

STUDIES ON DECAPOD CRUSTACEA FROM THE INDIAN RIVER
REGION OF FLORIDA. XVIII.
REDISCOVERY OF *PERICLIMENES* (*PERICLIMENES*) *PANDIONIS*
HOLTHUIS, 1951 (CARIDEA, PALAEMONIDAE) WITH NOTES ON
THE MALES AND ZOEAL STAGES

BY

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Periclimenes pandionis, a small marine shrimp, was described by Holthuis (1951) from a single female specimen, 18 mm long, collected from the "Gulf Stream" [= Florida Current], off Key West, Florida in 98 fms [179 m] in February 1902. The species has apparently not been reported since Holthuis' description in his monograph of American Palaemonidae (see Chace, 1972).

During a series of recolonization experiments utilizing a partitioned apparatus designed to test invertebrate recruitment rates off Ft. Pierce, on the central eastern Floridan nearshore continental shelf, 26 specimens of *Periclimenes pandionis* were obtained. Included in this material were 15 ovigerous females, one of which yielded larvae which we describe below. The adult series allowed us to re-examine in greater detail the morphological criteria used to identify *Periclimenes pandionis*, and to determine the range of variation in several of the features considered important by Holthuis (1951), including those seen in the previously unknown males of the species. Accordingly, we provide in this report supplemental data on both males and females of *P. pandionis*, including illustrations of several characters not discussed by Holthuis because he lacked additional material. We also provide a description and illustrations of the first 2 zoeal stages for the species, and briefly compare the larvae to those known from one other western Atlantic species of *Periclimenes*.

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MATERIALS AND METHODS

The larvae obtained on 2 November 1979 from a single ovigerous female (collection data noted under Material Examined) were reared at 20-21°C in 24-compartmented plastic trays in seawater of 35-36‰ salinity, using methodology previously described by Gore (1973). The first zoeal stage is described from observations on five larvae; that of the second zoea is based on

a single specimen, the only larva which molted to stage II. Measurements on the first zoeae represent the arithmetic average of the five specimens examined. Illustrations of zoeae and adults were made using binocular dissecting and compound stereomicroscopes in conjunction with ocular reticles. All of the illustrated adult appendages were taken from a male ("No. 17", rcl 5.9, tl 19.0 mm, USNM 173938) except the mandibles, which came from an ovigerous female ("No. 10", rcl 6.8, tl 22.0 mm, USNM 173939).

The adult specimens agreed in most respects with the original description by Holthuis for his female, although because of our larger series we did note variation. We therefore have expanded the species description, although we follow the format used by Holthuis (1951: 41-43) to allow comparisons. The 26 specimens of this report are divided among the following institutions: National Museum of Natural History, Washington, D.C. — 2♂♂, 6♀♀, 3 ovigerous, USNM 173937, 173938, 173939; Allan Hancock Foundation, University of Southern California, Los Angeles. — 3♀♀, ovigerous, AHF 1918-1; Indian River Coastal Zone Museum, Ft. Pierce, Florida. — 1♂, 7♀♀, 5 ovigerous, IRCZM 89: 4448, plus the larval series, 89: 4491; Rijksmuseum van Natuurlijke Historie, Leiden. — 2♂♂, 5♀♀, 3 ovigerous, D. 32689.

***Periclimenes (Periclimenes) pandionis* Holthuis, 1951 (figs. 1-4)**

Periclimenes (Periclimenes) pandionis Holthuis, 1951: 41-43, pl. 11 figs. a-i.

Periclimenes pandionis. — Chace, 1972: 30, 38.

Material examined: 5♂♂, 20♀♀, 14 ovigerous; 27°32.2'N 80°03.2'W, 33 m, from compartmented recolonization tray, 21 September 1977, R. W. Virnstein, coll. — 1♀, ovigerous, yielding larvae, 27°28.6'N 79°56.3'W, 122 m, from recolonization tray, 25 October 1979, R. W. Virnstein, coll.

Description of adults. — Rostrum (fig. 1A) straight, noticeably shorter or equal to, rarely reaching beyond, tip of scaphocerite; upper margin straight, with 7 to 9 teeth, 2 of which placed on carapace behind orbit; lower margin with 2 to 4 teeth, occasionally 1 additional minute dorsal or ventral tooth subapically. First carapacial tooth placed just before transverse midline, widely separated from next, placed in vertical line with hepatic spine; remaining teeth on rostrum proper relatively closer to each other. No postorbital ridge; midrib of rostrum merging with posterior margin of orbit; lower angle of latter a rounded lobe. Antennal spine present, set back from anterolateral margin of carapace; latter broadly quadrate (broadly rounded in holotype); hepatic spine stronger than antennal.

Eyes (figs. 1A, B) well-developed, cornea globular, slightly shorter than eyestalk; latter with distinct inflated transverse lobe along anterior margin.

Abdominal pleura broadly rounded ventrally; somite 6 half again to more than twice as long as somite 5, about half as long or equal in length to telson. Dorsal surface of telson (fig. 2H) with two pairs spines, placed about midway

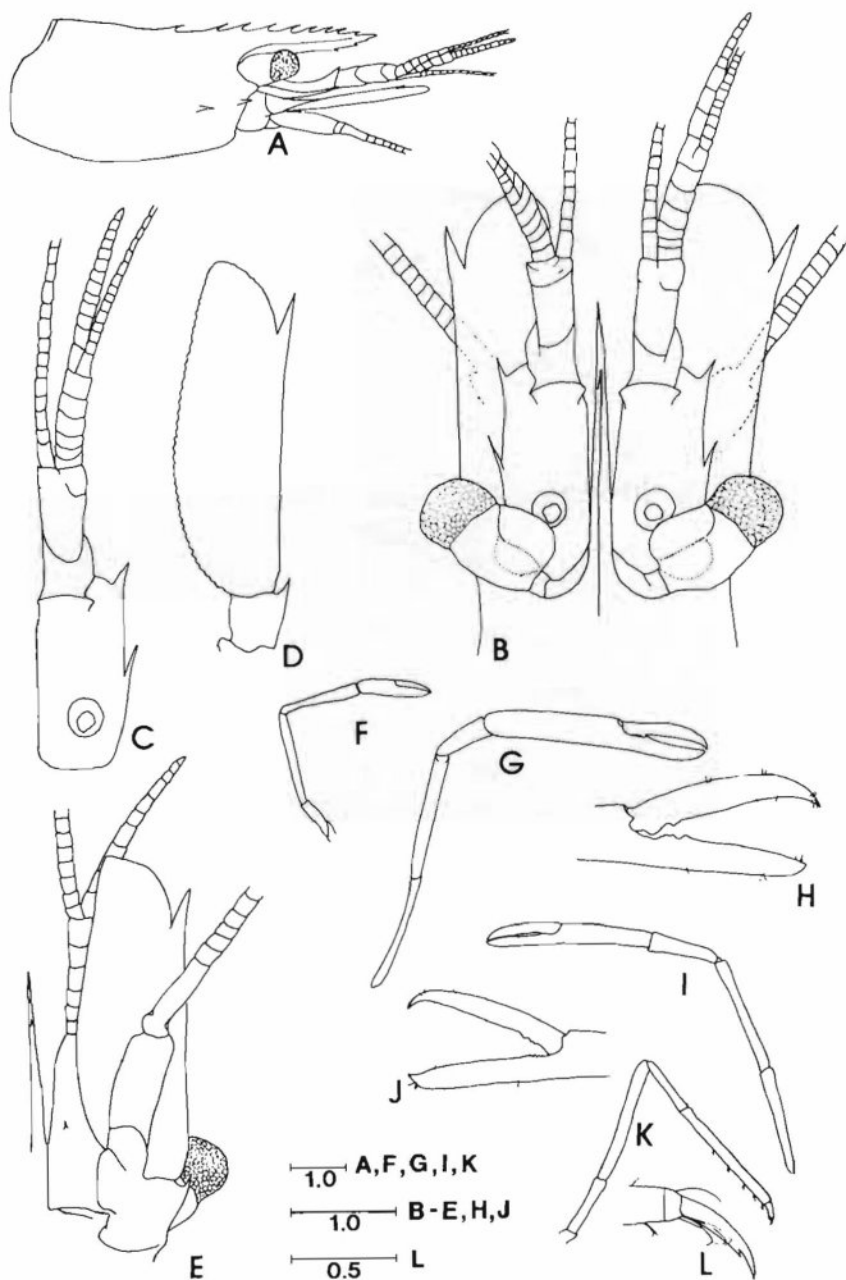


Fig. 1. *Periclimenes (Periclimenes) pandionis* Holthuis, 1951. A, carapace, lateral view; B, same, frontal region and sensory appendages, dorsal view; C, right antennule, dorsal view; D, right scaphocerite, dorsal view; E, left sensory appendages including carapocerite, ventral view; F, right pereiopod 1; G, right pereiopod 2; H, same, (major) chela; I, left pereiopod 2; J, same (minor) chela; K, right pereiopod 3; L, same, dactyl. Scale lines in mm.

and in posterior quarter of length; posterior telsonal margin with three pairs spinules, intermediate pair twice as long as medial pair. Uropods normal.

Antennular peduncle (fig. 1C, E) with spiniform stylocerite, overreaching middle of segment; anterolateral tooth of basal segment strongly produced, overreaching convex anterior margin of first segment, attaining approximate midline of second segment; ventrally a single small spine about middle of basal segment. Third antennular segment narrow, about 1.8 times longer than second; upper flagellum with rami fused for 5 or 6 segments; free parts consisting of 5 to 15 segments numbered from base of fused part, equal to or up to twice as long as fused part.

Antenna (fig. 1D, E) robust; scaphocerite distinctly extending beyond antennular peduncle, from three to four times longer than wide, outer margin slightly concave, produced distolaterally into strong tooth, latter falling far short of anterodistal margin of lamella. Carpocerite (fig. 1E) reaching to middle or slightly less of scaphocerite; a small external spine near base of latter.

Mandibles (fig. 2A) without palp; right molar process with rectangular, notched lamella and small tuft of setae, left with 4 strong, rounded teeth, no setae.

Maxillule and maxilla (figs. 2B, C) as illustrated. Maxilliped 1 (fig. 2D) with well-developed caridean lobe, bearing long setae-tipped lash; epipod large, noticeably bilobed. Maxilliped 2 (fig. 2E) with exopod indistinctly segmented near tip, bearing setae; a large epipod basally. Maxilliped 3 (fig. 2F) attaining end of antennal peduncle; ultimate segment subdivided into at least 7 segments, overall slightly less than half length of penultimate segment, about half length or slightly longer than antepenultimate; all with setae as illustrated. Exopod indistinctly two-segmented distally, setose; epipod present basally, no arthrobranch observed.

Pereiopod 1 (fig. 1F) attaining end of scaphocerite, fingers equal or slightly subequal in length to palm, unarmed. Carpus about equal to chela, slightly shorter than merus; ischium half length of chela. Pereiopod 2 (figs. 1G-J) unarmed, extending beyond scaphocerite, chelae unequal. Major chela fingers (fig. 1H) about half length of palm, tips crossing; cutting edge of movable finger with 1 to 3, of fixed finger with 2 to 4, teeth proximally. Carpus less than half length of palm, about half or less length of merus. Ischium from slightly less, to equal merus length. Minor chela fingers (fig. 1J) at least half or more palm length, cutting edges with 0-5, 0-4 denticles on movable and fixed fingers, respectively. Carpus distinctly shorter, to nearly as long as, palmar length, about 2/3 length of merus. Ischium slightly less, to half again as long as, meral length. Pereiopod 3 (fig. 1K, L) extending beyond scaphocerite; dactylus distinctly bifid; propodus 5 to 11 times length of dactyl, twice to thrice length of carpus. Merus slightly less, to slightly greater than, propodal length, from about equal to over twice as long as length of ischium. Pereiopods 4 and 5

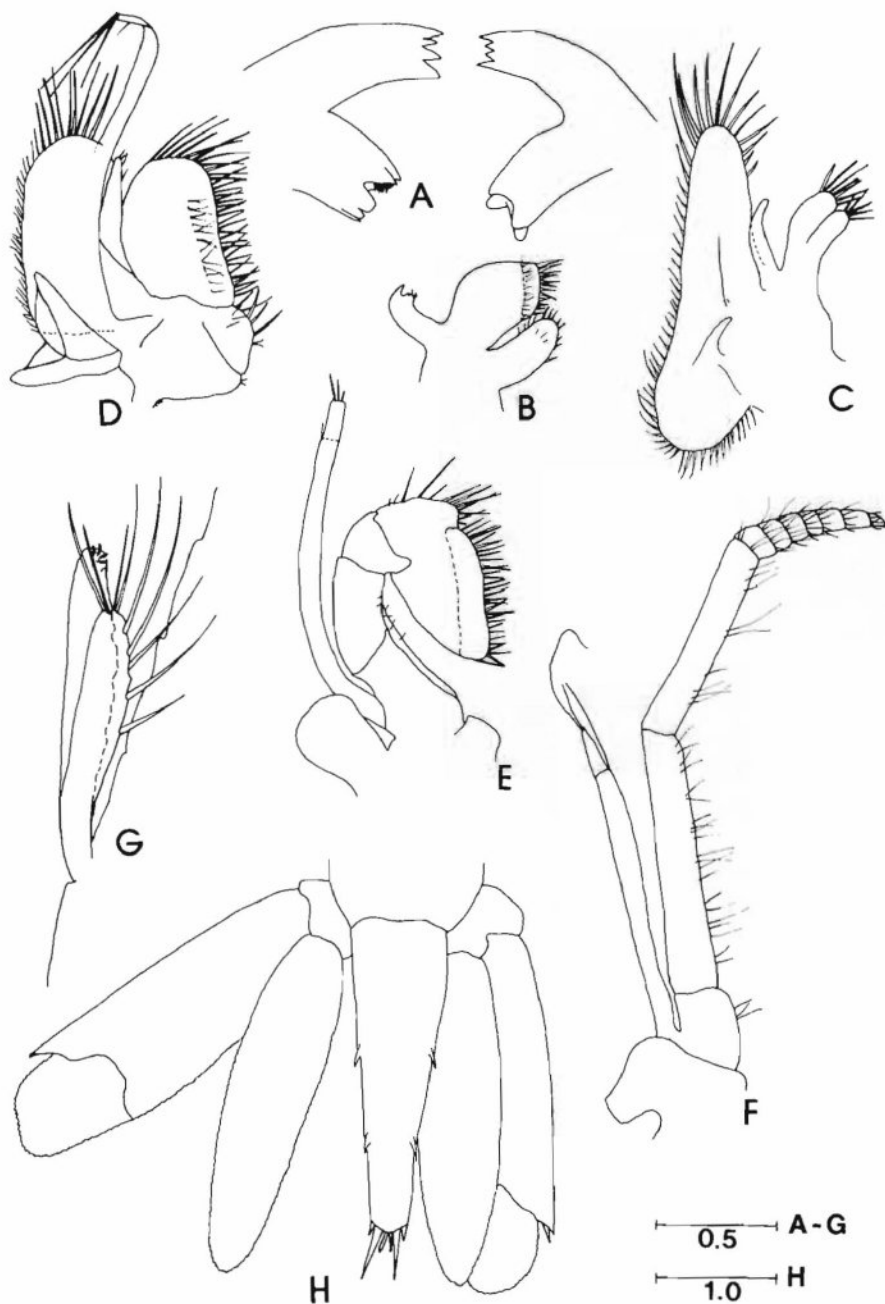


Fig. 2. *Periclimenes (Periclimenes) pandionis* Holthuis, 1951. A, mandibles; B, right maxillule; C, right maxilla; D, right maxilliped 1; E, right maxilliped 2; F, right maxilliped 3; G, right pleopod 2, male gonopod; H, telson and uropods, dorsal view. Scale lines in mm.

similar in shape to pereopod 3, similarly unarmed, with bifid dactyls, but shorter in overall length than preceding legs.

Pleopod 2 of male (fig. 2G) with appendix interna and strongly setose appendix masculina, as illustrated. Pleopod 1 endopod without palp-like lobe.

Measurements. — Rostral carapace length (rcl) in males, 4.6-5.9; females, 2.5-7.0; ovigerous females, 5.4-8.7 mm. Total lengths (tl) in males, 14.3-19.0; females 10.5-19.9; ovigerous females 15.5-24.6 mm. Egg diameters in latter about 0.4 mm.

Color. — Transparent; red and light brown chromatophores ventrally on eyestalks, on the surface of the hepatopancreas region, along the length of the chelipeds, and on the basal portion of pereopods. Similar pigments along abdominal ventral surface, concentrated near pleopods; basal portion of latter sparsely pigmented. Mouthparts not examined for coloration.

Remarks. — *Periclimenes pandionis* is a distinctive palaemonid shrimp which may be recognized by a combination of several characters, including elongate rostrum, 2 widely spaced rostral teeth on the carapace midline, an elongate scaphocerite, the lengthened anterolateral tooth of the antennular peduncle basal segment, and the lack of a distinct lobe on the first pleopod of the male. In regard to this latter character, none of the five males in the series had anything that could be construed as an elongate (i.e., nearly palp-like) lobe such as that seen in *Periclimenes tenellus* (Smith), and illustrated by Holthuis (1951: pl. 8 fig. k). However, three of the five males did exhibit a slight but noticeable emargination at about the same position as the lobe appears in *P. tenellus*; the fourth mature male showed this emargination only slightly, if at all, and the fifth was apparently a juvenile and showed no emargination whatever.

One of the more easily observed features in our Indian River material was the presence on the anterior margin of the eyestalks in all specimens of an inflated lobe (fig. 1B), which may aid in distinguishing *P. pandionis*.

Variation. — We were able to determine the range of variation of several characters deemed important enough by Holthuis to be included in his original description, and we provide these and a comparison with Holthuis' data in tables I and II. As can be seen, the meristics involving the number of segments in the free part of the short ramus of the antennular flagellum, and the length of this part to the short ramus exhibit a large range of variation. We note this only because these features were used in Holthuis' (1951) key as an identifying character. Our additional material shows that this feature, and perhaps some of the pereopodal meristics, should be viewed a bit more liberally, a philosophy which certainly is applicable toward many of the palaemonid species along the central eastern Florida coastline at least. Finally, one gravid female had the rostrum divided apically into two large teeth, with a smaller denticle interspersed between these; this was the only aberrancy noted in any of the specimens at hand.

TABLE I
Comparison of morphological features in *Periclimenes pandionis* Holthuis

Features	Holthuis, 1951	This study
Rostral teeth	$\frac{9}{4}$	$\frac{7-9^*)}{2-4^*)}$
Rostrum length	= to scaphocerite	\leq to scaphocerite
Carapace anterolateral angle	Broadly rounded	Broadly quadrate
Antennular flagellum		
Fused joints	5	5-6
Joints in free part of short ramus	5	5-15
Length of free part of short ramus	= to fused part	\leq to fused part
Eyestalk tubercle	Not mentioned	Present
Basicerite ventral spine	Not mentioned	Present
Major cheliped cutting edges	$\frac{1}{3}$ teeth	$\frac{1-3}{2-4}$ teeth
Minor cheliped cutting edges	Not available	$\frac{0-5}{0-4}$ denticles

*) In some specimens an additional minute spine was present at the distal tip of the rostrum. 20 specimens were examined for these data.

TABLE II
Comparison of meristics in selected characters of *Periclimenes pandionis* Holthuis

Character	Holthuis, 1951	(N)	This study	
			Range	Mean
Major cheliped				
Fingers:palm	0.5	13	0.4-0.6	0.5
Carpus:palm	0.3	13	0.2-0.4	0.2
Ischium:merus	1.0	13	0.7-1.0	0.8
Minor cheliped				
Fingers:palm	Not available	18	0.5-0.8	0.7
Carpus:palm	Not available	18	0.2-0.8	0.5
Ischium:merus	Not available	18	0.8-1.5	1.0
Pereiopod 3				
Propodus:dactylus	4	17	5-11	6
Propodus:carpus	2	17	2.0-3.3	2.4
Merus:propodus	1	17	0.8-1.1	1.0
Merus:ischium	2	17	1.8-2.5	2.3
Abdominal pleura				
Somite 6:somite 5	"almost twice as long"	20	1.5-2.4	1.9
Somite 6:telson length	0.8	20	0.6-1.0	0.8
Antennal scaphocerite				
Length to width	"thrice"	19	2.7-3.7	3.1

Discussion. — The Indian River area material was collected at a considerably shallower depth than the holotype, although all specimens of the species remain known only from the neritic continental shelf off eastern and southern Florida. *Periclimenes pandionis* may thus be considered a continental species at present, occurring in depths from 33 to 179 m; whether it will be found associated with deeper island shelves remains conjectural. Both the holotype, and the subsequent eastern Floridan specimens occurred on similar substratum, i.e. sand and shell hash. The Indian River specimens (and the holotype?) were apparently free-living, but the former were collected with polychaete worms, gastropod and bivalve molluscs, and amphipod, isopod, cumacean, and tanaidacean crustaceans which were living in the shelly sand within the experimental settling compartments. It would thus seem that the species, unlike several others in the genus, is not commensal with any sessile organism. Its relatively small size probably accounts for the dearth of specimens collected since 1902. In two years of extensive trawling off the central eastern Florida coastline, using a variety of nets and dredges, the only specimens of *P. pandionis* obtained were those which had settled in the recolonization compartment; in effect they were trapped.

DESCRIPTION OF THE LARVAE

First zoeae: Rcl 0.7 mm.

Carapace (fig. 3A, B) about as long as wide, unarmed, ventral and lateral margins simple; a short rostral spine, slightly curved ventrally, falling slightly short of distal margin of proximal antennule segment, unarmed; eyes sessile.

Telson (fig. 3C) triangularly spatulate; length 1.6 times width; a single small notch about halfway down lateral margin; posterior margin armed with 6 plumose, 1 non-plumose setae either side (setal formula = 7 + 7), among which interspersed several very fine, minute setae.

Antennule (fig. 3D) two-segmented rod, proximal segment 4 times length of distal, latter segment bearing 3 terminal aesthetascs, 1 subterminal plumose seta; proximal segment with elongate plumose seta at junction with distal.

Antenna (fig. 3E) biramous; endopodite produced into spine-like process equal in length to scaphocerite, bearing 1 elongate plumose seta; length of scaphocerite blade 3.3 times width, 12 marginal setae; protopodite with simple spine at junction with endopodite.

Mandibles (fig. 3F) asymmetrically dentate processes, incisor process well-developed, separate from dentate molar process; palp absent, but lacinia mobilis developed.

Maxillule (fig. 3G), endopodite a single segment, a large stout tooth plus 1 seta apically; basal endite with single stout spine, a smaller articulated spine, plus 2 setae; coxal endite with 3 strong setae.

Maxilla (fig. 3H), endopodite unsegmented, a single terminal seta; basal and coxal endites each with 2 strong setae on proximal and distal lobes;

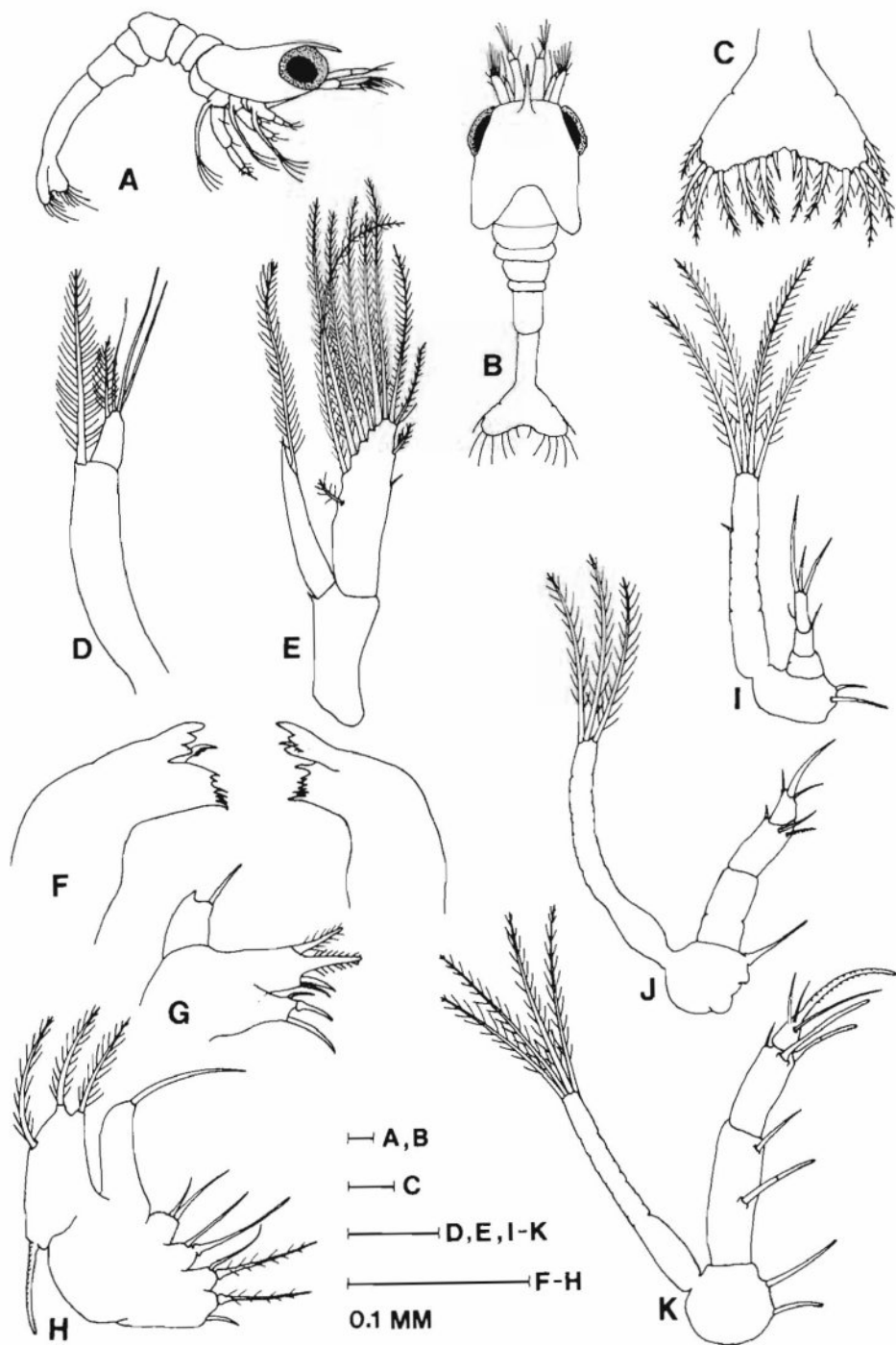


Fig. 3. *Periclimenes (Periclimenes) pandionis* Holthuis, 1951. First zoea. A, lateral view; B, dorsal view; C, telson, dorsal view; D, antennule; E, antenna; F, mandibles; G, maxillule; H, maxilla; I, maxilliped 1; J, maxilliped 2; K, maxilliped 3. All scale lines represent 0.1 mm.

scaphognathite with 3 marginal plus long apical seta, latter with minute spinules.

Maxilliped 1 (fig. 3I), endopodite three-segmented, setae progressing distally 0, 1, 1 + 3 terminally; exopodite appearing annulated along distal 2/3, a single lateral seta, plus 4 long plumose setae apically; protopodite with 2 setae.

Maxilliped 2 (fig. 3J), endopodite three-segmented, proximal segment indistinctly divided, setae progressing distally 0, 3 (including 1 serrated), 3; exopodite annulated as in maxilliped 1, 3 terminal setae; protopodite with single, elongate articulated strong seta; 2 bluntly rounded lobes ventrally.

Maxilliped 3 (fig. 3K), endopodite three-segmented; armed progressing distally with 2, 3, 3 + 1 elongate, serrated setae or spines; exopodite similarly annulated as above, 4 terminal setae; protopodite with 2 strong setae.

Pereiopods not yet developed.

Abdomen (figs. 3A, B) of five somites; length of third about equal to height; somite 5 distinctly shorter than telsonal somite, about 1/3 length of latter; no pleopod primordia evident.

Color: Zoea transparent; yellow chromatophores frontally between fixed eyes in transverse row, and posteriad along interior margin of eye, dorsally on third abdominal somite near junction with second, ventrally along inner posterior margin of eyes, labrum, and cutting edge of mandibles; red chromatophores interspersed among yellow between eyes dorsally and ventrally, and on third abdominal somite; a single red chromatophore on penultimate segment of endopodite of maxilliped 1; eyes with black pigment in cornea.

Second zoea: Rcl 0.75 mm.

Carapace (figs. 4A, B) slightly larger, more inflated; rostrum remains unarmed, slightly elevated distally, falling far short of elongate basal antennular segment; carapace otherwise as in stage I; eyes now mobile.

Telson (fig. 4C) similar in shape to that of previous stage; length 2.3 times width; lateral notches remain; marginal setal formula 9 + 9 (7 plumose, 2 non-plumose), plus minute setae interspersed as before; surface otherwise naked.

Antennule (fig. 4D), proximal segment 3.1 times length of distal; latter with 4 terminal aesthetascs plus minute spinule; single elongate plumose seta on proximal segment still present.

Antenna (fig. 4E), endopodite indistinctly two-segmented, distal with short stout articulated spine at tip, followed by 2 thin, 1 elongate plumose setae; proximal segment unarmed; scaphocerite now with 10 marginal setae, length of blade remains 3.3 times width; protopodite with simple small spine at inner and outer distal angles, otherwise unarmed.

Mandibles not dissected.

Maxillule (fig. 4F), endopodite with 2 terminal setae; basal endite with additional seta, making 5 processes; coxal endite unchanged from first stage.

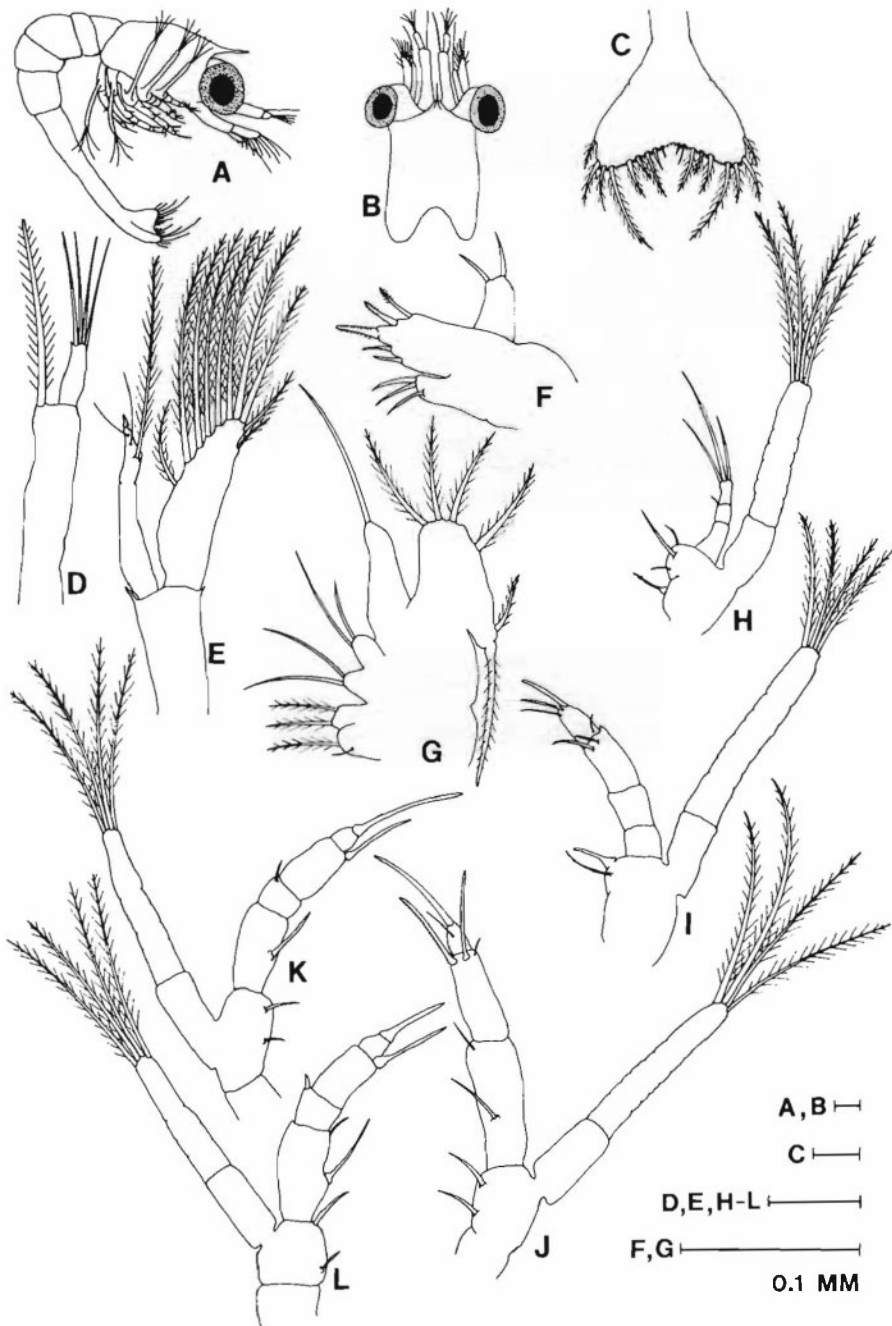


Fig. 4. *Periclimenes (Periclimenes) pandionis* Holthuis, 1951. Second zoea. A, lateral view; B, dorsal view, cephalothorax; C, telson; D, antennule; E, antenna; F, maxillule; G, maxilla; H, maxilliped 1; I, maxilliped 2; J, maxilliped 3; K, pereopod 1; L, pereopod 2. All scale lines represent 0.1 mm.

Maxilla (fig. 4G), endopodite unchanged; basal and coxal endite setal numbers unchanged, but distal lobe of coxal endite now with 2 plumose setae; scaphognathite with 5 plumose setae marginally, plus elongate plumose apical seta.

Maxilliped 1 (fig. 4H) essentially unchanged from that of previous stage, but endopodite lacking seta on penultimate segment; exopodite now two-segmented, lacking distolateral seta; protopodite indistinctly divided into coxopodite and basipodite, with 1 and 3 setae, respectively.

Maxilliped 2 (fig. 4I), endopodite now four-segmented, ultimate segment retaining, penultimate segment losing, short seta; exopodite clearly two-segmented, 4 apical setae; protopodite basal lobe with 2 setae, coxal lobe obscurely defined.

Maxilliped 3 (fig. 4J), endopodite nearly identical in setation to that of previous stage but lacking 2 elongate setae on ultimate segment; exopodite two-segmented, setation as in previous stage; basipodite now divided from protopodite, retaining 2 setae seen in stage I; coxopodite remains obscurely delineated.

Pereiopod 1 (fig. 4K), endopodite four-segmented, setal formula progressing distally 1, 1, 1, 1; exopodite two-segmented, distal segment annulated as in maxillipeds, 4 terminal setae; basipodite with 2 lateral setae, coxopodite naked.

Pereiopod 2 (fig. 4L) similar in form and setation to pereiopod 1, except endopodite proximal segment with 2 setae.

Pereiopods 3-5 undeveloped.

Abdomen (fig. 4A) of five somites; length of third about equal to height; fifth somite about 1/4 length of telson; pleopods absent from all somites.

Color: Similar to that of stage I; yellow pigment noticeably diffused on eye-stalks dorsally and ventrally; third abdominal somite as in first stage but yellow and red pigmentation more extensive; red and yellow chromatophores on last 2 segments of endopodite of maxilliped 1, on proximal 2 segments of endopodite of maxilliped 2; red pigment at base of proximal segment and tip of distal segment in antennule; black pigment in cornea.

Remarks. — In the Caribbean region and western Atlantic, larval stages have been described for several species within the genus *Periclimenes*, including *P. americanus* (Kingsley) (cf. Gurney, 1936; Kurata, unpubl.), *P. longicaudatus* (Stimpson) (cf. Gurney & Lebour, 1941), and *P. iridescens* Lebour (cf. Lebour, 1949). However, most of these descriptions treat late larval stages; consequently useful comparison of early zoeae is possible only between *P. pandionis* and Kurata's (unpubl.) *P. americanus*.

Although the first and second zoeal stages of *P. pandionis* are similar in general form to those of *P. americanus*, they may be distinguished from the latter species. In regard to similarities, the scaphocerites of both species bear 12 setae and have approximately the same length-to-width ratio in stage I. Maxillipeds

1 to 3 are well developed, the exopodites of maxillipeds 1 and 3 each have 4 terminal setae, and pereopods 1 and 2 are absent or rudimentary in the first two stages. Other similarities in the first zoeae include the ratios of the length of abdominal somite 5 to the telson (0.3 in both species), and the length of the telson to its width (1.6). Additionally, both species have 7 + 7 setae on the telson in the first stage, with minute setae interspersed between.

The first zoea, nevertheless, differs in several respects: *P. pandionis* larvae are slightly larger (rcl 0.7 mm compared to 0.54 mm for *P. americanus*); the maxillary endopodite of *P. pandionis* has a single lobe, whereas that of *P. americanus* has 2; the exopodite of maxilliped 2 has only 3 setae in *P. pandionis*, but 4 are seen in *P. americanus*; and *P. pandionis* lacks lateral spines on the anteroventral margin of the carapace and abdominal somite 5, these spines being present in *P. americanus* zoeae.

The second zoeal stage of *P. pandionis* can be easily distinguished from *P. americanus* by the telsonal setal formula (9 + 9 in the former, 8 + 8 in the latter); and by the absence of a small supraorbital spine and a second small spine on the anteroventral margin of the carapace (*P. americanus* possessing these spines). Interestingly, there is little or no apparent increase in rostral carapace length from the first to the second zoeal stage in either species.

RÉSUMÉ

Cinq mâles et 21 femelles de *Periclimenes pandionis* Holthuis, 1951 (Palaemonidae) ont été recueillis au large de Fort Pierce sur la côte centre-orientale de la Floride. L'espèce n'était connue jusqu'à présent que par l'holotype provenant de Key West, Floride. Ce matériel additionnel a permis une description élargie, incluant les mâles adultes. Le premier et le second stades larvaires, obtenus en laboratoire, sont aussi décrits.

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