After 27.5 min of closing, the female flew off but was captured.

The entrance was 0.5 cm in diameter. The tumulus was evenly dispersed around the entrance. The burrow entered the sand at a 40° angle to the horizon for 3 cm, plunged vertically for 2.3 cm, and then curved back on itself for an additional 6 cm (Fig. 1d). Its total length was thus 11.3 cm and it terminated in a cell, 7.4 cm beneath the surface. The cell, 0.7 cm high and wide and 0.95 cm long, contained a rather thoroughly paralyzed

*Lycosa* sp., immature (Lycosidae) placed cephalothorax outward and ventral side upward. The wasp's egg, 0.07 cm wide and 0.25 cm long, was affixed obliquely to the right side of the spider's abdomen near the base (Fig. 2d). The wasp weighed 46 mg and the spider, 52 mg.

*Anoplius stenotus* (Banks)

Ar; 13 March 1986; 1159 (EST). A female was seen digging at the base of a steer hoofprint, periodically backing out 3-4 cm from the opening, and removing sand alternately with the forelegs. Her movements were noticeably slower than those of *A. apiculatus pretiosus* (see above). A paralyzed *Arctosa* sp., immature, had been deposited, dorsum upward, in the shade, 7 cm from the entrance. The wasp occasionally rested and cleaned her antennae with the forelegs; then she would plug the entrance from below with damp sand, back out, and remove this accumulation every 4 to 8 (mean, 6.0; N=5) min. After 31 min of burrow construction, the female appeared in the entrance headfirst, as though finished with the tunnel, but then she continued to dig for an additional 61 min, possibly because of sand cave-ins within the burrow. Her total burrow construction time thus exceeded 1.5 h.

Periodic examinations of the spider were made by the wasp at intervals of 1-11 (mean 3.8; N=24) min. During each examination the female extended her antennae which were curled at the ends toward the spider and held them rigid for 20-30 sec; then, she turned and walked back into the opening. Six times the wasp repositioned the spider either dorsum or venter up in the vicinity of (1-4 cm) or within the entrance, each time grasping it by a hindleg with the mandibles, occasionally holding its body perpendicular to hers. Before her next to last repositioning of the prey, the wasp enlarged the entrance from 0.5 cm to 1.1 cm in diameter. She then flung the spider which lay partly in the entrance out of the opening to a distance of 1 cm from the entrance, while digging with forelegs, plugged the entrance from inside with damp sand, backed out removing the accumulation, went inside headfirst, turned around within, and pulled in the prey by its spinnerets, using the mandibles.

She appeared headfirst 3 min later, began filling the burrow by flinging sand backward, using the forelegs alternately, and hammered this sand into place with the end of the abdomen. During this behavior her antennae were spread laterally against the walls and curled at the ends. The wings were held flat on the dorsum.

Her entrance was in the side of the steer hoofprint near the bottom, 5.5 cm beneath the sand surface. The burrow was traced almost laterally for 3.5 cm but was lost in the dry, loose, collapsing sand. The wasp weighed 16 mg, and the spider weighed ca. 20-25 mg.

#### DISCUSSION

Very little is known about the behavior of females of the nearctic Scoliidae (Krombein 1979). Nothing is known about the behavior of the males. The tunneling of the male of *Campsomeris plumipes fossulana* as inclement weather approached and its subsequent passivity underground may represent typical *Campsomeris* behavior despite the fact that it has never been described. The burrowing behavior of the male evidently functions in enabling him to achieve an optimal depth for resting during the night and periods of inclement weather. The female tunnels to locate, sting, and oviposit upon prey. Her burrowing behavior is more efficient and more pronounced than that of the

male, i.e., she disappears from sight more quickly and her movements are more exaggerated (see Kurczewski 1963a). To facilitate this, her body is more robust and her legs are larger and more spinous than those of the male.

*Auplopus mellipes mellipes* constructs mud cells in the abandoned nests of certain Vespidae and Sphecidae, in tunnels in wood, beneath loosened bark, under exposed roots, and in abandoned bee burrows in the ground (Krombein 1979). The females prey upon Pisauridae, Gnaphosidae, Thomisidae, and Salticidae (Krombein 1979). As in other Auplopodini, the spider's legs are amputated prior to its placement in the cell (Evans & Yoshimoto 1962). Our record of this species preying upon ?*Aysha velox* (Anyphaenidae) introduces a new family, genus and species of prey.

The palearctic *Agenioideus cinctellus* (Spinola) apparently does not excavate its own nest but, instead, appropriates niches in walls, rotten wood, and abandoned burrows of other insects (summary in Richards & Hamm 1939). All 3 of the nearctic species of *Agenioideus* are attracted to walls, cliffs, and buildings (Evans 1950). The lack of fossorial spines on the forelegs of *A. birkmanni* hints at its use of pre-existing cavities for nesting sites. This species has been collected twice previously with prey, in each case a female of *Herpyllus vasifer* (Walckenaer) (Gnaphosidae) (Evans 1950, Kurczewski & Kurczewski 1968). Our record of *A. birkmanni* preying upon the salticid *Platycryptus undatus* introduces a new prey family, genus, and species. Richards & Hamm (1939) list a variety of Salticidae and Thomisidae as prey of *A. cinctellus*. Evans (1950) reported *A. birkmanni* transporting prey in flight but Kurczewski & Kurczewski (1968) noted this species "pulling" its spider through grass. In the observation presented herein, the wasp was pulling its prey across the bark of a tree (M. Deyrup, pers. comm.). Obviously manner of prey transport is dependent upon the size of the spider, as is presumably the case in the palearctic *A. cinctellus* (Richards & Hamm 1939).

*Episyron conterminus posterus* nests in sand and preys upon orb-weaving spiders (Krombein 1979). Rather extensive observations on the nesting behavior and nests of this species have been published by Krombein (1952, 1955, 1958, 1959, 1964) and by Kurczewski (1963b, 1981). The only new information we add to the known nesting behavior of *E. conterminus posterus* is the observation of 1 female placing twigs on its nest after closing it. In this regard this wasp resembles one female of *Poecilopompilus algidus algidus* (Smith) that, likewise, placed debris and pine needles atop its filled entrance (see Kurczewski 1981). *Araneus bonsallae* (Araneidae) is a new species of prey for *Episyron conterminus posterus*.

*Anoplius apiculatus* (Smith) is another sand-nesting pompilid that has been studied in some detail (Krombein 1979). Two subspecies, *A. apiculatus autumnalis* (Banks) and *A. apiculatus pretiosus* (Banks), prey almost exclusively on the sand spider, *Arctosa littoralis* (Lycosidae) (Evans & Yoshimoto 1962). After prey capture and during burrow construction, the spider is frequently moved close to the entrance and covered with sand (Krombein 1952, Evans, et al. 1953, present study). Our observations indicate that *A. apiculatus pretiosus*, like *A. apiculatus autumnalis* (see Evans, et al. 1953), may make several false starts, each time moving the spider to the vicinity of the excavation, before remaining in 1 place and completing a nest.

Virtually nothing is known about the nesting behavior of *Anoplius bequaerti*. Krombein (1964) described the prey transport of 1 female. Kurczewski (1981) collected 1 wasp with an immature *Schizocosa* sp. (Lycosidae). The record we present herein (*Lycosa* sp.) confirms the use of wolf spiders as prey. Our observations on the hunting, closure, nest structure and dimensions, cell contents, and egg placement provide new information for this species of pompilid.

*A. stenotus*, likewise, has been little studied (Krombein 1979). Krombein & Evans (1955) described the nest and prey of 1 female. Kurczewski & Kurczewski (1973) and

Kurczewski (1981) noted the prey of 2 other wasps. In all cases, including the present study, the prey comprised species of Lycosidae. The constant examinations of the spider and the periodic repositioning of the prey are noteworthy behaviors in this species of pompilid. The unusually lengthy period of burrow construction and the continual, apparent sand cave-ins that we report are reminiscent of those of *A. apiculatus autumnalis* (see Evans, et al. 1953) which also nests in loose sand.

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## ATTRACTION OF SOME ADULT MIDGES (DIPTERA: CHIRONOMIDAE) OF FLORIDA TO ARTIFICIAL LIGHT IN THE FIELD

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### ABSTRACT

The attraction of pestiferous species of adult Chironomidae to commercially available lamps of various colors and wattages was studied by employing New Jersey light traps along the shoreline of a central Florida lake. *Glyptotendipes paripes* Edwards, *Goeldichironomus holoprasinus* Goeldi, *Chironomus crassicaudatus* Malloch, and species of Tanypodinae were predominant in the collections. A comparison of 100-W incandescent lamps showed that white was preferred over yellow, and both were preferred over red, orange, green or blue. Analysis of deviance indicated that these differences were due primarily to differences in intensity (lux), although smaller effects of color and differences in response among species were detected. No differences were observed in preference between 60-W white incandescent or fluorescent lamps. These results were consistent with previous laboratory studies, and indicate that manipulating light intensity, rather than color, may be more appropriate in the overall development of an integrated control strategy of nuisance chironomid midges.

### RESUMEN

Se estudio la atracción de plagas de especies de Chironomidae por lámparas de varios colores y vatios de tipo New Jersey accesibles comercialmente, a lo largo de la costa de un lago en la parte central de la Florida. *Glyptotendipes paripes* Edwards, *Goeldichironomus holoprasinus* Goeldi, *Chironomus crassicaudatus* Malloch, y especies de Tanypodinae predominaron en las colecciones. Una comparación de lámparas incandescentes de 100 vatios indicó que el blanco era preferido sobre el amarillo, y que ambos eran preferidos sobre el rojo, verde, o azul. Análisis de desviación indicó que esas diferencias se debían principalmente a diferencias en intensidad (lux), aunque se detectó pequeño efectos por el color y diferencias en reacción entre las especies. No se observa-