VOL. 98 APRIL 1996 NO. 2
(ISSN 0013-8797)

PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY of WASHINGTON

PUBLISHED QUARTERLY

CONTENTS

(*Continued on back cover*)

THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

ORGANIZED MARCH 12, 1884

All correspondence concerning Society business should be mailed to the appropriate officer at the following address: Entomological Society of Washington, % Department of Entomology, MRC-168, Smithsonian Institution, Washington, D.C. 20560.

MEETINGS.—Regular meetings of the Society are held in the Natural History Building, Smithsonian Institution, on the first Thursday of each month from October to June, inclusive, at 8 P.M. Minutes of meetings are published regularly in the *Proceedings.*

MEMBERSHIP.—Members shall be persons who have demonstrated interest in the science of entomology. Annual dues for members are $25.00 (U.S. currency).

PROCEEDINGS.—The *Proceedings of the Entomological Society of Washington* (ISSN 0013-8797) are published quarterly beginning in January by The Entomological Society of Washington. POSTMASTER: Send address changes to the Entomological Society of Washington, % Department of Entomology, MRC-168, Smithsonian Institution, Washington, D.C. 20560. Members in good standing receive the Proceedings of the Entomological Society of Washington. Nonmember U.S. subscriptions are $60.00 per year and foreign subscriptions are $70.00 per year, payable (U.S. currency) in advance. Foreign delivery cannot be guaranteed. All remittances should be made payable to *The Entomological Society of Washington.*

The Society does not exchange its publications for those of other societies.

PLEASE SEE P. 218 OF THE JANUARY, 1991 ISSUE FOR INFORMATION REGARDING PREPARATION OF MANUSCRIPTS.

STATEMENT OF OWNERSHIP

Title of Publication: Proceedings of the Entomological Society of Washington.

Frequency of Issue: Quarterly (January, April, July, October).

Location of Office of Publication, Business Office of Publisher and Owner: The Entomological Society of Washington, % Department of Entomology, Smithsonian Institution, 10th and Constitution NW, Washington, D.C. 20560.

Editor: David R. Smith, Systematic Entomology Laboratory, ARS, USDA, % Department of Entomology, Smithsonian Institution, 10th and Constitution NW, Washington, D.C. 20560.

Books for Review: Gary L. Miller, Systematic Entomology Laboratory, ARS, USDA, Building 046, BARC-West, Beltsville, MD 20705.

Managing Editor and Known Bondholders or other Security Holders: none.

This issue was mailed 30 April 1996

Second Class Postage Paid at Washington, D.C. and additional mailing office.

PRINTED BY ALLEN PRESS, INC., LAWRENCE, KANSAS 66044, USA

♾ This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

PROC. ENTOMOL. SOC. WASH.
98(2), 1996, pp. 292–300

MORPHOLOGY OF *NEPHASPIS OCULATUS* AND *DELPHASTUS PUSILLUS* (COLEOPTERA: COCCINELLIDAE), PREDATORS OF *BEMISIA ARGENTIFOLII* (HOMOPTERA: ALEYRODIDAE)

TONG-XIAN LIU AND PHILIP A. STANSLY

Southwest Florida Research and Education Center, University of Florida, Institute of Food and Agricultural Sciences, P.O. Drawer 5127, Immokalee, FL 33934, U.S.A.

Abstract.—Two coccinellids, *Nephaspis oculatus* (Blatchley) and *Delphastus pusillus* (LeConte), are potentially good biological control agents of *Bemisia argentifolii* Bellows and Perring in Florida and elsewhere. The two species share many features of morphology and biology. We describe and compare the eggs, larvae, pupae and adults of the two coccinellids and provide detailed illustrations of all stages.

Key Words: Coccinellids, predators, whitefly, biological control

Nephaspis oculatus (Blatchley) and *Delphastus pusillus* (LeConte) are predacious coccinellids that have shown potential for biological control of *Bemisia argentifolii* Bellows and Perring in greenhouses (Hoelmer et al. 1993, Heinz et al. 1994, Heinz and Parrella 1994, Liu, unpublished data). *Nephaspis oculatus* is well established in Florida where it probably entered from its native Central America on imported plant material (Gordon 1972, 1985). Misidentified as *N. gorhami* Casey, beetles from Central America were released and established in California to control citrus whitefly (Rose and DeBach 1981). As *N. amnicola* Wingo, it was introduced from Honduras, Trinidad, and the West Indies to Hawaii in 1979–1980 where it has become effective in biological control of the spiraling whitefly, *Aleurodicus dispersus* Russell (Kumashiro et al. 1983). *Nephaspis oculatus* has been observed preying on *B. argentifolii* in Florida (Hoelmer et al. 1994, Liu unpublished data), but we are unaware of published studies on this prey relationship.

Delphastus pusillus has been recorded from 22 states of the United States, and noted to feed on many species of Aleyrodidae (Gordon 1970, 1975), including *Aleurocanthus woglumi* Ashby, *Pealius kelloggi* (Bemis), *Trialeurodes floridensis* (Quaintance), *Dialeurodes citri* (Ashmead), and *D. citrifolii* (Morgan). The earliest record of *D. pusillus* in the Florida State Collection of Arthropods (Gainesville, FL) was made by A. J. Mutohler in 1918 based on specimens collected from citrus infested with *D. citrifolii* and *D. citri. Delphastus pusillus* is one of the most common predators on citrus in Florida associated with high populations of several species of whiteflies (*D. citrifolii, D. citri,* and *Aleurocanthus woglumi* Ashby), purple scale (*Lepidosaphes beckii* [Newman]), and twospotted spider mite (*Tetranychus urticae* [Koch]) (Muma 1956, Cherry and Dowell 1979). More recently, *D. pusillus* has been found associated with high populations of silverleaf whitefly, *B. argentifolii,* reported as *B. tabaci* (Gennadius), on many ornamental plants in Florida (Hoelmer et al. 1993, 1994). Hoelmer et al. (1993) concluded that high consumption

rates of whitefly eggs by *D. pusillus* would favor suppression of heavy whitefly infestations, and that the ability to use alternative prey would favor survival when whitefly populations were low. The potential of this beetle as a biological control agent for *B. argentifolii* on greenhouse-grown poinsettia and cotton in conjunction with *Encarsia* spp. parasitoids was favorably evaluated in California (Heinz et al. 1994, Heinz and Parrella 1994).

The two species belong to different subfamilies: Sticholotidinae (tribe Serangiini) (*D. pusillus*), and Scymninae (tribe Scymnini) (*N. oculatus*). Adult characters which can be used to separate the two subfamilies include the apical segment of maxillary palpus, which is cornical or elongate oval in Sticholotidinae, but parallel sided or somewhat securiform in Scymninae, the mentum which is narrowly articulated with submentum in Sticholotidinae but broadly articulated with submentum in Scymninae, and the antennal insertion which is dorsal in Sticholotidinae, but short and inserted ventrally in Scymninae. Classification above the genus level using larval characters is not as well studied (Rees et al. 1994), but the two subfamilies can be separated by hairs and setae which are dense, long and fine in Sticholotidinae but limited to a few large setae on tubercles or strumae in Scymninae, and the mandibles which lack a retinaculum in Sticholotidinae, but have the retinaculum present in Scymninae.

Rees (1948) compared the morphology of *D. pusillus* larvae with *Catana clauseni* Chapin, and Yoshida and Mau (1985) described *N. amnicola* (= *N. oculatus*) in their biological study. However, their descriptions are brief and lack detailed illustrations. The two coccinellids are often confused because of their small size and similar morphology and biology. Given their likely roles in future biological control efforts, more detailed morphological and biological information is desirable. Here, we describe, illustrate and compare eggs, larvae, pupae, and adults of the two coccinellids.

Material and Methods

Description and illustration of all developmental stages of *N. oculatus* were based on fresh specimens collected from a greenhouse culture reared on *B. argentifolii* maintained on collards (*Brassica oleracea* L. var. *acephala,* 'Georgia LS'). Fresh specimens of *D. pusillus* were obtained from a collard and eggplant-based whitefly culture, and was initiated with pupae and adults provided by J. Nelson (University of California, Davis) originally from Florida, and reared on poinsettia (*Euphorbia pulcherrima* Willd.). Dry specimens collected in Florida by K. Hoelmer (USDA-APHIS, Brawley, CA) were also used for description and illustration. Temporary mounts of adult antennae were made on temporary microscopic slides for detailed examination. The adult abdomen was detached from the thorax to examine postcoxal lines. Larvae were mounted in Hoyer's mounting medium for microscopic examination. Voucher specimens were deposited either dried (adults, and larvae on microscope slides) or in alcohol (larvae and eggs) in the Insect Collection, Southwest Florida Research & Education Center, University of Florida, Immokalee.

Morphological terms used in the descriptions include the following: *struma:* mound like projection bearing few chalazae (Fig. 1K); *chalaza:* projection of the body wall bearing a seta (Fig. 1L); *collar seta,* seta surrounded by a raised collar at the base (Fig. 1M); *asperities,* small spinelike structures frequently arranged in rows or confined to specific areas (Fig. 2I). These terms are based on Peterson (1962), Gordon (1985), Gordon and Hilburn (1990), LaSage (1991), and Rees et al. (1994).

Body length and width of adult and eggs, and body length and head (capsule) width of each larval instar were measured at the longest and widest points using a stereo dissecting microscope equipped with a calibrated ocular micrometer (± 0.0025 mm). Each larval instar was measured <24 h af-

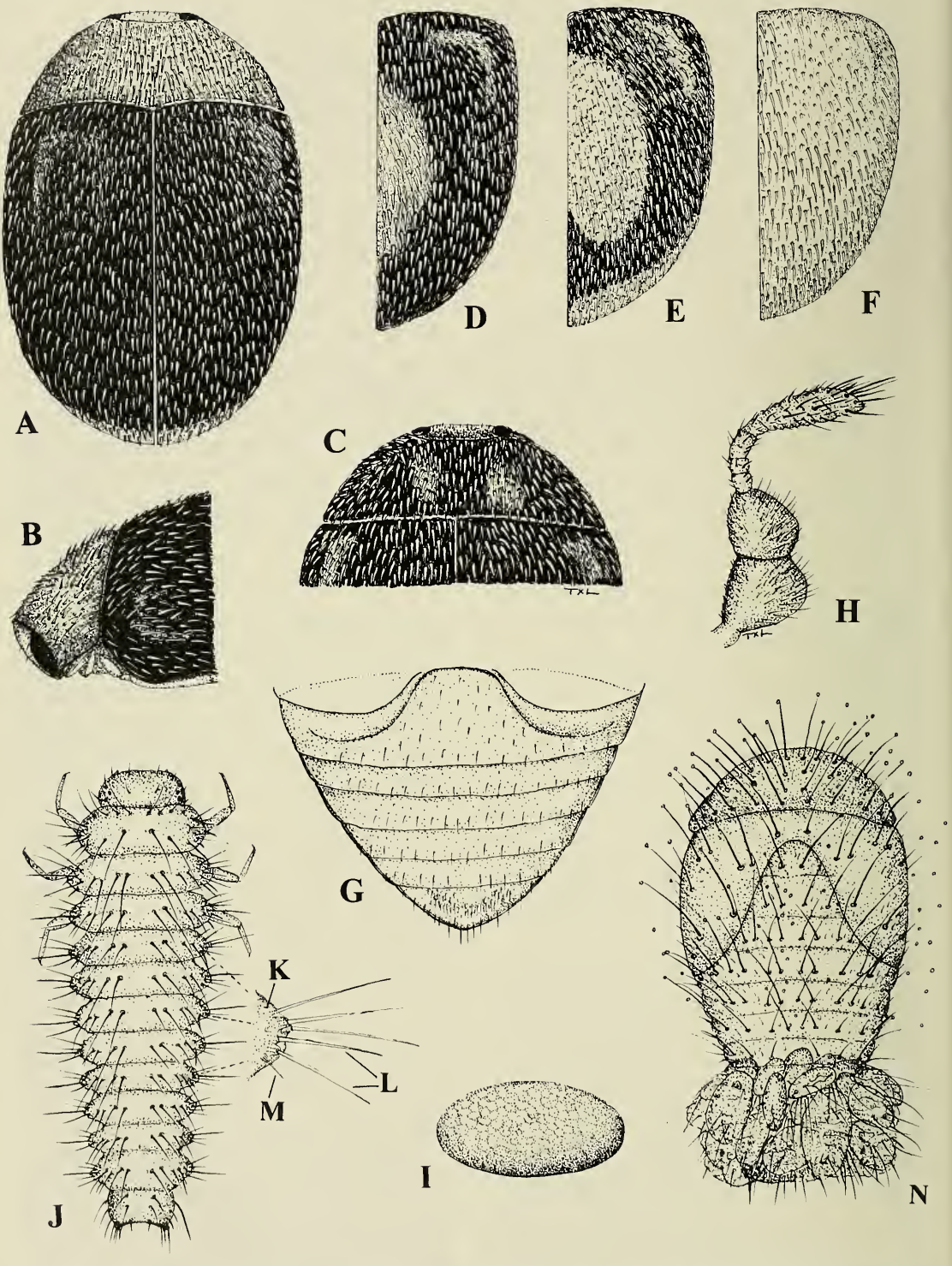

Fig. 1. *Nephaspis oculatus* (Blatchley). A, Male; B, Lateral view of anterior part of male; C, Head and pronotum of female; D-F, Variation in male elytron; G, Abdominal sterna (6 segments); H, Antenna; I, Egg; J, Larva (third instar); K, Strumum with chalazae (L) and collar setae (M); N, Pupa.

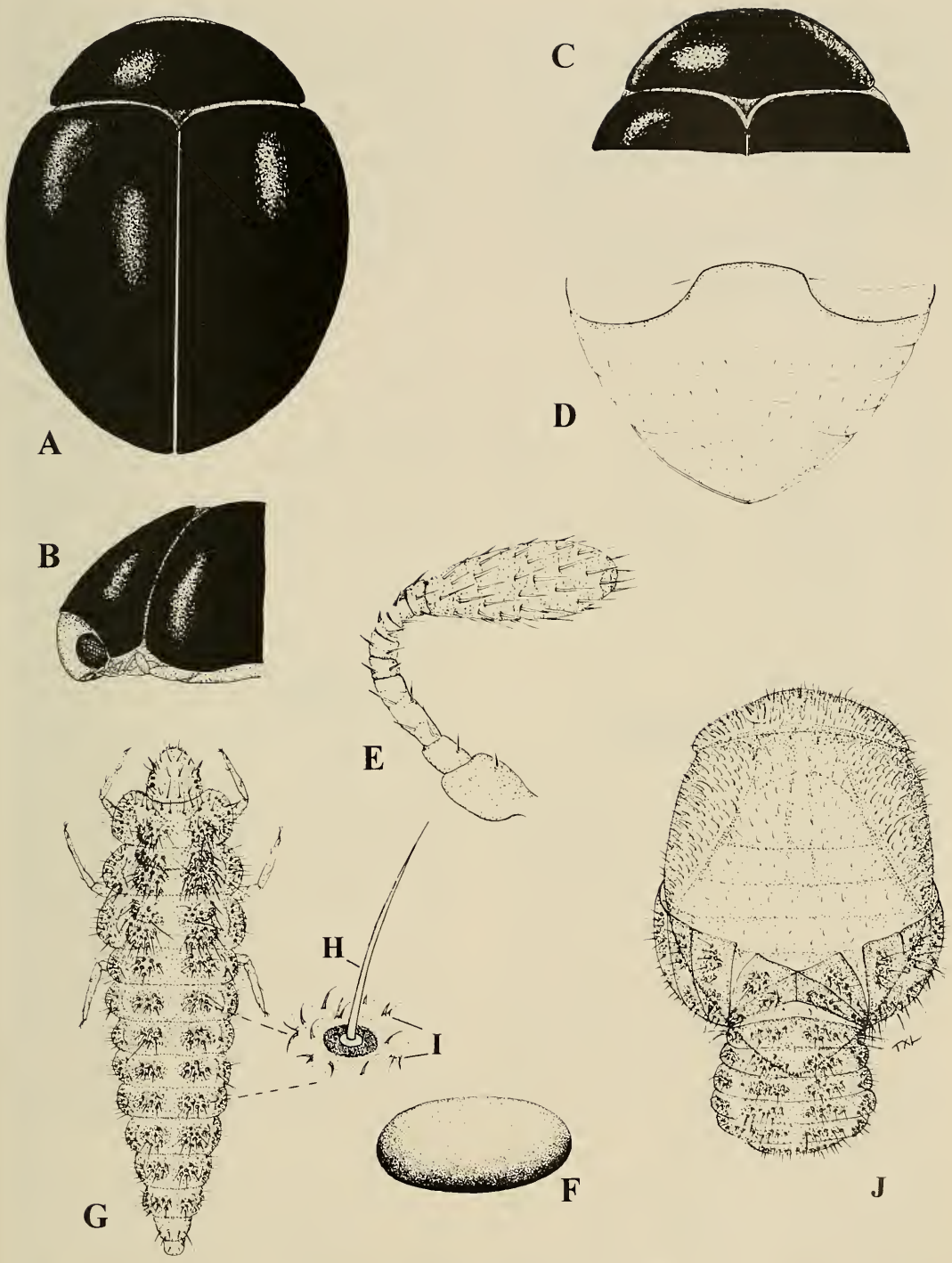

Fig. 2. *Delphastus pusillus* (LeConte). A, Female; B, Lateral view of anterior part of female; C, Pronotum and head of male; D, Abdominal sterna (5 segments); E, Antenna; G, Larva (third instar); F, Egg; H, Seta with a circular brown or dark area at base; I, Asperities: J, Pupa.

ter eclosion. All measurements (given in millimeters) are means followed by range and standard error in parentheses. Correlation between the body length and head (capsule) width for larvae was analyzed using the PROC CORR procedure (SAS Institute 1988).

Results and Discussion

Nephaspis oculatus (Blatchley) (Figs. 1, 3A, C, F, G)

Adult (Fig. 1A–G).—Body small, 1.26 (1.1–1.4, SE = 0.06) long, 0.87 (0.7–1.0, SE = 0.06) wide (N = 30), pubescent. Head visible when searching and feeding, invisible when at rest, with mouthparts directed posteroventrally (Fig. 1A–C), concealing prosternum; clypeus extending beyond eyes. Postcoxal line incomplete, curved from base medially and forward toward base of sternum laterally, abdomen with 6 sternal segments visible (Fig. 1G). Sexes easily separated. *Female:* vertex of head and pronotum entirely black, elytron usually piceous to black along base and lateral margin, central area of posterior margin yellowish brown (Fig. 1C). *Male:* pronotum yellow (Fig. 1A, B), meso- and metasternum piceous to black; elytron varying from completely black (except apical yellow area), to black or piceous with red or yellowish distal spots of various sizes and shapes (small and round, or elongate) (Fig. 1C–F). *Antenna* (Fig. 1H): small, whitish yellow, scape 8-segmented, with club 3-segmented; two basal segments extremely large, last 6 segments with length shorter than width; all segments with slender setae and large sensorial hairs.

Egg (Fig. 1I).—Usually elongate oval, 0.41 (0.35–0.49, SE = 0.02) long, 0.18 (0.15–0.23, SE = 0.04) wide (N = 30), greenish to yellowish white; under magnification of 20× or more, chorion appearing reticulate except ventral surface. Reticulation becoming more distinct after eclosion. Eggs laid singly on leaf surface, often in conjunction with whitefly eggs.

Larva.—Elongate, fusiform, white, widest across metathorax (Fig. 1J). Morphological characters for each instar not distinctly different except body size. Head (Fig. 3A), broader than long, widest across ocelli; 3 ocelli laterally on each side of head; mandible apically simple; maxillary palpus 3-segmented, palpifer; 2–3 pairs of small collar setae located on front area above mouthparts. Antenna (Fig. 3F) 3-segmented; second segment longer and thinner than first, with a minute spinelike sensorial process, with many sensorial acute processes on terminal area, and 1 long hairlike process; third segment indistinct with a large, acute conical sensorial process. All body segments broader than long. Pronotum (Fig. 3A), with 2 pairs of elongate setae near anterior margin, 3 pairs along posterior margin, and 1 pair in the middle; 7–10 pairs of chalazae on dorsolateral areas of each side. Mesothorax narrower or as wide as metathorax; metanotum with 1 pair of elongate principal setae beside midline, and 1 pair on submedian area of each side; 8–12 chalazae on dorsolateral areas. Setae on metanotum similar to mesonotum. Abdominal terga I–VIII with strumae (Fig. 1K), each bearing small chalazae (Fig. 1L), 7–10, and few long, slender collar setae (Fig. 1M). Tergite of ninth segment (Fig. 3C) with posterior margin truncate to slightly emarginate; 2 pairs of elongate setae beside midline, 2 pairs along posterior margin; 4 pairs of chalazae on dorsolateral area of each side; 1 pair of collar setae at posterolateral area of each side. One extremely long chalaza on each side of metathorax to abdominal segments I-VIII. Legs moderately elongate with few setae; tibia lacking terminal setae (Fig. 3G).

Larval head (capsule) width and body length of each instar well correlated (R = 0.86, P = 0.0001) although head (capsule) width less variable than body length (Table 1).

Four distinct larval instars were identified. The neonate is greenish white, and with each molt the body becomes larger and

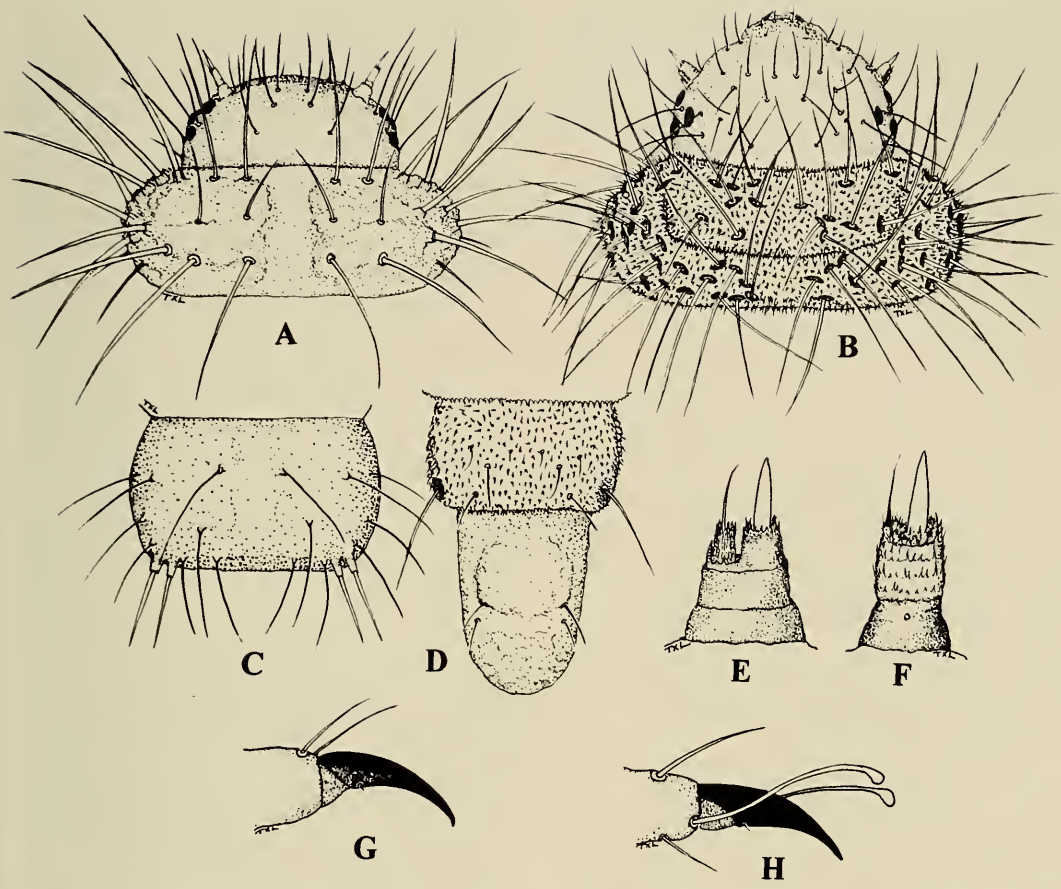

Fig. 3. Larval morphology of *N. oculatus* and *D. pusillus*. A, Head and pronotum of *N. oculatus*; B, Head and pronotum of *D. pusillus*; C, Abdominal segment IX of *N. oculatus*; D, Abdominal segment IX and uropod of *D. pusillus*; E, Antenna of *D. pusillus*; F, Antenna of *N. oculatus*; G, Tibia terminal and tarsal claw of *N. oculatus*; H, Tibia terminal and tarsal claw of *D. pusillus*.

Table 1. Body sizes of all stages of *Nephaspis oculatus* and *Delphastus pusillus*.

	Measurement (mm ± SE)					
	Nephaspis oculatus			*Delphastus pusillus*		
Stages	N	Length[a]	Width	N	Length	Width
Eggs	30	0.41 ± 0.02	0.18 ± 0.04	25	0.43 ± 0.01	0.23 ± 0.01
Larvae						
First instar	36	0.91 ± 0.08	0.16 ± 0.01	20	0.94 ± 0.05	0.17 ± 0.01
Second instar	20	1.43 ± 0.03	0.21 ± 0.01	20	1.52 ± 0.01	0.19 ± 0.01
Third instar	31	1.79 ± 0.04	0.26 ± 0.01	28	1.87 ± 0.01	0.25 ± 0.01
Fourth instar	27	2.37 ± 0.07	0.33 ± 0.01	27	2.83 ± 0.11	0.32 ± 0.01
Pupae	30	1.81 ± 0.74	1.02 ± 0.35	28	1.87 ± 0.01	1.08 ± 0.02
Adults	30	1.26 ± 0.06	0.87 ± 0.06	30	1.39 ± 0.07	1.09 ± 0.04

Correlation coefficients of head (capsule) width with body length for *Nephaspis oculatus*: $R = 0.87$, $P = 0.0001$; for *Delphastus pusillus*: $R = 0.98$, $P = 0.02$ (Proc Corr [SAS Institute 1988]).

whiter. Larvae move slowly when searching for prey, stopping frequently and moving the body from side to side using uropods on the caudal segment for process on the leaf surface. Debris often accumulates on the body including eggshells, wax and exuviae from whiteflies, and exuviae of the previous larval instar. Cannibalism among larvae and by adults on larvae was observed when prey were limited.

Pupa (Fig. 1N).—Newly formed pupa white, 1.81 (1.52–1.90, SE = 0.74) long, 1.02 (0.95–1.09, SE = 0.35) wide (N = 30), with long dark setae arranged as follows: 24–26 on head, 22–24 on thorax, 2 on abdominal segment I, 4 on II, 8 on III, and 12–14 on IV–VI with setae on VI weaker and thinner than on previous segments. A tiny, clear liquid droplet seen adhering to tip of each seta when relative humidity high. Pupal remains covered with whitefly debris attached at posterior end to previous (fourth) instar's exuvia.

Delphastus pusillus (LeConte)
(Figs. 2, 3B, D, E, H)

Adult (Fig. 2A–C).—Body small, 1.39 (1.2–1.6, SE = 0.07) long, 1.09 (1.0–1.2, SE = 0.04) wide (N = 30), hemispherical, oval or slightly elongate oval, black to dark brown, shiny with elytron slightly pubescent at base and apex; head, prosternum, and sterna somewhat lighter or yellowish; slightly pubescent; coarse punctures in a band across vertex; legs usually yellow; prosternum smooth, strongly lobed anteriorly, concealing mouthparts; head notched on each side for reception of antennae. Head normally visible dorsally, especially when feeding and searching for prey (Figs. 2A–C). Elytra appearing smooth, but with very fine sparse punctures, indistinctly pubescent at base and apex. Abdomen with 5 visible sterna (Fig. 2D); postcoxal line on first abdominal sternum incomplete, extending down posteriorly and nearly parallel to apical margin toward lateral margin (Fig. 2D). Sexes easily separated with the male having a brown head and lateral margin of pronotum yellow (Fig. 2C). *Antenna* (Fig. 2E): Nine-segmented, segments I and II short and stout, III long and thin, IV–VIII short with length equal to or shorter than width, and IX distinctly clubbed, enlarged apically; each segment with several slender and strong sensorial setae and sculpturelike wrinkles, setae and wrinkles dense on apical segment.

Egg (Fig. 2F).—White, elongate oval, smooth; 0.43 (0.38–0.46, SE = 0.01) long, 0.23 (0.20–0.25, SE = 0.01) wide (N = 25); laid singly or 2–4 together on leaf surface where whitefly eggs and nymphs are abundant.

Larva.—Body (Fig. 2G) pale whitish or pale yellowish white, fusiform, widest across metathorax, setiferous, weakly sclerotized without distinct sclerites. Head (Fig. 3B) elongate oval, widest through ocelli, gradually converging anteriorly; front suture incomplete, indistinct; approximately ⅔ to ¾ of width of anterior margin of prothorax; 3 ocelli on each side black; setae long and slender; mandible triangular, apically simple, curved, with molar area developed. Antenna (Fig. 3E), 3-segmented, distinct dorsally; second segment longer and thinner than first, anterior area with elevation bearing long, acute and slender sensorial process; third segment small, conical, terminating with several minute, acute sensorial papillae and a single, long acute sensorial process. Newly hatched first and second instars whitish pale, circular area at base of long seta slightly brown and indistinct; third and fourth instars with long setae, each with a brown or black circular area at base on each thoracic segment and abdominal segments I–VIII (Fig. 2H). All body segments rounded laterally, broader than long except for ninth (last) abdominal segment. Pronotum (Fig. 3B) with 2 clusters of principal setae rising from pigmented area (Figs. 2H, 3B) near anterior margin, 2 clusters near posterior margin beside midline, and 10–12 on dorsolateral area of each side. Meso- and metathorax each with 2 clusters

Table 2. Morphological comparison of *Nephaspis oculatus* and *Delphastus pusillus*.

Stages	*Nephaspis oculatus*	*Delphastus pusillus*
Adult-Female	Body brown; elytron piceous to black; yellowish hairs densely covering body and elytra	Body black or dark reddish; prosternum and legs yellow; shiny
Male	Pronotum, head, and prosternum whitish yellow; elytra completely black with apical area yellow, or black or piceous with red or yellow distal spot	Pronotum black, with lateral margin yellow; head brown
Mouthparts	Directed posteroventrally	Directed anteroventrally
Antennae	Segment I and II extremely large, club 3-segmented, slightly enlarged	Segments I and II larger than II–VI, club one segmented, extremely enlarged apically
Abdomen	Six abdominal sterna visible	Five abdominal sterna visible
Eggs	Reticulated	Smooth
Larvae	White; 7–8 pairs of dark slender setae on abdominal segments I–VIII; each segment with strumae each bearing small-based chalazae or collar setae; setae long; last segment (ninth) with posterior margin truncate to slightly emarginate	Pale yellow; densely covered with fine hairs and setae, and principal setae thin and long, a dark (brown or black) circular area at base; no strumae; asperities on submedian and lateral areas of each thoracic segment and segments I–VIII; last segment narrow, longer than width, conical
Pupae	White; setae dark and strong, often with a clear liquid droplet distally depending on humidity; exuviae of last instar larva covered with long setae and empty whitefly egg and nymphal shells attached to posterior end	Pale yellowish white; setae thin, more numerous on cephalic and thoracic regions, and sparse on abdomen. Exuviae of last instar larva attached at end but without empty whitefly egg or nymphal shells

of principal setae beside midline, and approximately 10–12 long setae on dorsolateral area of each side. Abdominal segments I–VIII successively narrower posteriorly, each with large brownish or dark brownish setiferous areas on submedian area on each side, containing 7–15 setae on dorsolateral area, and 6–16 on submedian area. Dorsolateral areas less setiferous than dorsal areas; pigmented spots at base of principal setae on dorsolateral and median areas lighter than those on submedian areas. Ninth abdominal segment (Fig. 3D) longer than wide, lightly pigmented area with 1 long seta located on posterolateral area on each side. Uropod present with 2 pairs of small setae in middle area (Fig. 3D). Asperities simple, double or triple (Fig. 2I), scattered on surface, more dorsolateral than submedian. Legs moderately long, slender, sparsely setiferous; two terminal setae of tibia distinct, capitate with terminal expansion abrupt and small, one located ventrolaterally on each side of claw (Fig. 3H). Larval head (capsule) width and body length for each instar were correlated ($R = 0.98$, $P = 0.02$, Table 1).

The majority of the larvae have four stadia, but occasionally a supernumery fifth instar occurs (Hoelmer et al. 1993).

Pupa (Fig. 2J).—Yellowish white or whitish grey; 1.87 (1.22–1.97, SE = 0.01) long, 1.08 (0.98–1.12, SE = 0.02) wide (N = 27). Cephalic region and thorax with numerous long slender and curved setae; abdominal segments with a few small slender setae. Abdomen with setiferous exuviae of fourth instar larva attached at posterior end covering 2–3 abdominal segments.

For convenience, the major morphological characters for each corresponding stadium for the two species are summarized and tabulated in Table 2.

Acknowledgments

We thank R. D. Gordon (Systematic Entomology Laboratory, U.S.D.A., Washington, D.C.) for valuable suggestions on an early draft of this manuscript, D. J. Schuster (University of Florida, Institute of Food and Agricultural Sciences, Bradenton, FL) for review of this manuscript, K. A. Hoelmer (USDA-APHIS, Brawley, CA) for providing materials, suggestions and a manuscript review, and M. Thomas (Florida State collection of Arthropods, Gainesville, FL) for verifying the identification of the two coccinellids. We also thank J. M. Conner, Y. M. Zhang, and T. Yost for technical assistance. This study was funded by USDA Competitive Grant #93-34103-8433. This is Florida Agricultural Experiment Station Journal Series R-04610.

Literature Cited

Cherry, R. and R. V. Dowell. 1979. Predators of citrus blackfly (Him.: Aleyrodidae). Entomophaga 24: 385–391.

Gordon, R. D. 1970. A review of the genus *Delphastus* Casey (Coleoptera: Coccinellidae). Proceedings of Entomological Society of Washington 72: 356–369.

———. 1972. A review of the genus *Nephaspis* Casey and a comparison with the genus *Clitostethus* Weise (Coleoptera: Coccinellidae). Review of Agriculture, Poracicaba 47: 145–154.

———. 1985. The Coccinellidae (Coleoptera) of America north of Mexico. Journal of the New York Entomological Society 93: 1–912.

Gordon, R. D. and D. J. Hilburn. 1990. The Coccinellidae (Coleoptera) of Bermuda. Journal of the New York Entomological Society 98: 265–309.

Heinz, K. M., J. R. Brazzle, C. H. Pickett, E. T. Natwick, J. M. Nelson, and M. P. Parrella. 1994. *Delphastus pusillus* as a potential biological control agent for sweetpotato (silverleaf) whitefly. California Agriculture 48(2): 35–40.

Heinz, K. M. and M. P. Parrella. 1994. Biological control of *Bemisia argentifolii* (Homoptera: Aleyrodidae) infesting *Euphorbia pulcherrima:* Evaluations of releases of *Encarsia luteola* (Hymenoptera: Aphelinidae) and *Delphastus pusillus* (Coleoptera: Coccinellidae). Environmental Entomology 23: 1346–1353.

Hoelmer, K. A., L. S. Osborne, and R. K. Yokomi. 1993. Reproduction and feeding behavior of *Delphastus pusillus* (Coleoptera: Coccinellidae), a predator of *Bemisia tabaci* (Homoptera: Aleyrodidae). Journal of Economic Entomology 86: 322–329.

———. 1994. Biological control of sweetpotato whitefly in Florida, pp. 101–113. *In* Rosen, D., F. D. Bennett, and J. L. Capinera, eds. Pest Management in the Subtropics: Biological Control—A Florida Perspective. Intercept, Andover, UK.

Kumashiro, B. R., P. Y. Lai, G. Y. Funasaki, and K. K. Teramoto. 1983. Efficacy of *Nephaspis amnicola* and *Encarsia haitiensis* in controlling *Aleurodicus dispersus* in Hawaii. Proceedings of Hawaiian Entomological Society 24: 261–269.

LaSage, L. 1991. Coccinellidae (Cucujoidea), the lady beetles, lady birds. pp. 485–494. *In* Stehr, F. W., ed. Immature Insects. vol. 2. Kendall/Hunt. Dubuque, Iowa.

Muma, M. H. 1956. Life cycles of four species of ladybeetles. Florida Entomologist 39: 115–118.

Peterson, A. 1962. Larvae of Insects, Part I. Columbus, OH.

Rees, B. E. 1948. The larva of *Catana clauseni* Chapin, and its comparison with the larva of *Delphastus pusillus* (LeC.). Proceedings of the Entomological Society of Washington 50: 231–234.

Rees, B. E., D. M. Anderson, D. Bouk, and R. D. Gordon. 1994. Larval key to genera and selected species of North American Coccinellidae (Coleoptera). Proceedings of the Entomological Society of Washington 96: 387–412.

Rose, M. and P. DeBach. 1981. Citrus whitefly parasites established in California. California Agriculture 35(7/8): 21–23.

SAS Institute. 1988. SAS/STAT User's Guide. SAS Institute, Cary, NC.

Yoshida, H. A. and R. F. L. Mau. 1985. Life history and feeding behavior of *Nephaspis amnicola.* Proceedings of Hawaiian Entomological Society 155–160.