

The Amphipoda of Bermuda - A century of taxonomy

Los anfípodos de Bermuda - Un siglo de taxonomía

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ABSTRACT

Prior to B. W. Kunkel's (1910) "The Amphipoda of Bermuda" biologists knew virtually nothing about the amphipod crustaceans of this group of Atlantic islands. Addison E. Verrill (1839-1926), Professor of Zoology at Yale University and Curator of Invertebrate Zoology at the Peabody Museum of Natural History, had led two collecting expeditions to Bermuda in the ten years prior to Kunkel's publication. The specimens collected during these expeditions and miscellaneous specimens deposited in the Peabody Museum from the mid- to late-1800s formed the basis for Kunkel's 1910 monograph. "The Amphipoda of Bermuda" listed, described and illustrated 45 species, including 17 of which were new species. More than 50 years later, E. L. Mills (1964) re-examined some of Kunkel's type specimens, noting their poor condition but nonetheless validated their type status. Discovery of more of Kunkel's type specimens was reported by Lazo-Wasem & Gable (1987). Beginning in 1985, the current authors have conducted five major collection expeditions and several smaller

ones in Bermuda. Today, the literature reports 81 species of amphipods from the waters of these islands. This study provides the current taxonomic status of Bermudian amphipods.

RESUMEN

Antes de la obra de B. W. Kunkel (1910) "The Amphipoda of Bermuda", los biólogos no sabían prácticamente nada sobre los crustáceos anfípodos de este grupo de islas atlánticas. Addison E. Verrill (1839-1926), profesor de Zoología de la Universidad de Yale y conservador de invertebrados en el Museo de Historia Natural de Peabody, había encabezado dos expediciones a las Bermudas diez años antes de la publicación de Kunkel. Los ejemplares recolectados durante estas expediciones y la mezcla de especímenes depositados en el museo Peabody desde mediados hasta finales del siglo XIX formaron la base de la monografía de Kunkel en 1910. La publicación "The Amphipoda of Bermuda" enumeró, describió e ilustró 45 especies, 17 de las cuales eran especies nuevas. Más de 50 años después, E. L. Mills (1964) examinó de nuevo algunos de los ejemplares tipo de Kunkel, indicando su mal estado, pero confirmando su validez como tipos. Lazo-Wasem & Gable (1987) descubrieron más ejemplares tipo de Kunkel. Desde comienzos de 1985, los autores han llevado a cabo cinco expediciones importantes y otras tantas de menor importancia a Bermuda. Hoy, la literatura cita 81 especies de anfípodos de las aguas de estas islas. Este estudio actualiza el conocimiento taxonómico de los anfípodos de Bermuda.

INTRODUCTION

Bermuda is a group of mid Atlantic subtropical islands located about 1,020 km east of Cape Hatteras, North Carolina, United States. Often referred to as a singular island, it is approximately 53 km² in size and is surrounded by fringing coral reefs that are supported by the warm currents fed by the northern flow of the Gulf Stream. Bermuda was first discovered in 1505 by the Spaniard Juan de Bermudez, but nearly a century later, Admiral Sir George Somers of the English Royal Navy "discovered" Bermuda by accident. Admiral Somers eventually became known as "The Father of Bermuda" with The Bermudas often referred to as Somers Island. In 1609, the English were the first to settle and establish colonies on Bermuda. Today, Bermuda remains the oldest and most populous British overseas territory.

In 1898 and 1901, Addison E. Verrill (Fig. 1), then Curator of Invertebrate Zoology at the Peabody Museum of Natural History at Yale University, conducted scientific expeditions to the Bermuda Islands. A subsequent trip in 1906 to reinventoriate his health presumably resulted in additional material. His observations along with his large collection of terrestrial and marine invertebrates led to several publications, including his 1902 monograph on the

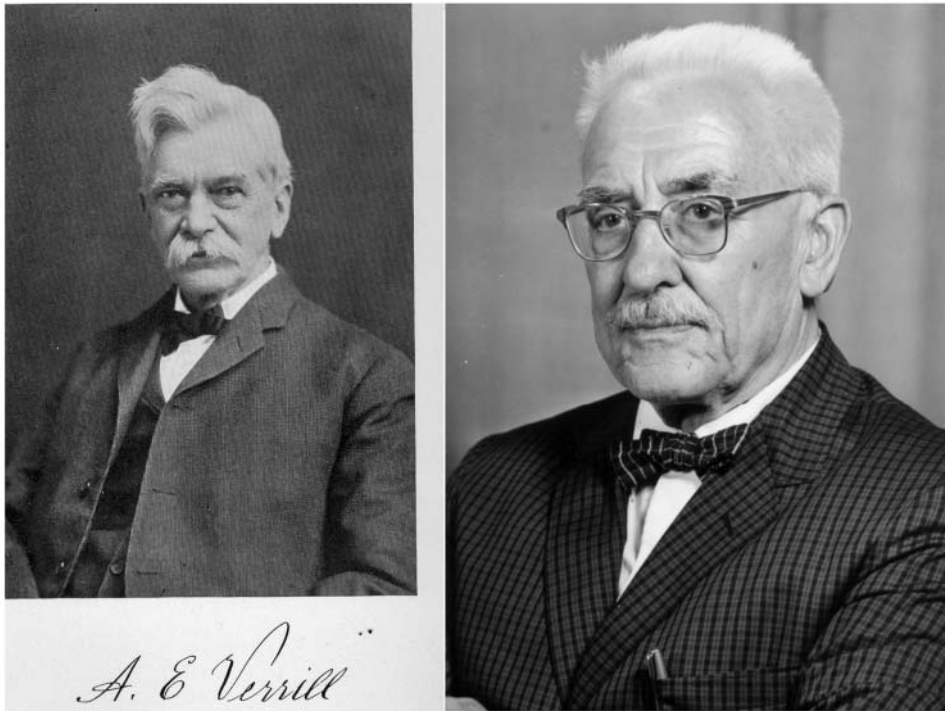


Fig. 1.—Addison E. Verrill (left) in 1902 and Beverly W. Kunkel (right) ca. 1960's (Kunkel photograph courtesy of the Lafayette College Archives).

Fig. 1.—Addison E. Verrill (izquierda) en 1902 y Beverly W. Kunkel (derecha) ca. 1960's (La fotografía de Kunkel es cortesía de Lafayette College Archives).

natural history and geology of the Bermuda islands and three major articles on the crustacean fauna occurring there (Verrill, 1902, 1908, 1922, 1923).

Beginning in 1985, the current authors began a series of field expeditions to collect amphipods as the basis of new taxonomic studies. From these studies and the work of others, the literature now reports 81 species of amphipods from the waters of these islands. This review provides a list of the known amphipod species from Bermuda and their current taxonomic status.

THE AMPHIPODA OF BERMUDA: 1910-1960's

The specimens collected during Verrill's expeditions, and other miscellaneous specimens deposited in the Peabody Museum of Natural History from the mid to late 1800's (most notable of which were collected in 1876-1877

by G. Brown Goode), were the material used by Verrill's student Beverly W. Kunkel (Fig. 1) to form his 1910 monograph on the Bermuda amphipod fauna. Prior to Kunkel's publication, biologists knew virtually nothing about the amphipods of Bermuda. To date, Kunkel's monograph remains the only significant study of its kind. In his monograph, Kunkel (1910) listed, described and illustrated 45 species which included 3 new genera and 17 new species. It must be emphasized, however, that Kunkel actually had very little material to work with and described most of his species on the basis of few individuals. Verrill clearly collected only by hand-picking individuals, and this method rarely results in larger collections of the smaller crustaceans such as amphipods and other peracaridan orders. For example, in discussing the cumacean fauna of Bermuda, Verrill (1923) reports only a single specimen of *Nanastacus hirsutus* Hansen. Richardson's (1902) short but detailed monograph of the isopods and tanaids of Bermuda was also based on the relatively few specimens collected primarily by Verrill.

Kunkel did not clearly designate type specimens for his newly described taxa and none of these were even cataloged for many decades. Over 50 years later, Mills (1964) re-examined some of Kunkel's type specimens, mentioned their poor condition, but nonetheless validated six of Kunkel's type specimens. For example, Kunkel (1910) described *Pontogenia verrilli* from several specimens collected from Castle Harbor in Bermuda. Mills (1964) then listed this species as *Eusiroides verrilli* within the Eusiridae and designated a lectotype (YPM 5338A) (Fig. 2) and many paralectotypes. Although some eusirids have been collected in Bermuda by the authors, none can be positively attributed to this species. Lazo-Wasem & Gable (1987) reported the discovery of more Kunkel type specimens, redescribing and refiguring five of these (*Maera tinkerensis*, *Melita planaterga*, *Parhyalella batesoni*, *Eurystheus* (= *Gammaropsis*) *lina*, *Caprella bermudia*). The dubious *Isaea longipalpus* was also found, but unfortunately its poor condition did not allow redescription.

THE AMPHIPODA OF BERMUDA: 1960's-2010

In 1985 the authors began visiting Bermuda to obtain new material. Sampling focused mainly on intertidal and subtidal areas, along with habitat specific areas, and at depths to 15 meters using SCUBA. Initially, specimens were collected by careful hand-picking and microscopic examination of large samples of substrate (algae covered rocks, coral rubble, etc.). Although this resulted in a relatively large amount of material, including rare species such as *Pariphinotus tuckeri* (found only by examining very



Fig. 2.—*Eusiroides verrilli* (Kunkel, 1910), lectotype, YPM 5338A (top) selected by E. L. Mills (1964). *Amphilochus brunneus* fide Kunkel (1910), ovigerous female (3.0 mm), YPM 27033 (middle). *Dulichiella* sp., YPM 49363, from Bermuda (bottom).

Fig. 2.—*Eusiroides verrilli* (Kunkel, 1910), lectotipo, YPM 5338A (arriba) seleccionado por E. L. Mills (1964). *Amphilochus brunneus* fide Kunkel (1910), hembra ovígera (3.0 mm), YPM 27033 (centro). *Dulichiella* sp., YPM 49363, de Bermuda (abajo).

large samples of turtle grass dislodged from the bottom), in 1988 formalin-wash techniques were used, which greatly increased sampling efficiency; chemical irritation causes the tightly nestling micro-crustaceans to abandon their substrate, making recovery of specimens much easier. These expeditions amassed tens of thousands of specimens for study by us and others, with the majority of the material housed within the Division of Invertebrate Zoology collections at the Peabody Museum of Natural History, Yale University (YPM). Specimens from these expeditions have led to many publications that have often included new species (*Deutella aspiducha* Gable & Lazo-Wasem, 1987; *Ensayara entrichoma* Gable & Lazo-Wasem, 1990; *Shoemakerella lowryi* Gable & Lazo-Wasem, 1990; *Podocerus tachyrheo* Baldinger & Gable, 1994; *Podocerus lazowasemi* Baldinger & Gable, 1994; *Maera ceres* Ruffo *et al.*, 2000; *Maera miranda* Ruffo *et al.*, 2000; *Maera ariel* Ruffo *et al.*, 2000; *Maera caliban* Ruffo *et al.*, 2000). Additionally, specimens from these expeditions led to other publications including one on the intertidal amphipod community structure (Baldinger & Gable, 1995), amphipod morphological variation (Gable *et al.*, 1988), as well as the first record of the ubiquitous freshwater species *Hyaella azteca* from Bermuda (Lazo-Wasem & Gable, 1989). Kunkel (1910) erected the genus *Pariphinotus* and described the phliantid amphipod *Pariphinotus tuckeri* from Bermuda. Debate over the validity of this genus had been reported in the literature for years, with many authors suggesting the genus *Heterophlias* as a synonym. Lazo-Wasem *et al.* (1989) concluded that indeed *Pariphinotus* was a senior synonym of *Heterophlias*. Similarly, the genus *Parhyaella* Kunkel, 1910 was erected for *Parhyaella batesoni* Kunkel from a single male specimen supposedly collected by Verrill in Bermuda. In their monograph, Lazo-Wasem & Gable (2001) revised this genus and redescribed *P. batesoni*. Unfortunately, the present authors have failed to discover any additional specimens of *Parhyaella* in Bermuda. Kunkel (1910) recorded the presence of *Amphilocheus brunneus* Delle Valle, 1893 in Bermuda. In a recent study on the Amphilocheidae of Bermuda, Baldinger *et al.* (in prep.) examined one specimen (Fig. 2) that was likely studied by Kunkel and other specimens of *Amphilocheus* collected by the present authors. It was concluded that these specimens are not *A. brunneus* and the *Amphilocheus* in Bermuda are more aligned with the Caribbean species *Amphilocheus casahoya* McKinney, 1978 and *Amphilocheus delacaya* McKinney, 1978. Other works (Karaman, 1980a; Karaman, 1980b; Stock *et al.*, 1986; Stock *et al.*, 1987) on the amphipods of Bermuda have focused on inland ground or anchihaline waters. These species are *Cocoharpinia illiffei* Karaman, 1980; *Idunella sketi* Karaman, 1980; *Pseudoniphargus carpalis* Stock *et al.*, 1986; *Pseudoniphargus grandimanus* Stock *et al.*, 1986; *Bogidiella*

(*Antillogidiella bermudensis* Stock *et al.*, 1987 and *Ingolfiella longipes* Stock *et al.*, 1987. All but *P. carpalis* are considered rare or endangered and are protected species (IUCN, 2010).

Currently 81 species of amphipods have been attributed to the waters around Bermuda (Appendix I). Undoubtedly more species await discovery, particularly in the larger dominant amphipod families such as the Melitidae [*Elasmopus* spp.; *Dulichella* sp. (Fig. 2)] and the Ampithoidae. Research continues today by the present authors on the Aoridae, Colomastigidae, and Hyalidae. Eventually, the present authors hope to clarify the status of many amphipod families that seem to be represented by one or two species based on only a handful of specimens.

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Appendix I. Amphipoda known from Bermuda.**Apéndice I.** Anfípodos conocidos de las Bermudas.**Gammaridea***Amphilocheus brunneus***Amphilocheus* sp. non *A. brunneus**Amphithoe crassicornis* Costa, 1853**Amphithoe longimana* Smith, 1873*Amphithoe pollex* Kunkel, 1910+*Amphithoe rubricata* (Montagu, 1818)*Bermudagidiella bermudensis* (Stock, Sket & Iliffe, 1987)+#*Ceradocus colei* Kunkel, 1910+**Ceradocus orchestiipes* Costa, 1853**Ceradocus parkeri* Kunkel, 1910+**Chelura terebrans* Philippi, 1839**Clessidra tinkerensis* (Kunkel, 1910)+*Cocoharpinia illiffei* Karaman, 1980+#*Colomastix* n. spp.*Corophium* n. spp.*Cymadusa coei* (Kunkel, 1910)+**Cymadusa compta* (Smith, 1873)*Cymadusa filosa* Savigny, 1816*Dulichella* sp.*Elasmopus magnispinatus* Kunkel, 1910+**Elasmopus pocillimanus* Bate, 1862**Elasmopus rapax* Costa, 1853**Elasmopus* spp. aff Baldinger & Gable, 1995*Ensayara entrichoma* Gable & Lazo-Wasem, 1990+*Erichthonius brasiliensis* (Dana, 1853)*Eusiroides crassi* Stebbing, 1888**Eusiroides verrilli* (Kunkel, 1910)+**Eusiroides* sp.*Gammaropsis lina* (Kunkel, 1910)+**Gammaropsis sophiae* (Boeck, 1861)**Gammarus breweri* Kunkel, 1910+**Gitanopsis petulans* Karaman, 1980*Hyale pontica* Rathke, 1847**Hyale prevostii* (Milne-Edwards, 1830)**Hyale trifoliadens* Kunkel, 1910 [= *Parhyale hawaiiensis* (Dana, 1853)]*Hyale* sp. aff Baldinger & Gable, 1995*Hyalella azteca* (Saussure, 1858)*Idunella sketi* Karaman, 1980+#*Insula antennullela* Kunkel, 1910+*

Isaea longipalpus Kunkel, 1910+
Konatopus sp.
Lembos longipes (Liljeborg, 1852)
Leucothoe spinicarpa (Abildgaard, 1798)*
Leucothoe sp.
Listriella sp.
Lysianassa punctata (Costa, 1851)*
Melita planaterga Kunkel, 1910+
 Melphidippidae sp.
Microdeutopus anomalus (Rathke, 1843)*
Neomegamphopus sp.
Neomicrodeutopus sp.
Panoploeopsis porta Kunkel, 1910+*
Parhyale hawaiiensis (Dana, 1853)
Parhyale sp. aff Baldinger & Gable, 1995
Parhyalella batesoni Kunkel, 1910+*
Pariphinotus tuckeri Kunkel, 1910+
Photis sp.
 Phoxocephalidae sp.
Platorchestia platensis (Kroyer, 1845)*
Podobothrus bermudensis Barnard & Clark, 1985+
Podocerus lazowasemi Baldinger & Gable, 1994+
Podocerus tachyrheo Baldinger & Gable, 1994+
Pseudoniphargus carpalis Stock, Holsinger, Sket & Iliffe, 1986+
Pseudoniphargus grandimanus Stock, Holsinger, Sket & Iliffe, 1986+#
Quadrimaera ariel (Ruffo, Krapp & Gable, 2000)+
Quadrimaera caliban (Ruffo, Krapp & Gable, 2000)+
Quadrimaera ceres (Ruffo, Krapp & Gable, 2000)+
Quadrimaera miranda (Ruffo, Krapp & Gable, 2000)+
Quadrimaera quadrimana (Dana, 1853)
Shoemakerella lowryi Gable & Lazo-Wasem, 1990+
Stenothoe marina (Bate, 1857) *
Stenothoe valida Dana, 1852 *
Stenothoe sp.

Caprellidea

Caprella danilevskii Czerniavski, 1868*
Caprella equilibra Say, 1818
Cyamus fascicularis Verrill, 1903*
Deutella aspiducha Gable & Lazo-Wasem, 1987
Deutella incerta (Mayer, 1903)
Fallotritella biscaynensis McCain, 1968
Hemiaegina minuta Mayer, 1890

Ingolfiellidea

Ingolfiella longipes Stock, Sket & Iliffe, 1987+#

+ = Bermuda endemic.

* = reported by Kunkel (1910) from Bermuda, but not yet observed by these authors.

= critically endangered.

