

A NEW GENUS AND TWO NEW SPECIES OF SUBTERRANEAN AMPHIPOD CRUSTACEANS (HADZIIDAE) FROM THE BAHAMAS AND TURKS AND CAICOS ISLANDS

by

JOHN R. HOLSINGER & JILL YAGER

*Department of Biological Sciences,
Old Dominion University, Norfolk, Virginia 23508, U.S.A.*

ABSTRACT

Bahadzia, new genus, and two new species of amphipod crustaceans are described from anchialine caves in the Bahamas and Turks and Caicos Islands. One of the species is recorded from three caves on Grand Bahama Island and one cave on Great Abaco Island, whereas the other species is recorded from two caves on the island of Providenciales. The new genus is apparently more closely related to *Metaniphargus* and *Saliweckelia* than other hadziid genera in the peri-Caribbean region, but it also shares some important characters with *Mayaweckelia*.

RÉSUMÉ

Le genre nouveau d'Amphipodes *Bahadzia* (avec deux espèces) est décrit de des grottes anchialines des îles Bahamas et de Turks et Caicos. Une des espèces a été découverte dans trois grottes de l'île Grand Bahama, ainsi que dans une grotte de l'île Great Abaco, tandis que la seconde espèce a été capturée dans deux grottes de l'île Providenciales. Le genre nouveau est apparemment plus proche de *Metaniphargus* et de *Saliweckelia* que d'autres genres de Hadziides de la zone péri-Caraïbe, mais il présente aussi quelques importants caractères de *Mayaweckelia*.

INTRODUCTION

Recent biological exploration of anchialine habitats in caves of the West Indies, Bermuda and the Canary Islands (see Yager, 1981; Iliffe et al., 1983; Iliffe et al., 1984), has yielded many new taxa of stygobiont crustaceans previously unknown to science. The term anchialine was introduced in the literature by Holthuis (1973: 3) to describe "pools with no surface connection with the sea, containing salt or brackish water, which fluctuates with the tides." More recently, anchialine has been used to characterize land-locked pools or cave lakes in limestone, coral or basalt with subterranean connections to the sea (Holsinger, in press).

Anchialine cave waters typically range from limnetic at the surface to polyhaline, or perhaps even euhaline, at greater depths. The biological significance of this specialized cave environment is now being recognized, and many new and exciting discoveries will undoubtedly be made there in the near future as exploration continues.

During an ongoing speleological investigation of Lucayan Caverns, an extensive anchialine cave on Grand Bahama Island in the Bahamas (see Yager, 1981), Yager and Dennis W. Williams have collected specimens of a stygobiont amphipod crustacean at depths of 10-15 m. Scuba gear modified for cave diving was utilized to gain access to this environment. Additional collections of these amphipods have been made from two other anchialine caves on Grand Bahama, one on nearby Great Abaco Island, and two on Providenciales in the Turks and Caicos Islands. The material in these collections represents a new genus and two new species which are described below.

The taxonomic work in this paper is that of Holsinger as indicated; the remainder of the paper is the work of both of us. A second paper, treating the zoogeographic implications of this new genus, was presented at the International Symposium on the Biology of Marine Caves in Bermuda, in October 1984, and will be published in the proceedings of that meeting.

***Bahadzia* Holsinger n. gen.**

New genus of Hadziidae (Holsinger, in press).

Diagnosis.— Without eyes and pigment, of subterranean facies. Interantennal (lateral) lobe

of head broad, bluntly rounded anteriorly. Antenna 1 elongate, greater than 50% of length of body, longer than antenna 2; aesthetascs present on most flagellar segments; accessory flagellum 3-segmented. Upper lip symmetrical, rounded and unnotched apically. Mandible: molar rather prominent, triturative; lacinia mobilis and molar seta present on both; palp 3-segmented, segment 3 with long row of D-setae and several E-setae. Lower lip: outer lobes high, well developed; inner lobes vestigial or absent; lateral (mandibular) processes rather short. Maxilla 1: inner plate with apical setae; outer plate with 8 apical serrate and/or pectinate spines; palp 2-segmented, apex with blade-like spines. Maxilla 2: inner plate broader than outer plate, bearing row of numerous, fine, naked facial setae. Maxilliped: outer plate broader than inner plate, expanded distally, bearing short, coarse setae along inner margin.

Gnathopod 1: dactyl short and thick; propod narrow and weak, palm very short, transverse, with several spines near defining angle; segment 5 elongate, richly setose, without posterior lobe; segment 4 with large, pubescent posterior lobe. Gnathopod 2 sexually dimorphic. Propod of gnathopod 2: palm short, oblique, with several spine teeth; propod 2 of male proportionately longer than that of female, with long, oblique palm armed with double row of blunt-tipped spine teeth. Segment 5 of gnathopod 2 in both sexes elongate, without posterior lobe and pubescence. Coxal plates of gnathopods large, deeper than corresponding body segments. Coxal plates of pereopods 3 and 4 differing; that of 3 longer than broad, not expanded distally; that of 4 larger, broader than long, greatly expanded distally, posterior margin with shallow excavation. Pereiopod 6 longer than pereopods 5 and 7, more than 50% of length of body. Coxal gills very large, with short peduncles, present on pereopods 2-6. Sternal gills absent. Brood plates sublinear.

Posterior corners of pleonal plates small and acute. Pleopods biramous, not sexually dimorphic. Uronites free (not fused), bearing few

dorsal spines. Uropods 1 and 2 not sexually dimorphic; rami and peduncles bearing normal spines; peduncle of uropod 1 with or without basofacial (ventrolateral) spine. Uropod 3 comparatively long, biramous; rami nearly equal in length (magniramus) but differing in width and pattern of armament (dispariramus), outer ramus with short second (terminal) segment. Telson relatively long; lobes completely separate and armed with both lateral and medial spines.

Type-species.— *Bahadzia williamsi* Holsinger. Gender feminine.

Etymology.— The generic name is derived by a combination of *Ba*, which comes from Bahama, and *Hadzia*, the nominate genus of the family Hadziidae.

Affinities.— *Bahadzia* is apparently more closely allied morphologically with *Metaniphargus* and *Saliweckelia* than other genera assigned to the family Hadziidae in the peri-Caribbean region of North America. The possibility remains, however, that *Bahadzia* also may be closely related to *Mayaweckelia*, a genus from caves on the Yucatán Peninsula presently assigned to the weckeliid group of Hadziidae (see Holsinger, 1977, and in press). But, as pointed out below, this relationship is problematic and needs further study.

Metaniphargus inhabits a variety of brackish to freshwater subterranean habitats throughout the Greater and Lesser Antilles, whereas *Saliweckelia* inhabits primarily the interstices of coral rubble saturated with polyhaline to full marine water surrounding the islands of Curaçao, Bonaire and Tortuga off the northern coast of Venezuela (Stock, 1977, 1983; Holsinger, in press). *Bahadzia* is also separated geographically from these genera, inasmuch as it is found north of the Antilles. Other hadziids of the peri-Caribbean region belong to the weckeliid group which is composed of nine mostly monotypic genera recorded from subterranean freshwater habitats in Cuba, Puerto Rico, the Yucatán Peninsula, northern Mexico, and south-central Texas (see Holsinger &

Longley, 1980; Holsinger, in press), and *Protohadzia*, a genus reported from "open" marine habitats in Bimini Lagoon in the Bahamas and Corona Reef off Puerto Rico (Zimmerman & Barnard, 1977).

The weckeliid group genera differ from *Bahadzia*, *Metaniphargus*, *Saliweckelia* and *Protohadzia* by the absence of a second (terminal) segment on the outer ramus of uropod 3 and reduction or absence of the mandibular palp. *Protohadzia* may be more closely allied with *Bahadzia*, *Metaniphargus* and *Saliweckelia* than with the weckeliid genera. However, it differs from all hadziids in the peri-Caribbean region by its occurrence in epigeal habitats, presence of small eyes, aberrant gnathopod 2 of the male which lacks a distinct propodal palm and has a short 5th segment, and absence of dorsal spines on the uronites.

Bahadzia shares a number of important characters with *Metaniphargus* and *Saliweckelia* (e.g., overall similarity of gnathopods, well-developed mandibular palp, 2-segmented outer ramus of uropod 3) (see also descriptions by Stock, 1977), but it differs from both of them by having: (1) a 3-segmented rather than 2-segmented accessory flagellum of antenna 1; (2) molar seta on both mandibles; (3) naked instead of plumose apical setae on the inner plate of maxilla 1; (4) 8 instead of 9-11 serrate/pectinate spines on the outer plate of maxilla 1; (5) short setae rather than blade-like spines on the inner margin of the outer plate of the maxilliped; (6) unmodified pleopods in both sexes; and (7) longer and less triangular-shaped telson lobes with a row of lateral spines extending nearly to the base. *Bahadzia* differs specifically from *Metaniphargus* by having an excavate posterior margin of coxal plate 4 and a longer and broader inner ramus of uropod 3. It differs specifically from *Saliweckelia* by having fewer setae on the propods of gnathopods 1 and 2, small but distinct peduncles of the coxal gills, and a broader inner ramus of uropod 3.

Despite the fact that *Mayaweckelia* has been included in the weckeliid group and differs from *Bahadzia* in the absence of a mandibular palp and second segment of the outer ramus of

uropod 3, it shares a number of important characters with this genus. The similarities shared by these genera include: (1) 3-segmented accessory flagellum; (2) absence of spines on the outer plate of the maxilliped; (3) lobate and pubescent posterior margin of segment 4 of gnathopod 1; (4) large 4th coxal plate with posterior excavation; (5) broad inner ramus of uropod 3; and (6) comparatively long telson with separate halves each bearing both medial and lateral spines. Although some of these character states occur in other genera of Hadziidae, the presence of all six of them in these two genera is rather striking. Whether these similarities represent parallelisms in two taxa heretofore regarded as members of separate phyletic lineages, or rather are indicative of a close (phylogenetic) relationship between *Bahadzia* and *Mayaweckelia* cannot be resolved without further study of the weckeliid genera and careful reevaluation of character state polarities in the hadziids.

***Bahadzia williamsi* Holsinger n. sp.**
(Figs. 1-3)

Material examined.—Bahamas. Great Abaco Island: Dan's Cave (ca. 12 km N. of Crossing Rocks), 1 ♀ paratype, D. Williams, 15 June 1984.

Grand Bahama Island: Asgard Cave on Sweetings Cay, 1 ♀ paratype, S. Cunliff, 22 July 1984; Bahama Cement Cave (Parcel No. 3) near Freeport, 4 ♀♀, 2 ♂♂ paratypes, D. Williams, 17 July 1984; Lucayan Caverns, holotype ♀, 3 ♀♀ and 3 ♂♂ paratypes, D. Williams, 10 Nov. 1983. Additional paratypes from Lucayan Caverns as follows: 3 ♀♀, D. Williams and J. Yager, 31 Oct. 1980; 1 ♀, 1 ♂, J. Yager and D. Williams, 9 Jan. 1982; 1 ♀, J. Yager, 8 Apr. 1982; 1 ♂, J. Yager, 30 Jan. 1983; 2 ♀♀, 1 juv., D. Williams, 10 Feb. 1983, 4 ♀♀, 2 juvs., D. Williams, 5 Nov. 1983; 2 ♀♀, 1 ♂, D. Williams, 12 Nov. 1983; 3 ♀♀, 1 ♂, D. Williams, 30 Jan. 1984; 1 ♀, 1 juv., D. Williams, 7 Apr. 1984.

The holotype has been deposited in the National Museum of Natural History (Smithsonian Institution); paratypes have been deposited in the Zoölogisch Museum, Amsterdam, the San Diego Natural History Museum, California, and in the collection of the senior author.

Diagnosis.—With the characters of the genus. Distinguished from *B. stocki* (described below), with which it is very closely allied, by

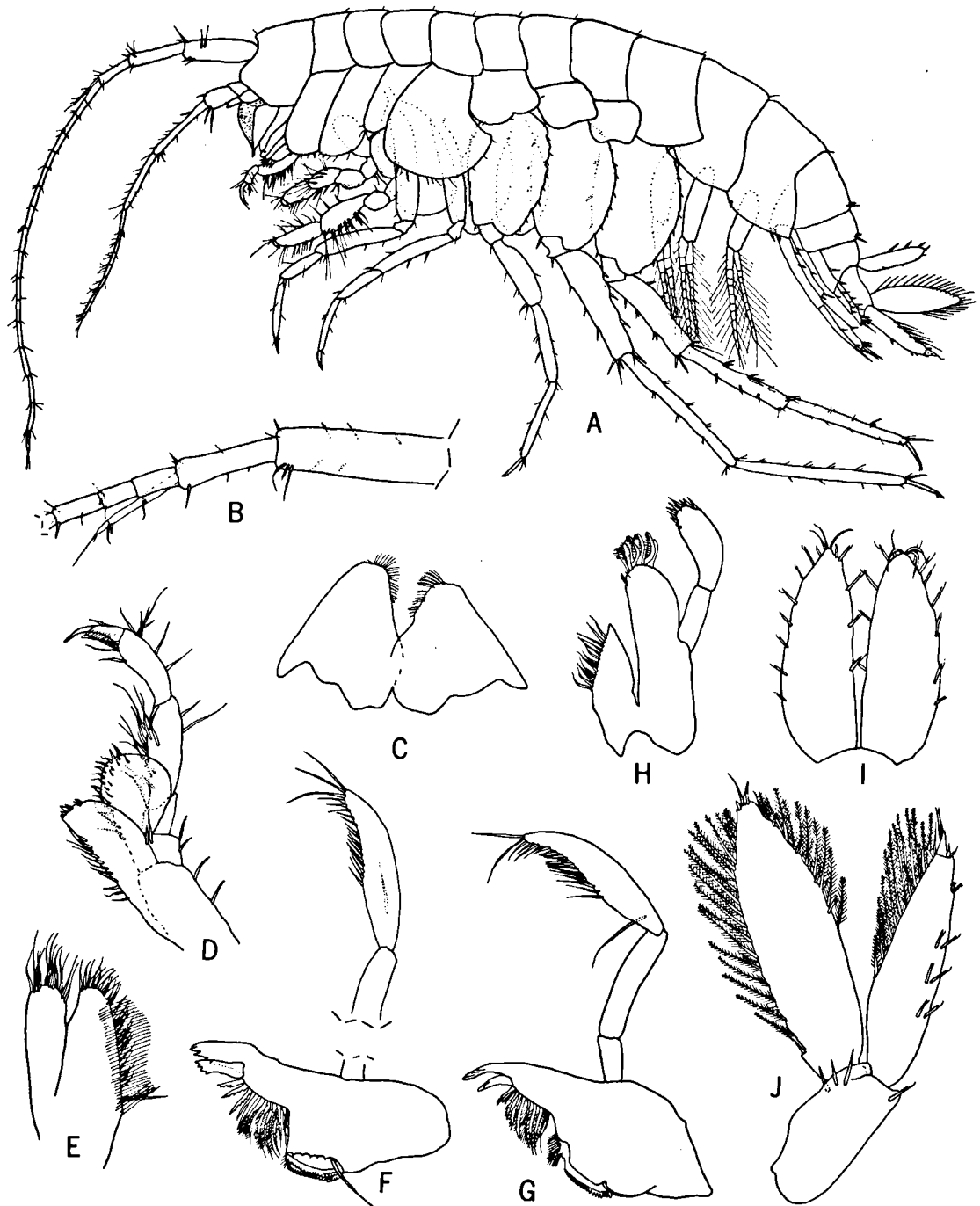


Fig. 1. *Bahadzia williamsi* n. sp., paratypes, Lucayan Caverns, Grand Bahama Island. Female (5.5 mm): A, entire animal from left side. Female (7.0 mm): B, part of antenna 1 showing accessory flagellum; C, lower lip; D, maxilliped; E, maxilla 2; F, left mandible (turned in preparation); G, right mandible; H, maxilla 1; I, telson; J, uropod 3. (All structures except mandibles to same scale.)

presence of a small basofacial spine on peduncle of uropod 1; fewer spines on distal end of peduncle of uropod 2; and fewer spines on telson lobes. Largest male, 6.0 mm; largest female, 8.5 mm (but rarely exceeding 7.0 mm).

Female.— Antenna 1: 70-100% of length of body, 40-50% longer than antenna 2; primary flagellum with up to 25 segments, aesthetascs very slender; accessory flagellum 3-segmented; peduncular segment 1 longer than 2, and 2 longer than 3. Antenna 2: flagellum with up to 10 segments; peduncular segments 4 and 5 subequal in length. Mandible: molar well developed; spine row with 10 to 14 long spines; palp segment 3 as long as combined lengths of segments 1 and 2, armed with 1 long A-seta, long row of D-setae, and 3 E-setae. Inner lobe of lower lip vestigial or absent (?). Maxilla 1: inner lobe with 14 non-plumose (?) apical setae; outer plate with 8 serrate/pectinate spines; palp bearing 9 blade spines and 1 coarse seta apically. Maxilla 2: inner plate with row of numerous facial setae and row of thicker setae on inner margin. Maxilliped: apex of inner plate armed with several small spines, inner margin with row of short, naked setae; outer plate broadly rounded and expanded distally, distal half of inner margin with double row of short setae.

Propod of gnathopod 1 narrow, at least twice as long as broad; palm very short, armed with few spines and setae; distal half of posterior margin richly setose. Segment 5 of gnathopod 1 longer than propod, bearing clusters of long setae on anterior, posterior and medial margins. Posterior margin of segment 4 of gnathopod 1 broadly lobiform and pubescent. Coxal plate of gnathopod 1 broadly expanded distally, margin with 12 setae. Dactyl of gnathopod 2 short and thick. Propod of gnathopod 2 narrow, elongate, more than twice as long as broad; palm short and oblique, armed with 3 distally-split spines near defining angle and several setae; posterior margin elongate, with clusters of setae; anterior margin with sets of long setae. Segment 5 of gnathopod 2 narrow and elongate, longer than propod,

posterior margin with clusters of long setae. Coxal plate of gnathopod 2 not as large as that of gnathopod 1, margin with 10 setae. Coxal plate of pereopod 3 rather narrow, longer than broad, margin with 7 setae. Coxal plate of pereopod 4 broadly expanded and excavate posteriorly, margin with 18 mostly short setae. Pereopod 6 longer than pereopods 5 and 7, between 80 and 100% of length of body. Bases of pereopods 5-7 comparatively broad; posterior margins convex; distoposterior lobes rather large and bluntly rounded. Dactyls of pereopods 5-7 comparatively short, 1/4 to 1/5 of length of corresponding propods. Coxal gills very large, subovate, extending to distal end of bases. Brood plates long and narrow, bearing long setae distally.

Pleonal plates: posterior margins with 1 short seta each; posterior corners acute; ventral margin of plate 1 without spines, plate 2 with 1 spine, plate 3 with 2 spines. Pleopods subequal in length; inner rami a little longer than outer rami; peduncles with 2 coupling spines each. Uronite 1 typically bearing 2 slender spines dorsodistally; uronites 2 and 3 usually with 4 such spines. Uropod 1: inner ramus a little longer than outer ramus, shorter than peduncle, armed with 6 or 7 spines; outer ramus with 7 to 10 spines; peduncle with about 14 spines, 1 of which is basofacial. Uropod 2: inner ramus longer than outer ramus and peduncle, armed with about 11 spines; outer ramus with 5 spines; peduncle with 8 spines, 5 of which are shorter and form a comb row between 2 longer spines dorsodistally. Uropod 3 approximately 17% of length of body; inner ramus slightly longer than outer ramus, inner and outer margins with short spines and plumose setae; outer ramus with few spines and plumose setae on inner margin, but with spines only on outer margin; peduncle with about 4 distal spines. Telson in 2 separate halves (lobes); lateral margins with 7 or 8 short, singly inserted spines each, medial margins with 5 spines each; apices of lobes typically with 3 setae each.

Male.— Differing from female in the structure of gnathopod 2 as follows. Dactyl rather long,

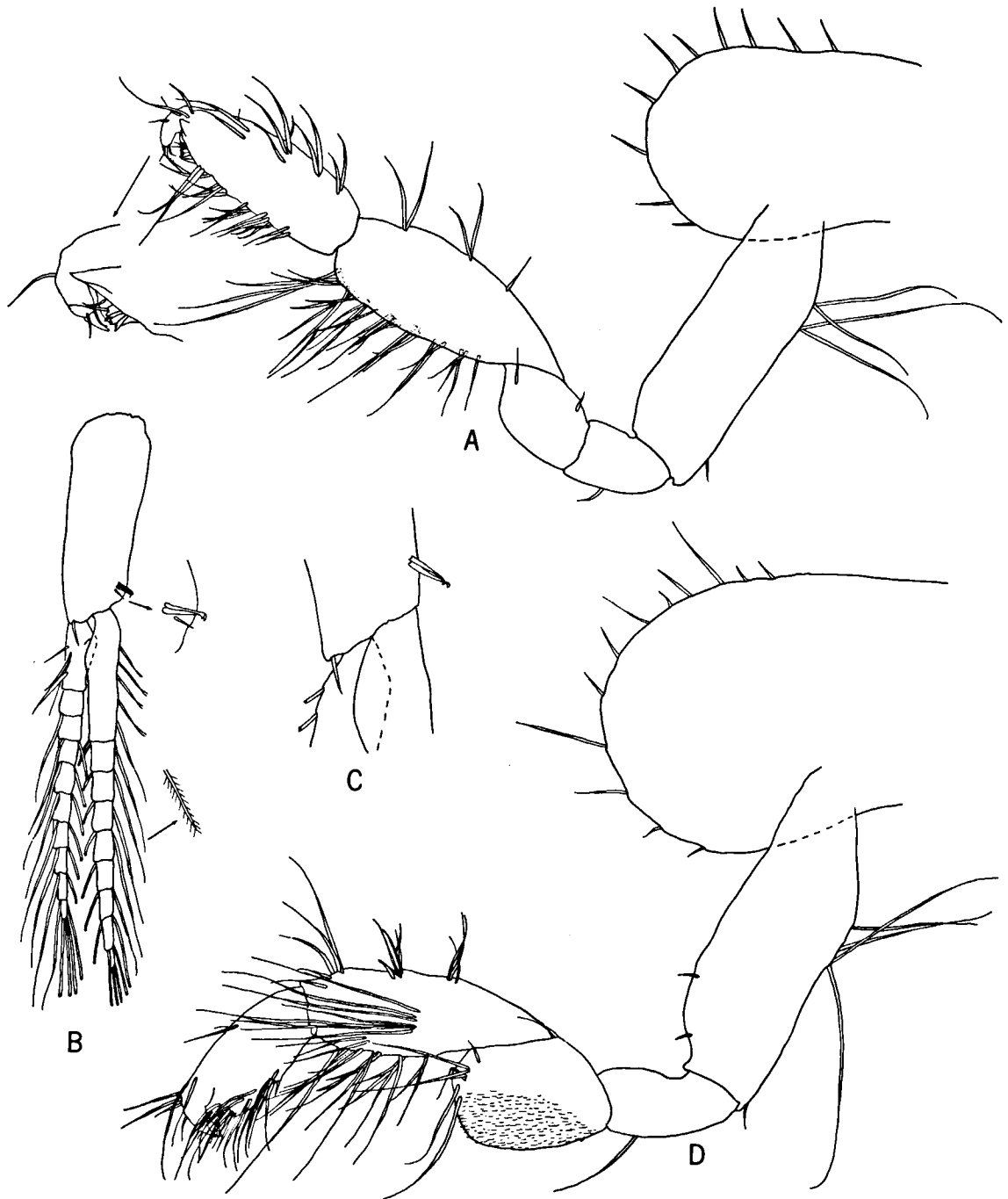


Fig. 2. *Bahadzia williamsi* n. sp., paratypes, Lucayan Caverns, Grand Bahama Island. Female (6.0 mm): A, gnathopod 2 (palm and dactyl enlarged); B, pleopod 1 (coupling spines enlarged); C, pleopod 3 in part (drawn to larger scale than pleopod 1). Female (7.0 mm): D, gnathopod 1. (Gnathopods to same scale and shown in medial view.)

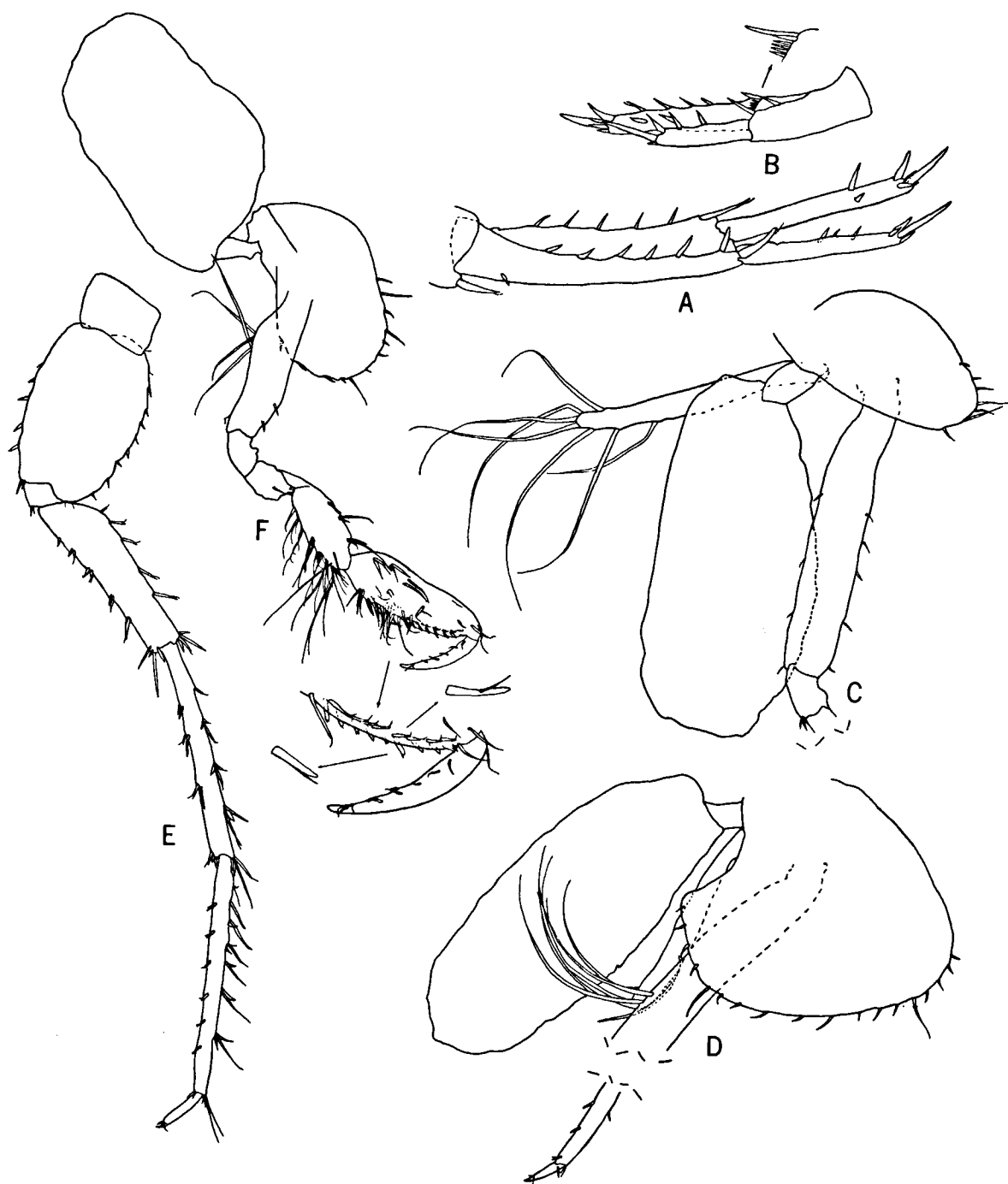


Fig. 3. *Bahadzia williamsi* n. sp., paratypes, Lucayan Caverns, Grand Bahama Island. Female (7.0 mm): A, B, uropods 1 and 2 (comb spines enlarged); C, D, pereopods 3 and 4 (in part). Female (6.5 mm): E, pereopod 6. Male (6.0 mm): F, gnathopod 2 (medial view) (to smaller scale than female gnathopods in fig. 2, palmar region enlarged). (Uropods and pereopods 3 and 4 to same scale, pereopod 6 to smaller scale.)

nail short. Propod long and narrow, a little longer than segment 5; palm long and gently convex, armed with double row of 8 or 9 blunt-tipped spine teeth; posterior margin subequal to palm in length, bearing clusters of setae; superior medial setae double inserted. Posterior margin of segment 5 bearing 6 or 7 clusters of long setae. Margin of coxal plate with 12 setae.

Type-locality.— Lucayan Caverns, located near the south coast of Grand Bahama Island approximately 29 km east of Freeport, is an extensive underwater cave system with over 10 km of passage surveyed to date.

Distribution and ecology.— Outside of the type-locality, this species is recorded from Bahama Cement and Asgard caves, both on Grand Bahama Island, and Dan's Cave on Great Abaco Island. The range covers a linear distance of 260 km and includes the two northernmost islands of the Bahamas (see fig. 5).

The majority of specimens collected to date are from Lucayan Caverns, where they were found swimming freely in open water below a halocline at depths between 10 and 15 m. The halocline occurs at a depth of 9 m. The physicochemical parameters of this habitat were: salinity, 18 ppt (polyhaline); temperature, 24°C; dissolved oxygen, 0.7 ppm or 14% saturation. Collection of amphipods was made with a squeeze bottle, utilizing a one-way valve designed by Boris Sket of Ljubljana University. Salinity was determined by either the refractive method or the conductive method using a Y.S.I. no. 33 (Yellow Springs Industries). Oxygen concentration was determined with a model 0-40 dissolved oxygen test kit purchased from CHEMetrics, Inc.

The amphipods were usually seen in the "Sleeper Room," located about 183 m from the nearest surface entrance to the cave. In this section of Lucayan Caverns, they were frequently associated with an eyed, lightly pigmented corophiid amphipod, *Grandidierella* sp. (probably *G. bonnieroides* Stephensen), a new species of the crustacean order Thermosbaenacea, unidentified copepods, and two kinds of fishes. The latter included the blind

ophidiid *Lucifuga spelaotes* Robbins and the epigeal spiney cheek sleeper *Eleotris*.

In Asgard and Bahama Cement caves, *B. williamsi* was collected from a habitat similar to that in Lucayan Caverns. In these caves, however, amphipods were associated with remipedian crustaceans of the genus *Speleonectes* (see Yager, 1981) and a new genus of cirrolanid isopod crustacean currently being described by Jerry H. Carpenter. In Dan's Cave, *B. williamsi* was collected from polyhaline water at a depth of approximately 16 m, where it was associated with the stygobiont pardaliscid amphipod *Spelaonicippe* sp. (probably *S. provo* described by Stock & Vermeulen, 1982), and a new genus of Remipedia.

Several females from the above caves had setose brood plates and were apparently sexually mature. These specimens ranged in length from 6.0 to 8.5 mm. One female (6.4 mm in length), in a collection from Lucayan Caverns made on 10 February 1983, was ovigerous. The brood pouch contained 1 large egg, but 3 detached eggs presumably also belonging to this female were found in the collection vial.

Etymology.— It is a pleasure to name this species in honor of our good friend, Dennis W. Williams, in recognition for his fine work on the exploration, study and protection of Lucayan Caverns.

***Bahadzia stocki* Holsinger, n. sp.**
(Fig. 4)

Material examined.— Turks and Caicos Islands. Providenciales: Airport Cave, holotype ♀, 2 ♀♀ and 2 ♂♂ paratypes, T. M. Iliffe, 31 Oct. 1982; The Hole, 1 ♂ paratype, T. M. Iliffe, 30 Oct. 1982. The holotype (partly dissected) has been deposited in the National Museum of Natural History (Smithsonian Institution); paratypes have been retained in the collection of the senior author.

Diagnosis.— Closely similar to *B. williamsi*, described above, and differing only from that species by the characters given in the following description. Largest male, 5.0 mm; largest female, 6.5 mm.

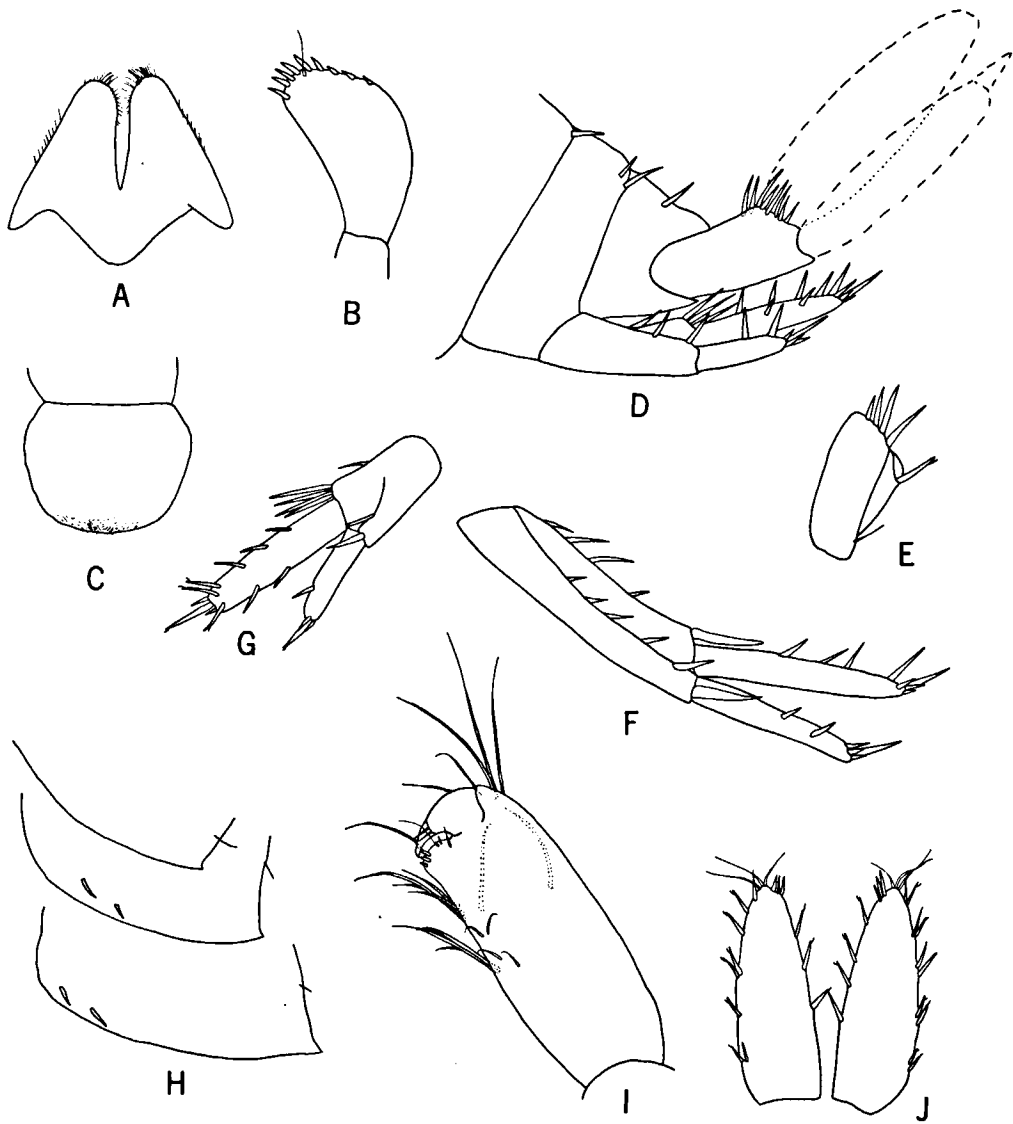


Fig. 4. *Bahadzia stocki* n. sp., holotype female (6.0 mm), Airport Cave, Providenciales, Turks and Caicos Islands: A, lower lip; B, palp segment 2 of maxilla 1; C, upper lip; D, posterior end of animal showing uronites and uropods 2 and 3; E, peduncle of uropod 3 from right side; F, G, uropods 1 and 2; H, pleonal plates; I, propod and dactyl of gnathopod 1 (lateral view); J, telson. (All structures to same scale except gnathopod, propod and palp segment which are to larger scale.)

Description.— Lower lip without inner lobes. Ventral margins of pleonal plates 2 and 3 with 2 spines each. Uronite 1 with 2 slender spines dorsodistally, uronite 2 with 5 or 6 such spines, uronite 3 with 2 such spines. Uropod 1: inner ramus armed with 8 spines, outer ramus with 6 spines; peduncle with 11 spines, basofacial spine lacking. Uropod 2: inner

ramus with 11 spines; outer ramus with 4-6 spines; peduncle with 6-7 long spines, 3 or 4 of which form a tight cluster dorsodistally toward the medial side. Peduncle of uropod 3 with 5 to 8 spines distally. Lateral margins of telson lobes with 8 to 10 (usually doubly inserted) spines each; medial margins with 6 or 7 spines each, of which those closest to apex are in a set of 3.

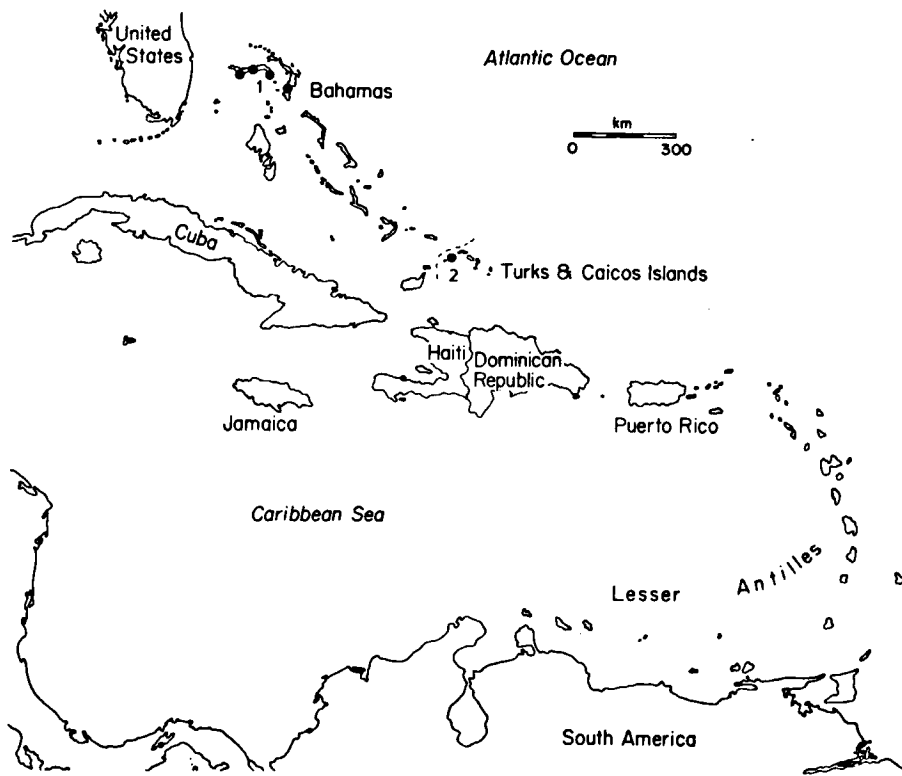


Fig. 5. Distribution of *Bahadzia* in the Bahamas and Turks and Caicos Islands: 1, *B. williamsi* (three localities on Grand Bahama and one on Great Abaco); 2, *B. stocki* (two localities on Providenciales).

Type-locality.— Airport Cave, located about 0.4-0.8 km north of the airport near Blue Hills on the island of Providenciales, is a vertical fissure, 12-15 m deep, giving access to a lake of brackish water. Airport Cave is undoubtedly the same locality as that described by Buden & Felder (1977: 109) as a “crescent-shaped fissure” with a saline pool. This cave was listed as a locality for the shrimp *Barbouria cubensis* (Von Martens) by these writers.

Distribution and ecology.— To date this species is recorded from two caves on Providenciales in the Turks and Caicos Islands. Providenciales is situated 700-800 km southeast of the localities recorded for *B. williamsi*.

Amphipods from Airport Cave were collected from a lake of polyhaline water at the bottom of the near-vertical entrance. All three of

the females from this cave had setose brood plates and were apparently sexually mature. They ranged in size from 5.0 to 6.5 mm. The single male specimen from The Hole (located approximately 10 km east of Airport Cave) was collected in a lake of polyhaline water at the bottom of a large, vertical, cenote-like pit, about 18 m deep. The oxygen concentration in both cave lakes was less than 1 ppm. In Airport Cave, *B. stocki* was found in association with a new genus of Remipedia being described by Yager and Frederick R. Schram, a stygobiont representative of a new family of shrimps being described by C. W. Hart, Jr. and Raymond B. Manning, and a new stygobiont genus of the crustacean order Leptostraca being described by Thomas E. Bowman. In The Hole, *B. stocki* was taken in association with the new leptostracan genus noted above.

Etymology.— It is a pleasure to name this new species in honor of our distinguished colleague, Professor Jan H. Stock of the Institute of Taxonomic Zoology, University of Amsterdam, in recognition for his many outstanding contributions to our knowledge of the subterranean crustacean fauna of the West Indies.

DISCUSSION

As presently known, the two species of *Bahadzia* inhabit anchialine caves on islands situated some 700 km apart (fig. 5). The two islands inhabited by *B. williamsi*, Grand Bahama and Great Abaco, are developed on the Little Bahama Bank at the northern end of the Bahamas. Providenciales, which is inhabited by *B. stocki*, is located in the Turks and Caicos Islands developed on the Caicos Bank. The Turks and Caicos Islands are geographically and geologically a southeastward extension of the Bahamas, and this continuous chain of islands is developed as the exposed tops of carbonate banks that lie between the latitudes of 20°N and 27°N.

In addition to distance, the Little Bahama and Caicos banks are isolated geologically by at least four deep marine channels, ranging in depth from about 2000 m in the Crooked Island and Mayaguana passages to between 3000 and 4000 m in the Northwest Providence Channel and Caicos Passage. Despite the great distance and deep marine channels separating these banks, the habitats occupied by *B. williamsi* and *B. stocki* are remarkably similar. Both species inhabit anchialine caves and occur in polyhaline water of extremely low oxygen concentration (less than 1 ppm) at depths between 10 and 16 m. These two species are also closely similar morphologically, but in our judgement the differences noted in the above descriptions are strong enough to justify recognition of separate taxa at the species level.

Although our present data suggest that *B. williamsi* and *B. stocki* are isolated at opposite ends of the Bahama chain, we suspect that subsequent biological investigation of caves on

some of the carbonate islands situated between the Little Bahama and Caicos banks will result in the discovery of additional populations of *Bahadzia*. Considering the fact that numerous anchialine caves exist throughout the Bahamas that have never been explored biologically, the probability of finding these organisms outside of their presently known ranges is very high. New morphological data obtained from the study of additional populations should give us a much better understanding of the limits of geographic variation in these species.

ACKNOWLEDGEMENTS

We are indebted to Dennis W. Williams for his assistance with the fieldwork and helpful comments during preparation of the manuscript. We also thank Thomas M. Iliffe and Sarah Cunliff for their assistance with the collection of specimens. Suzanne M. DeBlois, Katherine D. Payne and the Center for Instructional Development at Old Dominion University assisted with the preparation of the figures.

This study was supported by a grant from the National Science Foundation (DEB 8206716) to J. R. H. The fieldwork was supported by N.S.F. grants DEB 8009909 to T. M. Iliffe and BSR 8212335 to Frederick R. Schram.

REFERENCES

- BUDEN, D. W. & D. L. FELDER, 1977. Cave shrimps in the Caicos Islands. *Proc. biol. Soc. Wash.*, **90** (1): 108-115.
- HOLSINGER, J. R., 1977. A new genus and two new species of subterranean amphipod crustaceans (Gammaridae s. lat.) from the Yucatán Peninsula in Mexico. In: J. R. REDDELL ed., *Studies on the caves and cave fauna of the Yucatán Peninsula*. *Ass. mex. Cave Stud. Bull.*, **6**: 15-25.
- , in press. Zoogeographic patterns of North American subterranean amphipod crustaceans. In: F. R. SCHRAM ed., *Crustacean issues*, **3**. *Biogeography of the Crustacea* (A. A. Balkema, Rotterdam).
- HOLSINGER, J. R. & G. LONGLEY, 1980. The subterranean amphipod crustacean fauna of an artesian well in Texas. *Smithson. Contr. Zool.*, **308**: 1-62.
- HOLTHUIS, L. B., 1973. Caridean shrimps found in landlocked saltwater pools at four Indo-West Pacific localities (Sinai Peninsula, Funafuti Atoll, Maui and Hawaii Islands), with the description of one new genus and four new species. *Zool. Verh. Leiden*, **128**: 1-48, pls. 1-7.

- ILIFFE, T. M., C. W. HART, JR. & R. B. MANNING, 1983. Biogeography and the caves of Bermuda. *Nature*, **302** (5904): 141-142.
- ILIFFE, T. M., H. WILKINS, J. PARZEFALL & D. WILLIAMS, 1984. Marine lava cave fauna: Composition, biogeography, and origins. *Science*, **225**: 309-311.
- STOCK, J. H., 1977. The taxonomy and zoogeography of the hadziid Amphipoda, with emphasis on the West Indian taxa. *Stud. Fauna Curaçao*, **55** (177): 1-130.
- , 1983. The stygobiont Amphipoda of Jamaica. *Bijdr. Dierk.*, **53** (2): 267-286.
- STOCK, J. H. & J. J. VERMEULEN, 1982. A representative of the mainly abyssal family Pardaliscidae (Crustacea, Amphipoda) in cave waters of the Caicos Islands. *Bijdr. Dierk.*, **52** (1): 3-12.
- YAGER, J., 1981. Remipedia, a new class of Crustacea from a marine cave in the Bahamas. *J. crust. Biol.*, **1** (3): 328-333.
- ZIMMERMAN, R. J. & J. L. BARNARD, 1977. A new genus of primitive marine hadziid (Amphipoda) from Bimini and Puerto Rico. *Proc. biol. Soc. Wash.*, **89** (50): 565-580.

Received: 10 December 1984