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ORMENARIA RUFIFASCIA (HOMOPTERA: FULGOROIDEA: FLATIDAE): DESCRIPTIONS OF NYMPHAL INSTARS AND NOTES ON FIELD BIOLOGY[1]

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Abstract.—The five nymphal instars of *Ormenaria rufifascia* (Walker) are described and illustrated. A key to instars and comparisons of the morphology of 5 genera of U.S. flatid nymphs are provided. Features useful in separating nymphal instars include spination of metatibiae and metatarsomeres, numbers of metatarsomeres and abdominal waxpads, and differences in body and wingpad sizes. One generation per year was observed in south Florida. Average developmental times ($\bar{x} \pm$ SD) for the first-fifth instars are 23 ± 2.2, 20 ± 2.0, 19 ± 2.3, 24 ± 1.9, and 8 ± 1.1 days, respectively. Mean adult longevity is 12 ± 1.6 days. Of 13 palm species and one non-palm plant studied, only *Sabal palmetto* (Walt.) Lodd. and *Latania lontaroides* (Gaertn.) H. E. Moore served as breeding hosts for *O. rufifascia.*

Ormenaria rufifascia (Walker) has been recorded from Florida, Georgia, and Cuba (Metcalf and Bruner, 1948). It has been reported feeding on 9 species of palms and 3 species of other plants (Metcalf and Bruner, 1948; Mead, 1965; Table 1). Although occasionally common on palms, injury is apparently slight (Mead, 1965). Other than records of host plants, little information is available on the biology of this flatid. Mead (1965) noted that nymphs were observed feeding in conspecific groups and are present from late April–May, and adults from mid-May–July, in Florida. Moore (1961) reported that adults produce tymbal vibrations.

Information on the morphology of this flatid is very limited. Metcalf (1923) provided a color illustration of an adult's head and thorax and Metcalf and Bruner (1948) described the adult and illustrated the male genitalia. Mead (1965) briefly described the nymphal color patterns. Of the 33 species of U.S. flatids (Metcalf, 1957), only the immatures of *Anormenis septentrionalis* (Spinola), *Metcalfa pruinosa* (Say), *Ormenoides venusta* (Melichar) (Wilson and McPherson, 1981) and *Cyarda* sp. near *acutissima* Metcalf and Bruner (Wheeler and Hoebeke, 1982) have been described.

This paper presents descriptions of the five nymphal instars and notes on the field biology of *O. rufifascia* in south Florida.

MATERIALS AND METHODS

Description of immatures. Specimens to be described were obtained from field cages (see below) and preserved in 70% ethyl alcohol. The first instar is described in

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detail, but only major differences are described for subsequent instars. Comparative statements refer to earlier instars (e.g., more numerous). Measurements are given in mm as mean ± SE. Length was measured from apex of vertex to apex of abdomen, width across the widest part of the body, and thoracic length along the midline from anterior margin of the pronotum to posterior margin of the metanotum. Several specimens of each instar were cleared in 10% KOH to observe obscure features such as body pits and waxpads. Twenty specimens of each instar were measured.

Field study. The development of *O. rufifascia* was studied from January to June 1983 in a small palm planting at Ft. Lauderdale, Broward County, Florida. Cabbage palm [*Sabal palmetto* (Walt.) Lodd] was used as test plant. Sleeve cages made of clear butyrate tubing measuring 22 cm long (dia: 5 cm) enclosed portions of pinnae for nymph release. Newly hatched nymphs were collected in the field and released singly into the sleeve cages. Specimens were observed and moltings recorded every 1–2 days. Daily temperature was recorded throughout the 6-month study period for comparing the nymphal developing rate.

A group of 13 species of palms including *Carpentaria acuminata* (H. Wendl. & Drude) Becc., *Veitchia merrilli* (Becc.) H. E. Moore, *Pritchardia eriostachya* Becc., *Veitchia merrilli* (Becc.) H. E. Moore, *Pritchardia eriostachya* Becc., *Ptychosperma nicolai* (Sand. ex Andre) Burret, *Livistonia chinensis* (Jacq.) R. Br. ex Mart., *Washingtonia robusta* H. Wendl., *Heterospathe elata* Scheff., *Cocos nucifera* L., *Phoenix dactylifera* L., *Phoenix roebelenii* O'Brien, *Caryota mitis* Lour, *Dictyosperma album* (Bory) H. Wendl. and Drude, and *Latania lontaroides* (Gaertn.) H. E. Moore; and one non-palm, screw pine (*Pandanus utilis* Bory), were examined bi-weekly in the same study area for the presence of *O. rufifascia.*

RESULTS AND DISCUSSION

Descriptions of Nymphs

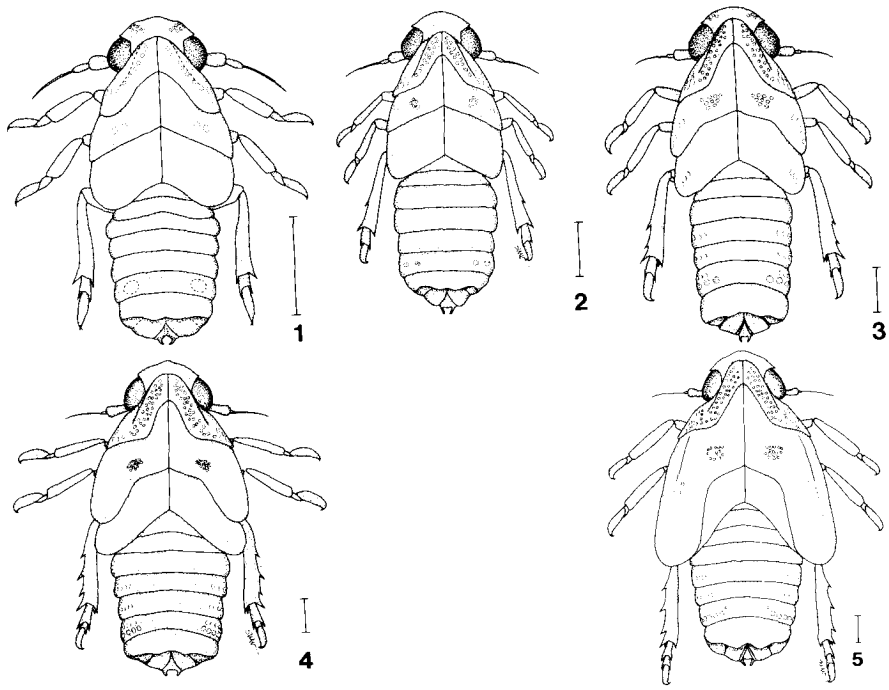
Nymphs are green with faint, longitudinal orange stripes and posterior filaments of white wax. Specimens turn white to stramineous when preserved in alcohol.

First instar (Fig. 1). Length 1.41 ± 0.018; thoracic length 0.60 ± 0.003; width 0.58 ± 0.006.

Form elongate, depressed, widest across mesothorax; body white (when preserved in alcohol), some specimens with posterior tergites tinged light brown.

Vertex rounded anteriorly, obscure pits in anterolateral corners, overlapped by pronotum posteriorly. Frons ovoid, length subequal to width; anterior margin convex, frontoclypeal juncture concave; lateral margins carinate (outer carinae), outwardly convex, and paralleled by pair of inner carinae ca. ⅔ distance from midline to outer carinae; row of pits between each inner and outer carina. Clypeus narrowing distally; consisting of subconical basal postclypeus and beaklike cylindrical distal anteclypeus. Beak 3-segmented, extending to base of metacoxae; segment 1 covered by anteclypeus, segments 2 and 3 subequal. Eyes red. Antennae 3-segmented; scape ringlike; pedicel subcylindrical, ca. 2× length of scape; flagellum whiplike distally with bulbous base slightly longer than pedicel.

Thoracic nota divided by longitudinal middorsal line into 3 pairs of plates. Pronotum rounded anteriorly, overlapping vertex, posterior margin sinuate; each plate with



Figs. 1–5. *O. rufifascia* nymphs. 1. First instar. 2. Second instar. 3. Third instar. 4. Fourth instar. 5. Fifth instar. Vertical bars = 0.5 mm.

weak, outwardly curved carina forming anterior margin then curving posterolaterally and bordered medially by row of ca. 9 obscure pits. Mesonotum with median length ca. 1½× that of pronotum, posterior margin slightly sinuate; each plate with 2 obscure pits in lateral ½. Metanotum with median length subequal to that of mesonotum, posterior margin slightly curved. Pro- and mesocoxae elongate, posteromedially directed; metacoxae globose, fused to metasternum giving appearance of being subrectangular and transverse. Metatrochanters each with row of small teeth on medial aspect. Remaining segments of legs with very fine setae. Metatibiae with transverse row of 4 black-tipped spines at apex on ventral aspect. Each tarsus with 2 tarsomeres; pro- and mesotarsomere 1 wedgeshaped; metatarsomere 1 cylindrical with transverse row of 4 black-tipped spines at apex on ventral aspect; tarsomere 2 of all tarsi subconical, curved, with pair of small claws and median pulvillus at apex.

Abdomen 9-segmented, segments 1–7 visible dorsally, segments 8–9 telescoped anteriorly. Tergites 3–7 curving around lateral margins to ventral aspect. Very obscure pits present on some tergites. Tergite 7 notched medially on posterior margin. Each segment with the following number of waxpads on either side of midline: segment 6 with 1 small, obscure, whitish-yellowish oval waxpad on tergite, segments 7–8 each with 1 elongate, oval, caudal, whitish waxpad. Segment 9 without waxpads, elongate

vertically, surrounding anus, with small, ventral, fingerlike process on either side of midline.

Second instar (Fig. 2). Length 1.79 ± 0.035; thoracic length 0.83 ± 0.007; width 0.79 ± 0.007.

Frons with length ca. ⅔× its width. Antennae with bulbous portion of flagellum ca. ½× length of pedicel.

Pronotal plates each with 2 rows of obscure pits bordering carina; ca. 15–20 total pits on plate. Mesonotal median length ca. 2½× that of pronotum; each plate with group of ca. 5 obscure pits midway between midline and lateral margin and ca. 2 pits near lateral margin. Metatibiae with 1 black-tipped spine in distal ⅔ of lateral aspect of shaft and transverse row of 5 black-tipped spines at apex on ventral aspect. Metarsomere 1 with transverse row of 5 black-tipped spines at apex on ventral aspect.

Abdominal tergite 6 apparently with 2 small, very obscure, whitish, oval waxpads on each side in lateral ½.

Third instar (Fig. 3). Length 2.54 ± 0.059; thoracic length 1.22 ± 0.006; width 1.20 ± 0.010.

Frons length ca. ¾× its width.

Pronotal plates each with 2–3 irregular rows of obscure pits bordering carina; ca. 25–30 total pits on plate. Mesonotal plates each with group of ca. 10 obscure pits midway between midline and lateral margin and ca. 4 pits near lateral margin. Metanotal median length ca. ⅔ that of mesonotum, with ca. 3 pits near lateral margin. Metatibiae with 2 black-tipped spines in distal ½ of lateral aspect of shaft and transverse row of 6 (rarely 5) black-tipped spines at apex on ventral aspect.

Abdominal tergites 3–6 each with ca. 5 pits laterally on each side; tergite 6 with 3 small, obscure, whitish, oval waxpads on each side in lateral ½.

Fourth instar (Fig. 4). Length 3.89 ± 0.076; thoracic length 1.75 ± 0.013; width 1.88 ± 0.020.

Antennae with bulbous portion of flagellum ca. ⅓× length of pedicel.

Pronotal plates each with 3 irregular rows of obscure pits bordering carina; ca. 35–40 total pits on plate. Mesonotal plates each with group of ca. 12–15 obscure pits midway between midline and lateral margin; pits near margin apparently absent; wingpad distinctly lobate and covering ca. ½ of metanotum laterally. Metatibiae with 3 (rarely 2) black-tipped spines on lateral aspect of shaft. Metatarsi with 3 tarsomeres; tarsomere 1 with transverse row of 7 black-tipped spines at apex on ventral aspect; tarsomere 2 with 1 black-tipped spine on each side at apex on ventral aspect; tarsomere 3 similar to terminal tarsomere of previous instars.

Abdominal tergite 6 with 4 small, obscure, whitish, oval waxpads on each side in lateral ½.

Fifth instar (Fig. 5). Length 4.68 ± 0.117; thoracic length 2.36 ± 0.017; width 2.88 ± 0.061.

Antennae with bulbous portion of flagellum ca. ¼× length of pedicel.

Pronotal plates each with 3–4 irregular rows of obscure pits bordering carinae; ca. 40–45 total pits on plate. Mesonotal plates each with 3 obscure pits on lateral ⅓; wingpad extending to apex of metanotal wingpad and to third abdominal tergite.

Abdominal tergites 3–6 with pits generally more numerous. Tergite 6 with 5 small, obscure, whitish, oval waxpads on each side in lateral ½.

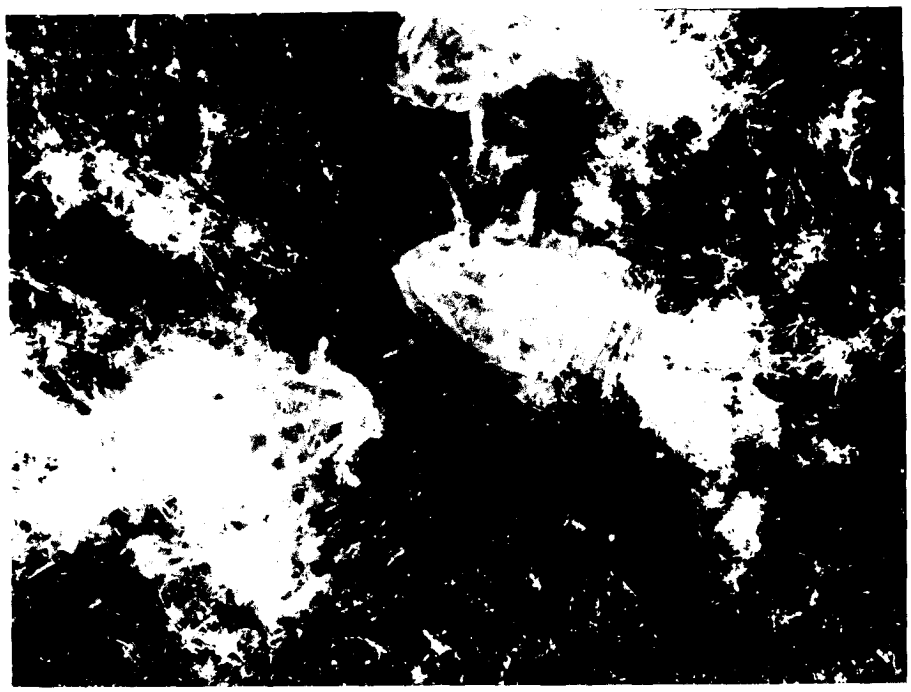


Fig. 6. Nymphs in life illustrating waxy exudate.

*Key to Nymphal Instars**

1. Metatarsi with 2 tarsomeres (Figs. 1–3) 2
– Metatarsi with 3 tarsomeres (Figs. 4, 5) 4
2. Metatibiae lacking spines on shaft, with an apical row of 4 spines; pronotal carinae bordered by 1 row of pits; abdominal tergite 6 with 1 oval waxpad on each side (Fig. 1) ..... First instar
– Metatibiae with 1 or more spines on shaft and an apical row of 5–6 spines; pronotal carinae bordered by 2 irregular rows of pits; abdominal tergite 6 with 2–3 waxpads on each side (Figs. 2, 3) 3
3. Metatibiae with 1 spine on shaft; abdominal tergite 6 with 2 waxpads on each side (Fig. 2) ..... Second instar
– Metatibiae with more than 1 spine on shaft; abdominal tergite 6 with 3 waxpads on each side (Fig. 3) ..... Third instar
4. Mesonotal wingpads covering ca. ½ of metanotum laterally; abdominal tergite 6 with 4 waxpads on each side (Fig. 4) ..... Fourth instar
– Mesonotal wingpads extending to apex of metanotum; abdominal tergite 6 with 5 waxpads on each side (Fig. 5) ..... Fifth instar

* This key will also work for nymphs of *A. septentrionalis, M. pruinosa,* and *O. venusta.*

Table 1. Plants associated with *Ormenaria rufifascia* and used in rearing experiments.

Taxon	Common name	Reference	Adults collected	Support nymphal development
Arecaceae				
Carpentaria acuminata (H. Wendl. & Drude) Becc.	Carpenter palm	This study	No	No
Caryota mitis Lour	Fish tail palm	This study	No	No
Cocos nucifera L.	Coconut palm	This study	Yes	No
Colpothrinax wrightii Griseb & H. Wendl.	Barrel palm	Metcalf and Bruner (1948)	Yes	—
Dictyosperma album (Bory) H. Wendl. & Drude	Hurricane palm	This study	No	No
Heterospathe elata Scheff.	Sagisi palm	This study	No	No
Latania loddigesii Mart.	Blue latan palm	Mead (1965)	Yes	—
Latania lontaroides (Gaertn.) H. E. Moore	Red latania palm	This study	Yes	Yes
Livistonia chinensis (Jacq.) R. Br. ex Mart.	Chinese fan palm	Mead (1965)	Yes	—
Phoenix canariensis Hort.	Canary Islands date palm	Mead (1965)	Yes	—
Phoenix dactylifera L.	Date palm	This study	No	No
Phoenix roebelenii O'Brien	Pigmy date palm	This study	No	No
Pritchardia eriostachya Becc.	Fan palm	This study	No	No
Pritchardia sp.	Fan palm	Mead (1965)	Yes	—
Ptychosperma nicolai (Sand. ex Andre) Burret		This study	No	No
Sabal etonia Swingle	Scrub palmetto	Mead (1965)	Yes	—
Sabal palmetto (Walt.) Lodd.	Cabbage palm	Mead (1965)	Yes	Yes
Serenoa repens (Bartr.) Small	Saw palmetto	Mead (1965)	Yes	—
Veitchia merrilli (Becc.) H. E. Moore	Christmas palm	This study	Yes	No
Washingtonia robusta H. Wendl.	Washington palm	Mead (1965)	Yes	—
Orchidaceae				
Cattleya sp.[a]	Cattleya orchid	Mead (1965)	Yes	—
Pandanaceae				
Pandanus utilis Bory	Screw pine	This study	No	No
Moraceae				
Ficus sp.[a]	Fig	Mead (1965)	Yes	—
Rosaceae				
Rosa sp.[a]	Rose	Mead (1965)	Yes	—

[a] Unconfirmed host record (Mead, 1965).

Table 2. Duration (in days) of the 5 nymphal instars and adults of *Ormenaria rufifascia* on *Sabal palmetto* in south Florida from January to June, 1983.

Instar	Range	Mean ± SD	# observed
1	18–28	23 ± 2.2	36
2	17–25	20 ± 2.0	28
3	15–26	19 ± 2.3	24
4	19–28	24 ± 1.9	21
5	5–10	8 ± 1.1	20
Adult	8–16	12 ± 1.6	20

Comparisons of Species of Flatid Nymphs

O. rufifascia is the fifth U.S. flatid in which the immatures have been described and illustrated. Immatures of the five species can be separated by color (in life; all turn white when preserved in alcohol) and external morphology. Identification by association with adults when collecting is risky since at least 3 species feed in mixed species feeding assemblages (Wilson and McPherson, 1980).

Live specimens of *O. rufifascia* and *O. venusta* are both green but *O. rufifascia* has orange longitudinal stripes whereas *O. venusta* has white stripes; the other 3 species are white in life. Preserved specimens can be separated by the following features. Late instar *A. septentrionalis* and *Cyarda* sp. (near *acutissima*) generally bear dark markings on the mesonotal wingpads, *A. septentrionalis* has a j-shaped waxpad on each side of abdominal segment 6 and c-shaped waxpads on abdominal segment 7. The waxpads on segments 6 and 7 are all ovoid on *Cyarda* sp. and the other species. *O. venusta* bears small, dark marks laterally on abdominal tergites 6–7, which are absent in the remaining species. *M. pruinosa* and *O. rufifascia* are the most morphologically similar. *M. pruinosa* is smaller, the vertex is truncate anteriorly, bears a weak median carina on the frons, and has ca. 6–8 weakly developed teeth on the inner margin of each metatrochanter. *O. rufifascia* is larger, has a broadly rounded vertex, lacks a median carina on the frons, and bears ca. 10 strongly developed teeth on the inner margin of each metatrochanter.

Field study. Ormenaria rufifascia adults have been collected or observed on 12 species of palms and non-palms (Metcalf and Bruner, 1948; Mead 1965; Table 1), but tests have never been conducted to determine if these or any other palms are breeding and/or feeding hosts. During a 2-year period (1982–1983), 14 species of palms and 1 non-palm species (Table 1) were examined in Fort Lauderdale and only cabbage palm, *S. palmetto* and red latania palm, *L. lontaroides,* supported nymphal development (Table 1). Cabbage palm is a native North American plant distributed throughout Florida and is a common host for *O. rufifascia.* Red latania palm is an uncommon introduced ornamental palm and is not an important host for *O. rufifascia.*

Field observations and cage rearing studies indicate that *O. rufifascia* is univoltine with five nymphal instars (Table 2). Numerous dissections of palm leaves were made

in an effort to discover oviposition sites. Eggs were never found. However, females probably insert eggs in palms because they have a sawlike ovipositor similar to those of flatids known to deposit eggs in plant tissues (Wilson and McPherson, 1981). The oviposition host is probably cabbage palms, because first instars were always found on this plant. Females were dissected in order to obtain eggs however none was found. As with other North American flatids (Wilson and McPherson, 1981), eggs are probably laid in summer, and hatch in January. Neither immatures nor adults have ever been found on palms from July to December in south Florida. The average instars (1–5) durations ($\bar{x} \pm$ SD) in the field were 23 ± 2.2, 20 ± 2.0, 19 ± 2.3, 24 ± 1.9, and 8 ± 1.1 days, respectively (Table 2). First instars were detected the second week of January. Adults emerged during the second week of May; mean adult longevity was 12 ± 1.6 days, with the last adults found in late June. Average monthly temperatures for January through June were 62.3, 65.0, 65.5, 65.8, 68.8, 75.1, and 77.9°F, respectively. The relatively rapid development of fifth instars may have resulted from the higher May temperatures.

Early instar nymphs exhibit gregarious and sedentary behavior near the basal portions of pinnae. Nymphs were never observed on the upper surfaces of palm leaves. The numbers of nymphs per aggregation ranged from 5 to 21. A white wax excreted by nymphs and presumed to serve a protective function (Hepburn, 1967) was always associated with nymphal aggregations. As nymphal development progressed, later instars tended to disperse and were often found singly on the undersides of leaves. Adults were often found near nymphal aggregations, but were rarely in groups of more than 3 individuals.

Occasionally large nymphs were observed with drops of honeydew attached to the posterior end. Nymphal aggregations were tended by 1 ant species, *Camponotus floridanus* Buckley. When disturbed, nymphs jumped up to 80 cm and away from aggregations, adults jumped and flew erratically while producing audible vibrations.

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