THE ECHMEPERTHYX HAGENI COMPLEX
(PSOCOPTERA: LEPIDOPSOCIDAE) IN FLORIDA

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ABSTRACT

The Echmepteryx hageni complex in Florida includes 3 species. Two are described as new and a full description of E. hageni (Packard) is presented. In Florida, E. youngi n. sp. seems to be the only bisexual member of the complex. Males of E. intermedius n. sp. are unknown, and those of E. hageni are extremely rare. In southern Florida E. youngi occurs in most plant communities dominated by trees or shrubs but where its range overlaps that of E. hageni, it is restricted almost entirely to the sand scrub communities and occurs primarily on 2 species of pine.

The type species, Echmepteryx hageni (Packard), of a largely tropical genus, occurs commonly on tree trunks and branches throughout the eastern United States and southeastern Canada. Forms, presumably all distinct species, very closely allied to it occur in Florida, most islands of the Caribbean, southeastern Mexico, and Belize. These presumed species plus E. hageni constitute the Echmepteryx hageni complex.

In Florida and the southeastern corner of Georgia this complex consists of 3 discrete species. Two are allopatric with respect to each other, while the third broadly overlaps the ranges of the other 2.

The purpose of this paper is to describe 2 of these species as new, to present an augmented description of E. hageni, and to discuss ecological and phylogenetic relationships among these species.

In all members of the complex described here, the face is marked with a singular pattern (Fig. 1, 4, 7) always involving an arched mark in each parietal region over the lateral ocellus. The lacinial tip is tridentate (Fig. 20) and the pretarsal claw (Fig. 21) bears a large preapical denticle, several minute denticles at the ends of striae in the middle region, and a basal acuminate bristle. The female subgenital plate has a small triangular pigmented area with apex of the triangle anterior; the area is setose with 4 setae longer than the others on its posterior margin. The sense cushion of the paraprostoma is diffuse and includes 6 trichobothria and 1 long seta with no basal floret. Female gonapophyses, as in all members of the genus, are reduced to the setose third valvulae, which are elongate, slender, and joined to each other by membrane along the mid-line. The spermathecal duct from its external orifice for a short distance back is surrounded by a sclerotized collar. Proportions of this collar differ in the different species.

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1 Contribution No. 386, Bureau of Entomology, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Fla. 32602.
Fig. 1-9 *Echmepteryx hageni* complex species: 1) *E. hageni* (Packard) female, facial markings (scales in mm); 2) *E. hageni* (Packard) female, forewing; 3) *E. hageni* (Packard) female, anterior tibia; 4) *E. youngi* n. sp. female, facial marking, scale of Fig. 1; 5) *E. youngi* n. sp. female, forewing, scale of Fig. 2; 6) *E. youngi* n. sp. female, anterior tibia, scale of Fig. 3; 7) *E. intermedia* n. sp. female, facial markings, scale of Fig. 1; 8) *E. intermedia* n. sp. female, forewing, scale of Fig. 2; 9) *E. intermedia* n. sp. female, anterior tibia, scale of Fig. 3.
Fig 10-18 *Echmepteryx hageni* complex species: 10) *E. hageni* (Packard) female, left valvula; 11) *E. hageni* (Packard) female, collar of spermathecal duct; 12) *E. hageni* (Packard) female, distal segment of maxillary palpus; 13) *E. youngi* n. sp. female, left valvula, scale of Fig. 10; 14) *E. youngi* n. sp. female, collar of spermathecal duct, scale of Fig. 11; 15) *E. youngi* n. sp. female, distal segment of maxillary palpus, scale of Fig. 12; 16) *E. intermedia* n. sp. female, left valvula, scale of Fig. 10; 17) *E. intermedia* n. sp. female, collar of spermathecal duct, scale of Fig. 11; 18) *E. intermedia* n. sp. female, distal segment of maxillary palpus, scale of Fig. 12.
MATERIALS AND METHODS

Material examined consisted of 250 adult specimens and 140 nymphs, the latter determined to species by their facial pattern. Of these, 91 adults and 23 nymphs represent *E. hageni*, 123 adults and 72 nymphs represent *E. youngi*, and 36 adults and 45 nymphs represent *E. intermediata*. With exception of 1 locality in southeastern Georgia near the Florida line, all material is from Florida.

Measurements are stated in microns and have an error of ±0.77μ. Abbreviations for structures measured are as follows: Fw = forewing length; f₁, f₂ = lengths of first and second flagellomeres; F = posterior femur length; T = posterior tibial length; t₁, t₂, t₃ = lengths of first, second, and third tarsomeres. The micrometer unit used in constructing the scatter diagram (Fig. 23) of relationship of forewing length to greatest forewing width is approximately 16.3μ and is not converted to metric units in the diagram.

_Echmepteryx hageni_ (Packard)

*Amphientomon hageni* Packard, 1870:406.
_Echmepteryx agilis_ Aaron, 1886:17.
_Echmepteryx hageni_ (Packard), Enderlein 1906:104.

Diagnosis.—Parietal arched marks of face including a narrow band on each side close to and paralleling margin of compound eye (Fig. 1). Forewing relatively broad (Fig. 2, 23). Third valvula long and slender (Fig. 10).

Color (in alcohol; sexes similar).—Compound eye of fresh specimen pale grayish-green with a dark brown band running from region of antero-ventral eye margin nearest antennal socket postero-dorsally, not reaching posterior margin. Compound eye black on specimens in alcohol several months or more. Face marked (Fig. 1), with dark areas dark brown, pale areas dull creamy white to pale brown. Thorax dorsally clothed in dark brown scales, the cuticle under these medium brown. Thoracic pro- and mesopleura dark brown; remainder of thorax pale to medium brown. Legs from coxa to middle of each femur pale to medium brown. Distal half of each femur darker brown. Each tibia banded in pattern of Fig. 3 with dull creamy white and dark brown. Each tarsus with dark brown basal band, fading distally, occupying basal third of t₁; remainder dull creamy white. Forewings clothed in dark brown scales, the membrane medium brown except colorless in distal fifth. Preclunial abdominal segments sparsely clothed in medium brown scales; the cuticle (or subcuticular pigment?) pale brown. Clunium, epiproct, paraprocts, and external genitalia dark brown.

General morphological features.—Head in frontal view with posterior margin approximately straight, slightly depressed at mid-line. Fourth segments of maxillary palpus (Fig. 12) relatively slightly dilated toward apex.

Male external genitalia.—Hypantrium smoothly rounded posteriorly, setose over its entire margin except on lateral margins. Phallosome (Fig. 19) of general type seen in *E. madagascariensis* (Kolbe) and *E. terricolis* Badonnel. External parameres long and slender, distally enclosing at least in part the internal parameres; externals bearing a few pores near their tips, tapering at their tips. Internal parameres elongate, slender, hollowed internally, also bearing pores. At bases of internal parameres a pair of bulb-like structures, and basal to these a cup-shaped region divided medially.

Female genitalia.—Third valvula as described in diagnosis. Collar of spermathecal duct (Fig. 11) elongate and slender.
Distribution.—Eastern United States and southeastern Canada west to central Iowa, southeastern Kansas, and eastern Texas.


Georgia.—Camden Co.: Crooked River State Park, 16 Oct. 1973, beating scrub live oak (Quercus geminata), and long-leaf pine, 2 females.

Echmepteryx youngi, n.sp.

Diagnosis.—Parietal arched marks of face lacking a narrow band on each side paralleling margin of compound eye (Fig. 4). Forewing relatively slender (Figs. 5, 23). Third valvula (Fig. 13) relatively short and stubby.

Color (in alcohol; sexes similar).—Compound eye in fresh specimen pale grayish-green with a dark brown band of irregular width from just above antero-ventral margin toward postero-dorsal margin, ending before reaching latter margin, and a large dark brown blotch in region of eye bordering gena. Compound eyes black in specimens in alcohol several months or more. Face marked as in Fig. 4, with dark areas dark brown, pale areas dull creamy white to pale brown. Thorax dorsally clothed in medium brown, shining scales, the cuticle under these medium brown. A broad band through pro- and mesopleurae dark brown; remainder of thorax creamy white. Coxae mottled
dusky brown to creamy white; femora creamy white except medium brown distally. Tibiae banded as in Fig. 6 with dull creamy white and dark brown, the dark brown bands relatively narrower than in *E. hageni*. Each tarsus with dark brown basal band, fading distally, occupying basal third of tarsus. Forewings (Fig. 5) spottily clothed in dark brown scales, the membrane variegated brown to clear. Preclunial abdominal segments sparsely clothed in medium brown scales; subcuticular pigmen pale brown, darker on sides. Clunium, epiproct, paraproct, and external genitalia dark to pale brown.

Measurements.—Table I.

General morphological features.—Head in frontal view (Fig. 4) with posterior margin slightly indented at mid-line, from there arching slightly up on each side and down to compound eye margin. Fourth segment of maxillary palp (Fig. 15) decidedly more dilated toward its apex than in *E. hageni*.

Male external genitalia.—Hyandrium as described for *E. hageni*. Phallosome (Fig. 22) in general as described for *E. hageni* but differing as follows: external parameres each bearing a decided transverse crease near its tip; tip more bent inward; internal parameres distal of the 2 bulbous structures decidedly shorter; each internal paramere decidedly constricted in a

Fig. 19-22 *Echmepteryx hageni* (Packard) and *E. youngi* n. sp.; 19) *E. hageni* (Packard) male, phallosome; 20) *E. hageni* (Packard) male, lacinial tip; 21) *E. hageni* (Packard) female, pretarsal claw; 22) *E. youngi* n. sp. male, phallosome, twice scale of Fig. 19.
Mockford: The Echmepteryx hageni Complex

short region just distad of the bulbous structures; the bulbous structures narrower; the divided cup-shaped region basal to the two bulbous structures more diffuse.

Female genitalia.—Third valvula as described in diagnosis. Collar of spermathecal duct (Fig. 14) relatively short.

Type locality.—Florida: Sarasota Co.: Myakka River State Park, 30 August 1951, on trunks of cabbage palms (Sabal palmetto); holotype male, allotype female, 1 male, and 6 female paratypes. The type material is in the author's collection.


I take pleasure in naming this species for Dr. Frank N. Young, who introduced me to the natural history of Florida.

Echmepteryx intermedia, n. sp.

Diagnosis.—Parietal arched marks of face (Fig. 7) lacking a narrow band on each side paralleling margin of compound eye. Forewing relatively slender, of intermediate width between those of E. hageni and E. youngi (Fig. 8, 23). Third valvula (Fig. 16) shorter than in E. hageni, somewhat longer and more slender than in E. youngi.

Color (in alcohol).—Compound eyes black in specimens in alcohol several months or more. Face marked as in Fig. 7, with dark areas dark brown, pale areas dull creamy white. Generally each parietal arched mark with a pale spot in its broadest part. A narrow brown band on posterior surface of head behind parietal mark. Thorax dorsally at least partially clothed in medium brown

Measurements.—Table I.
**TABLE 1. Measurements (in microns) for Florida Species of the *Echmepteryx hageni* complex.**

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scales, the cuticle under these medium brown. Thoracic pleura and legs as described for *E. youngi*, except dark tibial bands slightly wider (Fig. 9). Tarsi as described for *E. youngi*. Forewings clothed in brown scales (largely rubbed off in specimens on hand); long marginal scales in alternating patches of dark and pale around distal margin of wing. Forewing membrane mostly pale brown, with clear basal and distal regions as indicated in Fig. 8. Preclunial abdominal segments sparsely clothed in medium brown scales; subcuticular pigment creamy white, somewhat darker on sides. Clunium, epiproct, paraprocts, and external genitalia dark to medium brown.

General morphological features.—Head in frontal view (Fig. 7) with posterior margin slightly indented at mid-line, approximately straight on either side. Fourth segment of maxillary palpus (Fig. 18) more dilated distally than in *E. hageni*, its distal margin more oblique than in *E. youngi*.

Female genitalia.—Third valvula as described in diagnosis. Collar of spermatic duct (Fig. 17) relatively short and slender.

Type locality.—Florida: Palm Beach Co.: Highway 441 w. Boynton Beach, 3 Dec. 1970, beating slash pines, holotype female, 6 female paratypes, and 5 ny. The types are in my collection.

Records.—Florida: Collier Co.: Collier Seminole State Park, 23 Feb. 1956, on royal palm (*Roystonea regia*) trunk in hammock, 1 female; 2 mi. 

Discussion.—In an earlier paper (Mockford, 1971) I considered the Florida species of this complex to be a single species. I noted the existence of the 3 forms which, without stating it, I thought were geographic races. I also noted the regular occurrence of males of “form B” (*E. youngi*) in the southern half of the Florida Peninsula. Data gathered since that publication strongly suggest the new interpretations given here. *E. youngi* occurs throughout most of Florida (Fig. 24) and is apparently bisexual throughout its range. It is sympatric with *E. intermedia* and overlaps the southern edge of the range of *E. hageni*. There is no evidence for its hybridization with either of the other 2 species, both of which seem to be parthenogenetic. Considering the absence of hybridization as well as its morphological differences, it must be regarded as a distinct species from either of the other 2.

Parthenogenesis has already been shown for *E. hageni* (Mockford 1971) and, to my knowledge, only a single male has been taken in Florida. This male was taken on my first collecting trip to Florida in 1951. Absence of males in any subsequent collections suggests that there is no bisexual population of the species in the state.

Parthenogenesis in *E. intermedia* must be verified by additional collecting and laboratory rearing, but absence of males to date is certainly suggestive.

*E. hageni* in Florida and *E. intermedia* appear to be allopatric agamospecies. There is a collecting hiatus between their known ranges, and filling in of the hiatus will be important in testing this conclusion. Morphologically, the 2 are completely separable and at least as distinct as some sympatric pairs of biospecies known in the Psocoptera.

*E. youngi* shows a notable narrowing of its habitat in northern Florida where it overlaps with *E. hageni*. South of the range of *E. hageni*, it has been taken on trunks and leaves of cabbage palm, leaves of thatch palm, mangroves, geiger tree, and slash pine. Thus, it occurs in the major tree- and shrub-dominated vegetation types of southern Florida: hardwood hammocks, mangrove swamp, pine flatwoods, and coastal scrub. Within the range of *E. hageni*, *E. youngi* has been found almost entirely in sand scrub, where it occurs primarily on long-leaf pine and sand pine, and to a lesser extent on turkey oak and live oak. In northern Florida it has never been taken in pine flatwoods, and only a single specimen has been found in a hardwoods hammock. In Florida, *E. hageni* occurs in all tree-dominated vegetation types within its range, but in sand scrub it appears to be more abundant on oaks than on long-leaf pine, and it has never been taken on sand pine. Habitat restriction of *E. youngi* in northern Florida may have resulted from competition with *E. hageni*. 
Fig. 24. Distribution pattern of 3 species of *Echmepteryx* in Florida. Superimposed symbols and pairs of symbols connected by an arrow indicate sympatry.

**Acknowledgments**

The majority of records from the Florida Keys resulted from material contributed by Dr. E. O. Wilson of Harvard University and Dr. D. Simberloff
of Florida State University. Four specimens, including the only material on hand from the Dry Tortugas, were borrowed from the Florida State Collection of Arthropods, Gainesville, through the curator, Dr. Howard V. Weems, Jr. Specimens also were contributed by Dr. and Mrs. Lauren Brown and Dr. R. O. Rilett of Illinois State University, Dr. P. Kannowski of the University of North Dakota, and Mr. A. Manzano, Normal, Illinois. I acknowledge with thanks the loans and gifts of material from the above named individuals and institutions.

LITERATURE CITED


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MEIOSIS IN THE GRASSHOPPER. III. CHIASMA FREQUENCIES IN FEMALES AFTER ELEVATED TEMPERATURE—(Prepublished Abstract.) The effect of high temperature on chiasma formation during oogenesis has been studied in the grasshopper Melanoplus femur-rubrum (De Geer). Prolonged heat treatment (40° C.) during mid-prophase of meiosis causes a reduction in the mean chiasma frequency per cell. Only those bivalents in which more than 1 chiasma occurs are affected by the heat. The pattern of chiasma frequency response to heat is similar to that which occurs in males of the same species. Heredity, 1974, 32(2): 159-164; K. Church, Arizona S. Univ., Tempe 85281.