

Shrimps of the family Atyidae from Guam, Mariana Islands

TRINA LEBERER

*Division of Aquatic & Wildlife Resources
192 Dairy Road
Mangilao, Guam 96923
email: tleberer_1999@yahoo.com*

YIXIONG CAI

*Department of Biological Sciences
National University of Singapore
Lower Kent Ridge Road
Singapore 119260
Republic of Singapore
email: sinoshrimp@hotmail.com*

Abstract—There are at least 6 species of atyid shrimp found on the island of Guam, including one undescribed species. Probably only two species have previously been recorded correctly from the island. Specimens were collected from a wide range of locations and habitat types, including inland freshwater, brackish and anchialine. Most of them are widespread in the Indo-Pacific region. *Atyoida pilipes* was the most common atyid in collections. Guam's stream atyids are considered amphidromous, developing in the marine environment as larvae and living in freshwater as adults. Reproduction for the hypogeal species is less well understood. Although some of the species mentioned in this paper are new records for the island, all recorded species are considered native to Guam.

Introduction

Shrimps in the family Atyidae are commonly found on Pacific islands. Guam is home to at least six recorded stream species (although two of these may be misidentifications) and at least two hypogeal species (Table 1). All of the species found on Guam are native, with only one as yet known to be endemic to the island. Characteristics of the family Atyidae include chelae with excavated carpi on the first two pairs of pereopods and apical tufts extending from the tips of the fingers.

Table 1. Records of atyid shrimps from Guam.

Cat. #: Voucher specimens deposited in: UGI = University of Guam Invertebrate collection, BPBM = Bernice P. Bishop Museum, Honolulu.

Lit. cit.: Literature cited: 1. Best & Davidson, 1981⁴; 2. Bouvier 1925¹; 3. Chace 1983¹; 4. Edmondson 1935³; 5. Ellis-Neill 1987⁴; 6. Holthuis 1982¹; 7. Leberer & Nelson 2001⁴; 8. Maciolek 1983⁴; 9. new record. (¹Record in taxonomic revision of group. ²Fully documented record in taxonomic publication, with voucher specimen. ³Reliable record in taxonomic publication, without voucher specimen. ⁴Other records.)

Notes: see after table

Taxon	Cat. #	Lit. cit.	Notes
<i>Atyoida pilipes</i> (Newport, 1847)	UGI	1,3,5,7	A
* <i>Atyoida serrata</i> (Bate, 1888)		1	B
* <i>Atyopsis spinipes</i> (Newport, 1847)		1,4	C
<i>Caridina brachydactyla</i> De Man, 1908	UGI	7	D
<i>Caridina mertonii</i> Roux, 1911	UGI	1,5,7	E
<i>Caridina typus</i> H. Milne-Edwards, 1837	UGI	1,2,5,7	F
<i>Antecaridina lauensis</i> (Edmondson, 1935a)	UGI	9	G
* <i>Halocaridinides trigonophthalma</i> (Fujino & Shokita, 1975)	BPBM	8	H
<i>Halocaridinides</i> sp.		9	I

* Dubious record; see notes.

Notes:

- A. Recorded from the Marianas in general, without island specified, in Chace (1983).
- B. Dubious record; Best & Davidson's (1981) record of *Atya serrata* from Guam may be based on misidentified *Atyoida pilipes*. The reliable distribution of *Atya serrata* is restricted to the Indian Ocean (Madagascar, Comoros Islands, Seychelles, Mauritius, and Réunion - Chace 1983).
- C. Dubious record; may be based on misidentification of *Atyoida pilipes*. Edmondson's (1935) record is from the Marianas in general, without island specified.
- D. This species was previously recorded from Guam as *C. longirostris* H. Milne-Edwards, 1837 by Leberer & Nelson (2001); more specimens are needed to confirm current identification. Bouvier (1925) and Edmondson (1935) previously treated *brachydactyla* as a variety of *C. nilotica*.
- E. This species was previously recorded from Guam under the names of *C. nilotica* (Roux, 1833), *C. weberi* de Man, 1892 and *C. serratirostris* de Man, 1892 (Best & Davidson 1981, Ellis-Neill 1987, Leberer & Nelson 2001).
- F. Recorded from the Marianas in general, without island specified, by Bouvier (1925).
- G. Widespread in the Indo-Pacific (Maciolek 1983, Sket 1997).
- H. Maciolek's (1983) record of *Halocaridinides trigonophthalma* from Guam needs to be confirmed; more likely it represents the undescribed *Halocaridinides* we encountered.
- I. An undescribed species under study by the authors.

Methods

Specimens were collected from two rivers in the southern half of Guam from 1995-1997. The Asmafines River is a small, steep river in the west (coordinates at the mouth: lat. 13° 19' 37" N; long. 144° 39' 03" E, channel length = 1341 m, elevation = 134 m at the headwaters; Best & Davidson 1981). The Ugum River is

a main tributary of the Talofofu River in a large watershed on the eastern side of the island (coordinates at the confluence: lat. 13° 20' 11" N; long. 144° 45' 08" E, channel length = 11,460 m; elevation = 183 m at the headwaters; Best & Davidson 1981). Hypogeal shrimps were first collected on Guam in 1981 (specimens deposited in the Bernice P. Bishop Museum, Honolulu; recorded as *Halocaridinides trigonophthalma* in Maciolek 1983). Several different cave organisms were collected by Dr. Thomas Iliffe (Department of Marine Biology, Texas A&M University at Galveston) in 1985, including shrimp specimens from Marbo Cave, Faifai Beach Cave, Ritidian Cave, Tweed's Cave, and Tarague Water Well #4. Guam specimens were also collected from a sinkhole in the southern village of Ypan and a freshwater cave near Andersen Air Force Base (from 1995-2000). Specimens collected from 1995-2000 were fixed in 80% ethanol for later identifications.

Results and Discussion

Leberer & Nelson (2001) reported collections from two rivers: the Asmafines River in southwestern Guam and the Ugum River in southeastern Guam (n=189). *Atyoida pilipes* was the most common species in total collections (n=80, 42 %; Asmafines n=43, 39%; Ugum n=37, 46%). *Caridina typus* (n=43, 39%) and *C. mertoni* (n=21, 19%; recorded as *C. weberi* and *C. serratiostris* in Leberer & Nelson 2001) predominated in collections from the Asmafines River. The only specimen of *C. brachydactyla* (recorded as *C. longirostris* in Leberer & Nelson 2001) collected from Guam also came from the Asmafines River. *Caridina mertoni* (recorded as *C. nilotica* in Leberer & Nelson 2001) was the dominant species in collections from the Ugum River (n=39, 49%).

According to Maciolek (1983), some hypogeal shrimps collected from Guam in 1981 were identified as *Halocaridinides trigonophthalma*. The 35 specimens collected from various caves in northern Guam in 1985 by Iliffe were sent to Dr. A.J. Bruce and Dr. Satish Choy (Queensland Museum) for identification, but no results were forthcoming. In various collections at the Ypan sinkhole, the first author observed what appeared to be two different species of hypogeal shrimps. Some of these specimens were sent to Dr. A.J. Bruce for identifications, but unfortunately, he had retired and those specimens were lost. Later specimens, of only one type, were identified by the present authors as *Antecaridina lauensis*, an anchialine species that is widely distributed in the Indo-Pacific, found in Fiji, Mozambique Channel, Dahlak (Red Sea), Hawaii, and the Daito, Ryukyu, Solomon Islands (Maciolek 1983) and Bohol Island, Philippines (Sket 1997). Three specimens collected from a freshwater cave near Andersen Air Force Base proved to be an undescribed species of the genus *Halocaridinides* Fujino & Shokita, 1975 (Cai & Leberer, in preparation). Guam may thus have more than two species of hypogeal shrimps, but more specimens, including those deposited in the BPBM collections, will need to be reexamined to verify this. Atyid reproductive strategy can often be determined by examining egg size (Shokita

1976). *Halocaridinides trigonophthalma* is classified as a “medium egg-landlocked type” (Maciolek 1983). The reproduction of *Antecaridina lauensis* is not clear, given the absence of ovigerous females in rather extensive collections (Maciolek 1983). Conversely, based on egg size (Table 2) and number, all of Guam's stream atyids are considered amphidromous, spending their larval life developing in the ocean, recruiting to rivers as juveniles, and spending the rest of their lives in freshwater (Shokita 1976, Benzie 1982).

Table 2. Average egg size of atyid species on Guam

Species	N	Average Egg Size	
		length (mm)	width (mm)
<i>Atyoida pilipes</i>	54	0.50 ± 0.02	0.28 ± 0.01
All <i>Caridina</i> species combined	27	0.42 ± 0.01	0.26 ± 0.01

Due to their pelagic larval stage, the stream species found on Guam are mostly widespread throughout the Pacific (Bouvier 1925, Edmondson 1935, Bright 1979, U.S. Army Corps of Engineers 1981, Chace 1983, Chace 1997, Maciolek & Ford 1987, Bright 1989, Hung et al. 1993). Ovigerous females have been collected during most months of the year, but there appears to be a slight peak in their numbers in the rainy season (first author, pers. obs.). Chace (1983) suggested that specimens of *A. pilipes* from Palau exhibit partial protandry. Data from Guam also support this, with female atyids significantly larger than males for all species examined (Table 3).

Table 3. Size comparison between sexes of atyid shrimps on Guam (1-way ANOVA).

Species	Sex	Average Carapace Length (mm)	F-value	df	P-value
<i>Atyoida pilipes</i>	female	8.7 ± 0.2	82.49	90	<0.0001
	male	6.4 ± 0.1			
All <i>Caridina</i> species combined	female	8.3 ± 0.5	20.35	66	<0.0001
	male	6.4 ± 0.1			

Atyids are ubiquitous in Guam's rivers. In the lower reaches, juveniles can often be found buried within the substratum, apparently to avoid predation, probably mainly by the flagtail *Kuhlia rupestris*, a fish of the perciform family Kuhliidae (Leberer & Nelson 2001). Above barrier waterfalls, adults are more commonly seen out in the open (Leberer & Nelson 2001). *Atyoida pilipes* are found more commonly on hard substrates in riffle areas, while species in the genus *Caridina* can be seen more frequently in deeper areas with calmer waters, such as pools and runs (Leberer & Nelson 2001). This habitat differentiation corresponds with morphological differences in the shrimp. *Atyoida* possess

longer setae appropriate for filter-feeding in faster moving water (Chace 1983, Ellis-Neill 1987) while *Caridina* have both short and long setae appropriate for filtering or scraping in a wider range of habitats (Bouvier 1925, Ellis-Neill 1987).

Both *Halocaridinides trigonophthalma* and *Antecaridina lauensis* are euryhaline, feed primarily by scraping the substrate, and possess red integumentary chromatophores (Maciolek 1983). They are found in interstitial habitats, including pools, fissures, and wells. Given their wide range of salinity tolerance and association with anchialine habitat, Maciolek (1983) surmised that these shrimps may also be found in submerged rock throughout the tropical Indo-Pacific, allowing for widespread but disjointed distributions. The collection record for the undescribed species, *Halocaridinides* sp. is too simple to provide any biological information except that it is found from a cave in freshwater.

In the local language Chamorro, atyids are referred to as “uhang”, the same name given to all shrimp, freshwater or marine (G.V. San Nicolas, pers. comm.). Chamorros traditionally utilized stream atyids for food, occasionally preparing them in a local dish called kélaguen (G.V. San Nicolas, pers. comm.).

Acknowledgements

We wish to thank Brent Tibbatts, Michelle Gaither, and Frank Camacho for their help in collecting specimens, and Drs. Peter Ng and Gustav Paulay for their help in critically reading the manuscript. Contribution 488 of the University of Guam Marine Laboratory.

References

- Benzie, J. A. H. 1982. The complete larval development of *Caridina mccullochi* Roux, 1926 (Decapoda, Atyidae) reared in the laboratory. *Journal of Crustacean Biology* 2:493-513.
- Bouvier, E.-L. 1925. Recherches sur la morphologie, les variations, la distribution géographique des crevettes de la famille des Atyidés. *Encyclopédie Entomologique* 4:1-370.
- Bright, G. R. 1979. The inland waters of Palau, Caroline Islands. Office of the Chief Conservationist, Trust Territory of the Pacific Islands, Palau. 61pp.
- Bright, G. R. 1989. The freshwater decapod crustaceans of Yap, Caroline Islands. In S.G. Nelson (ed), *The Inland Aquatic Habitats of Yap*, pp. 33-36. University of Guam Marine Laboratory, Mangilao, Guam.
- Chace, F. A., Jr. 1983. The Atya-like shrimps of the Indo-Pacific region (Decapoda: Atyidae). *Smithsonian Contributions to Zoology* 384: 54 pp.
- Chace, F. A., Jr. 1997. The caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition, 1907-1910, part 7: families Atyidae, Eugeonatonotidae, Rhynchocinetidae, Bathypalaemonellidae, Processidae, and Hippolytidae. *Smithsonian Contributions to Zoology* 587: 106 pp.

- Edmondson, C. H. 1935. Atyidae of southern Polynesia. B.P. Bishop Museum Occasional Papers 11: 3-19.
- Ellis-Neill, L. 1987. Distributional and production dynamics of benthic invertebrates in a tropical stream on Guam. Master Thesis. University of Guam. 51pp.
- Fujino, T. & S. Shokita. 1975. Report on some new atyid shrimps (Crustacea, Decapoda, Caridea) from the Ryukyu Islands. Bulletin of the Science and Engineering Division, University of the Ryukyus 18: 93-113.
- Holthuis, L. B. 1982. Notes on the Indo-West Pacific Crustacea. II. The genus *Halocaridinides* Fujino and Shokita and its type species *H. trigonophthalma* (Fujino and Shokita). Crustaceana 42: 31-36.
- Hung, M.-S., T.-Y. Chan & H.-P. Yu. 1993. Atyid shrimps (Decapoda: Caridea) of Taiwan, with descriptions of three new species. Journal of Crustacean Biology 13: 481-503.
- Leberer, T. & S. G. Nelson. 2001. Factors affecting the distribution of atyid shrimps in two tropical insular rivers. Pacific Science 55: 389-398.
- Maciolek, J. A. 1983. Distribution and biology of Indo-Pacific insular hypogeal shrimps. Bulletin of Marine Science 33: 606-618.
- Maciolek, J. A. & J. I. Ford. 1987. Macrofauna and environment of the Nanpil-Kiepw River, Ponape, Eastern Caroline Islands. Bulletin of Marine Science 41:623-632.
- Shokita, S. 1976. Early life-history of the land-locked atyid shrimp, *Caridina denticulata ishigakiensis* Fujino et Shokita, from the Ryukyu Islands. Researches on Crustacea, Carcinological Society of Japan 7:1-10.
- Sket, B. 1997. Hypogean aquatic fauna in Bohol Island, Philippines. In Our Caves. Bulletin of the Speleological Association of Slovenia, supplement, 39:62-67.
- U.S. Army Corps of Engineers. 1981. American Samoa stream inventory, island of Tutuila, American Samoa water resources study. Honolulu District, Honolulu, Hawaii. 122pp.