A SECOND OCCURRENCE OF THE BRAZILIAN FRESHWATER SHRIMP, *POTIMIRIM POTIMIRIM*, ALONG THE CENTRAL EASTERN FLORIDA COAST[1]

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ABSTRACT: *Ovigerous females with viable eggs which hatched occurred in South Relief Canal, Indian River County, but the population may have been eliminated by the January 1977 cold period.*

THE atyid freshwater shrimp *Potimirim potimirim* is primarily a South American species known from Rio Itajai, Itajai, Estado do Santa Catarina, and Rio Gurjau, Recife, Estado do Pernambuco, Brazil (Villalobos, 1960). Abele (1972) first reported the apparent continental introduction of the species into eastern Florida in drainage canals of the Loxahatchee River system in Palm Beach County. We report here a second occurrence of *P. potimirim*, now from the central eastern Florida coast, in a freshwater drainage canal in Indian River County.

Rostral carapace length (RCL) was measured from the tip of the rostrum to the posterior median margin of the carapace; total length (TL) extended from the rostral tip to the posterior median margin of the telson.

MATERIAL EXAMINED—1 male, RCL 4.3, TL 12.9 mm; 6 females, ovigerous, RCL 8.2-10.5, TL 23.0-28.6 mm; Florida, Indian River County, Vero Beach, South Relief Canal, S. R. 605 (Old Dixie Highway), clinging to aquatic vegetation along banks; 10 ft seine net; 18.5° C, 0 ‰; 7 January 1977; G. R. Kulczycki and P. A. Hastings, collectors.

REMARKS—We noted three different color patterns in our living specimens:

Pattern 1): Carapace and abdomen overall, van-dyke brown, former speckled with numerous, red, "snowflake" chromatophores, those on latter white to pale green; dorsally a longitudinal, median, irregular, clear stripe from rostrum to anterior third of telson, stripe outlined with pale green chromatophores, otherwise speckled with gold, copper, or red; carapace laterally with irregular, whitish to translucent longitudinal streaks. Rostral spine, antennular segments and flagella, clear, former two with distinct, copper-colored chromatophores. Scaphocerite clear translucent blue, with red chromatophores; antennal flagella clear to reddish brown. Eyestalks translucent, outlined in dark brown, with red and gold chromatophores interspersed. Posterior two-thirds of telson and distal half of uropods dark bluish-brown; outer margin of exopod, and posterior margin of exopod and endopod clear, speckled with red and pale green; setae on same pale golden yellow. Walking legs translucent with numerous red chromatophores, later becoming brownish on pereiopod 5. This pattern is similar to that illustrated by Abele (1972), although differing slightly in color; it was seen in quiescent ovigerous females isolated in specimen bowls.

[1]Studies on Decapod Crustacea from the Indian River Region of Florida. VIII.

[2]The costs of publication of this article were defrayed in part by the payment of charges from funds made available in support of the research which is the subject of this article. In accordance with 18 U.S.C. § 1734, this article must therefore be hereby marked "*advertisement*" solely to indicate this fact.

Pattern 2): Carapace and abdomen overall cerulean blue; translucent lateral maculations and median dorsal stripe present, with chromatophores as in brown phase above; stripe more noticeable due to light blue coloration, appearing in refracted light under the dissecting microscope as if dusted with myriad tiny scintillating motes of copper, gold and pale green. This pattern, also noted by Abele (1972), was exhibited by agitated ovigerous females upon capture, and during laboratory observation and handling; it undoubtedly is a "fright pattern".

Pattern 3): Pattern similar to above, but overall hue pale yellow-brown, with many more pale green to yellow-green spider-like chromatophores. This pattern was exhibited by the male, and one ovigerous female which subsequently died.

Our specimens agreed well with the description provided by Villalobos (1960) but we noted some variation in characters used in the diagnosis by that author. For example, the diametrical index (i) of the *appendix masculina* (Fig. 1) in our male specimen was 50.77; Villalobos gave 50.46 in his species diagnosis for *Potimirim potimirim*, so our specimen agrees well in that respect. However, we did not see, nor apparently did Abele (1972, fig. 3, D) in his specimens, the long seta next to the *appendix interna* on this appendage. We also noted in our same male specimen that the carpus of pereiopod 4 lacked a distal spine, and the merus of pereiopod 5 had three distal spines (instead of the diagnostic 2); both of these spinal features are diagnostically indicative of *Potimirim mexicana* (Saussure, 1857 *fide* Villalobos, 1960). All ovigerous females had the distal carpal spine on pereiopod 4, but 2 specimens had 3 (instead of 2) distal meral spines on pereiopod 5, again showing similarity to *P. mexicana* (Fig. 1). The latter species differs in several meristical features from *P. potimirim*, including the *appendix masculina* (i=58.75), although both species are otherwise morphologically quite similar.

Discussion.—The South Relief Canal, the Indian River County collection site for our specimens of *Potimirim potimirim*, is approximately 100 km (60 miles) north of Abele's (1972) collection site. This small, freshwater canal is about 20 m wide and usually is less than 0.5 m deep. The channel is artificial, possesses floodgates at several points along its 8 km (5 mile) length, and drains farmland and citrus groves in the western interior of Indian River County directly into the estuarine waters of the Indian River lagoon. While in no sense pristine, the waters of the canal are not heavily polluted. Freshwaters from the St. Johns River Valley marshland, citrus and agricultural artesian well water from the deep Floridan Aquifer, and suburban and agricultural shallow wellfield water from the Pleistocene Aquifer (primarily rainfall—renewed), make up the majority of the effluent. Rainwater runoff and isolated point-source sewage form the minor component. Seasonally heavy rainfall raises inland water levels and the canal floodgates are opened aperiodically to afford relief. Water flow and current are dependent on whether the canal is actively (floodgates open) or passively (gates closed) draining.

Like many other drainage canals in the Indian River area, South Relief Canal is heavily vegetated along either bank, and large populations of the palaemonid

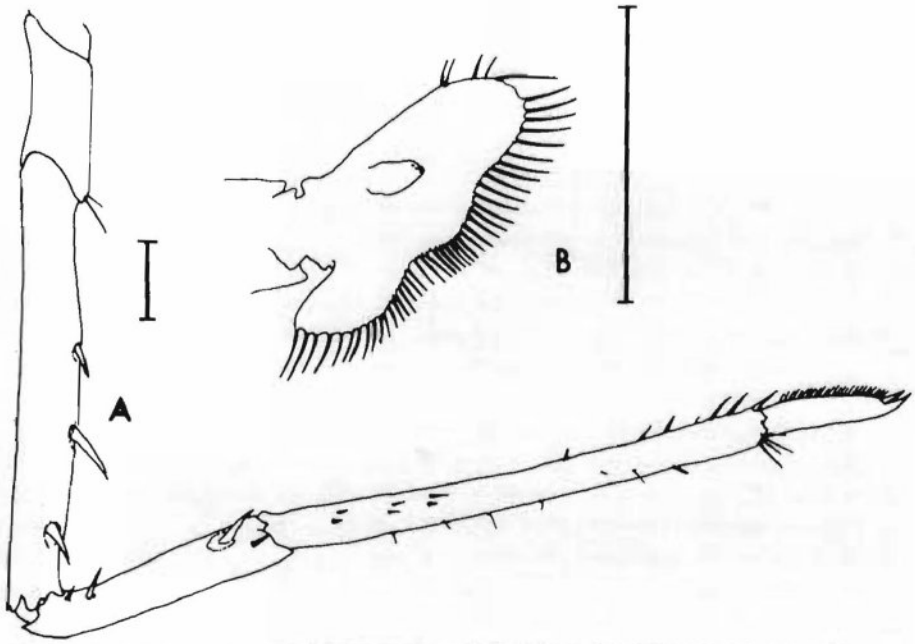

FIG. 1. *Potimirim potimirim* (Müller, 1881). A. Left pereiopod 4, male. B. Right appendix masculina, medial view. Scale lines equal 1.0 mm.

shrimp *Macrobrachium acanthurus* (Wiegmann) and *M. carcinus* (L.) find refuge here along with *P. potimirim*. The bordering vegetation overhangs the water, often becomes densely foliated, and consequently is removed either by mechanical dragline, the application of phytotoxins, or a combination of both. The population of *Potimirim potimirim* in the South Relief Canal is thus subjected to both pesticide (citrus and agricultural) and herbicide (canal vegetational maintenance) stress.

Based on ovigerous females in his collections from Palm Beach County, Abele (1972) suggested that *Potimirim potimirim* may have established a Floridan population; he thought its presence "highly probable" in other canals, both man-made and natural, of the interconnected Florida drainage system. Our findings show Abele may be right in his supposition. The Indian River locality approximately 100 km (60 miles) north of Abele's collection site, is interconnected with other canals along the central eastern Florida coast, and undoubtedly with the Florida Flood Control system. The latter, in turn, receives inflow from the numerous naturally-occurring lakes, rivers and streams in the area. It is thus entirely possible that the Indian River County population of *Potimirim* is simply an element of that noted by Abele (1972) from farther south in Palm Beach County.

On the other hand, at least eight tropical fish farms are operative in Indian River County, and several are known to culture species of Brazilian fishes. The possibility cannot be ruled out, therefore, that the Indian River population of *Potimirim* came from stowaway specimens either in tropical fish or limnetic plant shipments brought in from South America (but see below).

A third possibility is that the species arrived in Florida by rafting. Villalobos (1960) noted that *Potimirim potimirim* has been encountered out at sea, presumably carried there in the masses of fluviatile vegetation swept loose by river currents. If such rafts are not destroyed by wave action the species could conceivably be carried long distances. This supposes, of course, that osmoregulatory mechanisms in this primarily freshwater shrimp are capable of adjusting to marine salinities. Villalobos noted that the closely related *Potimirim mexicana* has been collected in localities with a salinity as high as 29.45‰.

Larvae were obtained from three females and reared at 0, 10, 16, 23‰, and 2 through 20‰. *Potimirim potimirim* hatched as a prezoea and, depending on salinity regimen, remained as stage I zoea, or molted to stage II, III, possibly stage IV, and stage III zoeae, respectively. Maximum survival was seen in constant 23‰ culture trays. These results will be further developed elsewhere. We consider it highly unlikely, but not, of course, impossible that *P. potimirim* larvae could withstand an extended sojourn in the plankton from South America and thus colonize the fresh waters of the eastern Florida seaboard. An extensive barrier island system, with estuarine or marine lagoonal waters interposed behind, extends for nearly the entire length of the eastern Florida coast. The numerous rivers, canals, and streams which occur along the western shores of this system would provide ample opportunity for colonization should the proper environmental conditions occur.

The fact that all 6 females we collected were ovigerous indicates that the Indian River specimens came from a breeding population, but not necessarily one that was firmly established. Following the severe cold period of 18-20 January 1977, in which air temperatures fell to about -3° C and fresh water temperatures dropped to 5-8° C, a second collection of *P. potimirim* was attempted. No specimens were obtained, and monthly collections at the same site through April 1977 have produced no further atyid shrimp, suggesting that the Indian River population of *Potimirim potimirim* was extremely localized, and vulnerable to extreme cold. The shrimp has not been obtained in any other freshwater collections from the Indian River region, from Cape Canaveral to Jupiter Inlet.

Specimens from this study are deposited in the National Museum of Natural History, Washington, D. C. (2 females, ovigerous; USNM 169231) and the Harbor Branch Foundation, Inc., Museum at Link Port, Fla. (1 male, 4 females, ovigerous; SIFP 89.3181).

ACKNOWLEDGMENTS—We thank Misses Nina Blum and Kim Wilson for aid during the laboratory culture of the larvae. This is Scientific Contribution No. 89 from the Smithsonian Institution-Harbor Branch Foundation, Inc., Scientific Consortium, Link Port, Ft. Pierce, Florida 33450.

LITERATURE CITED

ABELE, L. G. 1972. Introductions of two freshwater decapod crustaceans (Hymenosomatidae and Atyidae) into Central and North America. Crustaceana 23:209-218.

MÜLLER, F. 1881. Atyoida *Potimirim*, eine schlammfressende Susswassergarneele. Kosmos 9:117-124.

SAUSSURE, H. DE. 1857. Diagnoses de quelques Crustacès nouveaux de l'Amérique tropicale. Rev. Mag. Zool. Pure Appliquée ser. 2, 9:501-505.

VILLALOBOS, A. 1960. Contribucion al conocimiento de los Atyidae de Mexico. II. (Crustacea, Decapoda). Estudio de algunas especies del genero *Potimirim* (= *Ortmannia*), con descripcion de una especie nueva en Brasil. An. Inst. Biol. Mexico 30:269-330.

Florida Sci. 41(1):57-61. 1978.

SUITABILITY AMONG NATIVE OR NATURALIZED PLANT SPECIES OF SOUTHERN FLORIDA FOR CITRUS BLACKFLY DEVELOPMENT—

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ABSTRACT: Myrsine guianensis *(Aubl.) Kuntz (Myrsine) and* Ardisia escallonioides *Schlecht and Cham. (Marlberry) support development of* Aleurocanthus woglumi *Ashby to the adult stage and are native to southern Florida.* Ardisia solanacea *Roxb.,* Schinus terebinthifolius *Raddi (Brazilian Pepper Tree) and* Eugenia uniflora *L. (Surinam Cherry) are naturalized plants which also support complete* A. woglumi *development.* Citrus *spp. and these native or naturalized plants, which support complete development are considered as potential refugia of* A. woglumi *and can affect the chances of its eradication.*[*]

CITRUS BLACKFLY, *Aleurocanthus woglumi* Ashby (Homoptera: Aleyrodidae), is a major pest of citrus. Native to southern Asia, *A. woglumi* was first discovered in the Western Hemisphere in Jamaica by Ashby in 1913. Since then it has become established in Mexico, the Caribbean (Dietz and Zetek, 1920), and the United States (Howard and Neel, 1977). Recently *A. woglumi* has been reported from Broward, Dade and Palm Beach Counties primarily in dooryard citrus and in nursery plant material. It is the subject of an eradication program by the Division of Plant Industries (Florida Department of Agriculture and Consumer Services) and the Animal and Plant Health Inspection Service (United States Department of Agriculture). The eradication effort includes a quarantine on the movement of citrus and other plants which act as hosts for *A. woglumi.* Since an eradication program requires a thorough knowledge of all acceptable hosts of the target species, studies were initiated at the Agricultural Research Center, Ft. Lauderdale, to determine those native, naturalized, and imported plants that support *A. woglumi* development. Here we report the results of our tests with native and naturalized plants; a previous study of species wild and cultivated in Florida (Howard and Neel, 1977) is reported elsewhere.

MATERIALS AND METHODS—Potted plants of 10 species (Table 1) approximately 0.3 m tall were infested with *A. woglumi* by placing the plants within a meter of infested citrus trees for 12-15 days. These plants were then returned to the Agricultural Research Center, Ft. Lauderdale for observations of *A. woglumi* development. Potted citrus plants were used as an oviposition check. Development on *Myrsine guianensis* (Aubl.) Kuntze and *Ardisia solanacea* Roxb. is based on field observations in John D. Easterlin County Park, Ft. Lauderdale, and a swamp at U.S. Geological Survey quadrant T.49S., R.42E., Sec. 10, northeast portion respectively. We also observed *A. escallonioides* Schlecht. & Cham.,

[1]Florida Agricultural Experiment Station Journal Series No. 683.
[*]The costs of publication of this article were defrayed in part by the payment of charges from funds made available in support of the research which is the subject of this article. In accordance with 18 U. S. C. § 1734, this article must therefore be hereby marked "*advertisement*" solely to indicate this fact.

TABLE 1. A list of the highest developmental stage of *A. woglumi* observed on native or naturalized plants in either lab. (°) or field conditions (+).

Plant Species	Common Name	Highest Stage of *A. Woglumi* Devel.
+ *Myrsine guianensis* (Aubl.) Kuntze	Myrsine	Adult
° + *Ardisia escallonioides* Schlecht. & Cham.	Marlberry	Adult
+ *Ardisia solanacea* Roxb.		Adult
° + *Schinus terebinthifolius* Raddi	Brazilian Pepper Tree	Adult
° + *Eugenia uniflora* L.	Surinam Cherry	Adult
° *Baccharis halimifolia* L.	Groundsel	Fourth instar
+ *Persea borbonia* (L.) Spreng.	Red Bay	Fourth instar
° *Psychotria nervosa* Sw.	Wild Coffee	Fourth instar
° *Salix caroliniana* Michx.	Coastal-Plain Willow	Fourth instar
° *Coccoloba uvifera* (L.) L.	Sea Grape	First instar
° *Sambucus simpsonii* Rehder	Southern Elderberry	First instar
° *Peltandra virginica* (L.) Schott & Endl.	Peltandra	First instar
° *Ipomoea alba* L.	Moon Flowers	No oviposition

Eugenia uniflora L., *Schinus terebinthifolius* Raddi and *Persea borbonia* (L.) Spreng. in the field for *A. woglumi* presence. Determination of plants as native or naturalized species is based on information from local floristic studies (Long and Lakela, 1971; Steinberg 1976).

RESULTS AND DISCUSSION—Five of the 13 plants observed were able to sustain complete development of *A. woglumi* (Table 1).

A primary purpose of the current quarantine is to prevent the movement of *A. woglumi* into the major citrus growing regions of the state. Based on our results, it seems unlikely that native or naturalized plant species in southern Florida could serve as such a transfer medium. Of those plants tested upon which *A. woglumi* completed its development, only *Schinus terebinthifolius* (a common plant in disturbed habitats) is widespread enough to be considered as a potential route to the citrus groves. However, this plant supports much lower numbers of *A. woglumi* than citrus species. Tests indicate that less than one adult per plant emerged from *S. terebinthifolius* compared with 41.8 per plant from *Citrus sinensis* (L.) Osbeck when potted plants of similar size were compared. (Howard and Neel, 1977).

One problem facing any eradication program is the discovery and elimination of small isolated populations (refugia) of the target organism. Native or naturalized plants suitable for complete development of *A. woglumi* can form such refugia. *Myrsine guianensis* and *Ardisia escallonioides* are native plants which support complete *A. woglumi* development. *Myrsine guianensis* is common in swamps and wetter sites of Pine Flatwoods vegetation. *Ardisia escallonioides* commonly occurs in Low Hammock and Tropical Hammock vegetation. These species are supporting populations of *A. woglumi* in several locations in the Ft. Lauderdale area. *Ardisia solanacea, Schinus terebinthifolius* and *Eugenia uniflora* are naturalized species in southern Florida on which field popu-