



New light on the nomenclature, taxonomy, and biology of *Hemipholis* species (Echinodermata: Ophiuroidea: Ophiactidae)

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Abstract

Hemipholis cordifera is the correct name for the only known Western Atlantic species of *Hemipholis*. *Hemipholis elongata*, a name which has been used in place of *H. cordifera*, is a *nomen dubium* that cannot unambiguously be assigned to any known species of brittle star. Evidence is presented that the genus *Hemipholis* presently comprises only *H. cordifera* and its geminate Eastern Pacific congener *Hemipholis gracilis*, and it is shown that the latter name has priority over *Hemipholis affinis*. *Hemipholis gracilis* and *H. cordifera* are illustrated and compared to show how mature individuals can be distinguished. However, small individuals of both species are extremely similar. The latitudinal distributions of *H. cordifera* and *H. gracilis* appear to be causally related to coastal water temperature, possibly in conjunction with divergent ocean currents, and the relatively broad range of *H. cordifera* compared to *H. gracilis* is attributed to its cold tolerance and to the influence of widespread warm-water boundary currents in the central Western Atlantic. As regards the two other congeners that have been described, *Hemipholis wallichii* is revealed to be a juvenile ophiuroid *incertae sedis*, and *Hemipholis microdiscus* was previously transferred to the Amphiuridae and assigned the *nomen novum*, *Amphiura microdiscoida*.

Key words: *Amphiura microdiscus*, *Amphiura microdiscoida*, *Amphiodia riisei*, brittle star, geminate species, *Hemipholis affinis*, *Hemipholis cordifera*, *Hemipholis elongata*, *Hemipholis gracilis*, *Hemipholis microdiscus*, *Hemipholis wallichii*, zoogeography

“...every working naturalist is painfully conscious of the great amount of time and labor that he is constantly obliged to spend in unraveling the intricate synonymy of well known genera and species, most of which has been caused by the careless or willful neglect of the salutary rules of nomenclature, in which *priority of publication* is one of the most fundamental principles. And whenever a naturalist, to save his own time, selfishly neglects to ascertain the correct synonymy of the species which he describes or mentions, he is merely heaping up labor for future naturalists, whose time might be better employed, than in correcting the imperfect work of their predecessors.” A.E. Verrill’s (1871:573) comments regarding the nomenclature of *Hemipholis*.

Introduction

A convoluted series of mistakes has led to the use of incorrect names for species of *Hemipholis*, and since the genus will continue to attract the attention of scientific investigators, the present contribution is intended to rectify nomenclatural and taxonomic errors and to provide new information about the species. The only known species of *Hemipholis* from the Western Atlantic is relatively well-studied in comparison with other brittle stars. It has repeatedly been cited in ecological, environmental, and biological studies owing to its abundance, broad geographic range, and its remarkable morphological and physiological specializations (selected references in Hendler *et al.* 1995). A principal objective herein is to show that although the Western Atlantic species is frequently called *Hemipholis elongata* (Say, 1825), *Hemipholis cordifera* (Bosc, 1802) is its correct name. In addition, evidence is presented that a geminate Eastern Pacific species, *Hemipholis gracilis* Verrill, 1867, is the sole congener of *H.*

cordifera, and illustrations are provided showing that mature individuals of both species are morphologically distinguishable. Although *H. gracilis* has been regarded as a junior synonym of *Hemipholis affinis* Ljungman, 1867, it has priority based on the dates that the names were published.

The genus *Hemipholis* was first integrated into a modern biological classification when Ljungman (1867) incorporated it in his newly erected family Amphiuroidae. Nearly a century later the genus was transferred to the Ophiactidae (Fell 1960). Lyman (1865, 1882) provided an excellent diagnosis of *Hemipholis* based on characteristics of the disk with thick, conspicuous scales, large and closely united radial shields, nearly naked ventral interradial, and a continuous ring of adoral shields; also based on characteristics of the arms with three short, tapering spines, and single tentacle scales. He characterized the type species as having arms eight or nine times the diameter of the disk, papillae on the disk at the base of the arms, and a series of protruding genital ducts. Lyman also found that *Hemipholis* has oral plates with an expansive abradial muscular fossa, vertebrae with a voluminous ventral canal, single peristomial plates, and he found that it lacks genital scales. His description erred in two important respects, as bursal slits are lacking in members of the genus (Lütken 1859, Mortensen 1920). Also, strictly speaking each jaw bears two pairs of oral papillae (Hendler, pers. obs.). Besides the distal oral papillae, there are inconspicuous papillae on horizontal ridges separating the oral tentacle pores, which may be buccal scales (*sensu* Hendler 1988). It is also noteworthy that features shared by *Hemipholis* and some *Ophiactis* species, such as a ring of contiguous adoral shields and the presence of Simroth's organs, suggest a close systematic relationship between both genera.

Results

Hemipholis cordifera versus *Hemipholis elongata*

Hemipholis cordifera was described and originally named *Asterias cordifera* Bosc, 1802, by the French naturalist Bosc, who reported its occurrence off the coast of Carolina (Bosc 1802). Bosc did not designate a holotype, and specimens that he examined have not been located at the Muséum national d'Histoire naturelle (Paris), the Natural History Museum (London), or the National Museum of Natural History (Washington, DC) (C. Ahearn, A. Cabrinovic, and M. Eléaume, pers. comm.). This is not surprising as Bosc reported that dried specimens were difficult to conserve. Moreover, type specimens of other marine invertebrates that he named have been lost (e.g., Kohn 1981, Blake & Maciolek 1987, Wormuth 1988). Bosc provided a brief description and a rather imprecise figure of *A. cordifera*, but he specified that individuals have five arms that are nine times longer than the disk, round gray disk scales with white borders, cordiform radial shields separated by three small scales, and five slender arms with three white spines that are shorter than the arm's width. Although he neglected to mention several distinguishing features of *Hemipholis* species, such as nearly naked interradial and the absence of bursal slits and infradental papillae, all of the features that he cited, especially the characteristic pairs of heart-shaped radial shields, match those of the Western Atlantic *Hemipholis* species. Particularly compelling was Bosc's account of extensile red tentacles beneath the arm ("qui s'alonge à la volonté de l'animal") (Bosc 1802:114). Similar tube feet filled with red coelomocytes have been reported in only three species of North American ophiuroids (Christensen *et al.* 2008), of which *H. cordifera* alone has five arms. It is the sole species from Carolina with the precise suite of features specified by Bosc, and is known as the "blood brittle star" (Ruppert & Fox 1998:70) because of its red tube feet.

A putative species of *Hemipholis* collected from Charleston Harbor, South Carolina, was described and originally named *Ophiura elongata* Say, 1825, by the American naturalist Say, a contemporary of Bosc. Say (1825) did not designate a holotype, and specimens of *O. elongata* that he studied are not in the Academy of Natural Sciences of Philadelphia where they were presumed to be deposited (Ives 1889, Spamer & Bogan 1992, Thomas 1962); neither are they in the Natural History Museum (London) where some of Say's crustacean type specimens reside (Spamer & Bogan 1992, G. Patterson, pers. comm.). Say reported that the species has a pentagonal, finely scaled disk five mm in diameter, and slender arms about 35 mm long with ovoid dorsal arm plates, quadrate ventral arm plates, and three, short, blunt arm spines. The only potentially diagnostic detail that he mentioned is that the arm spines are "hardly more than equal to half the width of the segment; the intermediate spine ... more obtuse than the others, and ... minutely echinate." In contrast, the spines of *H. cordifera* are tapered rather than obtuse or echinate. In comparison with Bosc's reasonably informative account, Say's description of *O. elongata* is so vague that the species' identity is indeterminable, even to family. Furthermore, Say's (1825:146) assertion that the "species inhabits

Gorgoniae” along with *Ophiothrix angulata* (Say, 1825) is perplexing, since *H. cordifera* invariably burrows in soft sediment. Stimpson (1852:226) found that in Charleston Harbor, “It is gregarious, living in companies of twenty or thirty. The existence of these groups is indicated at low water by spaces of about a foot in diameter covered with small holes, looking very much as if a charge of shot had been fired into them. If these spots are watched as the tide rises, from each hole an arm of the star-fishes will be seen to protrude and wave about in the water, with the red tentacular filaments, by which the respiration is effected, clothing the sides.” Thus, nothing in Say’s description shows that *O. elongata* is a *Hemipholis* species, or that it is identical to *H. cordifera* or another South Carolinian species, or that it resembles any ophiuroid species that is epizoic on gorgonians. Since the name cannot be interpreted, one must conclude that *O. elongata* and equivalent combinations such as *H. elongata* are *nomina dubia*, names of unknown application.

Discrepancies in the allocation of the species’ names first came to light when Lütken (1859:180) transferred ophiuroids that he regarded as *Asterias cordifera* and *Ophiura elongata* to the genus *Amphiura*. Lyman (1860:203) soon realized that specimens from Charleston, South Carolina, which Lütken had identified as *Amphiura elongata*, must have been the species that Bosc named *Asterias cordifera*. Additionally, Lyman recognized that it was actually a new species of ophiuroid from St. Thomas, The Virgin Islands, which Lütken (1859) had identified as *Amphiura cordifera*. As a result, Lyman advocated that the species from South Carolina should be called *Amphiura cordifera*, and that a new name was required for the species from St. Thomas, and after consultation he reported that “Dr. Lütken agrees with me ... and wishes to change the name *Amphiura cordifera* (Ltk.) [i.e., the name of the West Indian specimens misidentified as *A. cordifera*] to *Amphiura Riisei*, (Ltk.)” (Lyman 1860:258). Subsequently, Verrill (1899) transferred *A. riisei* to his newly erected genus *Amphiodia*, as *Amphiodia riisei* (Lütken, 1859).

When Lyman (1865) erected the new genus *Hemipholis*, he fixed *A. cordifera* as its type species by monotypy. It is regrettable that he treated *O. elongata* as a junior synonym of *H. cordifera* without providing a justification, and it is not known whether Lyman or his contemporaries ever examined specimens that Say himself had identified as *O. elongata*. Regardless, the name *H. cordifera* remained in general use until Koehler (1914:39), who misconstrued Lyman’s evidence regarding priority of publication and who accepted Lütken’s mistaken identifications of *A. cordifera* and *A. elongata*, erroneously substituted the name *H. elongata* “instead of *H. cordifera*, under which it is usually known.” Regrettably, H.L. Clark (1915:237) accepted Koehler’s ill-advised decision in his “Catalog of Recent ophiurans,” which still serves as a standard reference for ophiuroid nomenclature. Other authors followed suit, and when Fell (1960) transferred *Hemipholis* to the Ophiactidae, he cited *H. elongata* as the type species of the genus. Recently, *H. cordifera* has been treated as a *nomen oblitum*, a forgotten name, based on the presumption that it had not been used in the literature since 1899 (Stöhr 2010). However, the name *H. cordifera* was indeed used after 1899 by Ludwig (1904), Koehler (1907), and by Mortensen (1920:4) who pointedly referred to “*Hemipholis cordifera*, or as it should be named according to H.L. Clark *Hemipholis elongata* (Say).” Consequently, *H. cordifera* is not an eligible *nomen oblitum* since the name does not meet the conditions set in Articles 23.9.1 and 23.9.2 of the ICZN (International Commission on Zoological Nomenclature 1999). Rather, in accordance with the Principle of Priority, *H. cordifera* should be deemed the correct name for the Western Atlantic species of *Hemipholis*.

Hemipholis affinis* versus *Hemipholis gracilis

In addition to *H. cordifera*, four species of *Hemipholis* have been named including two from the Eastern Pacific. The description of *H. gracilis* was based on 8 syntypes (the largest approximately 5 mm in disk diameter), which were collected from the Gulf of Panama at a depth of 7.3 m (Verrill 1867). The description of *H. affinis*, was based on six syntypes (up to 11 mm disk diameter) from the Bay of Guayaquil, Ecuador, in 27–36 m depth (Ljungman 1867). Exchange records of the Peabody Museum of Natural History, Yale University (YPM) indicate that one syntype of *H. gracilis* was sent by Verrill to the Museum of Comparative Zoology, Harvard University (catalog number MCZ 1117), and another to Lütken at the Zoological Museum Copenhagen (E. Lazo-Wasem, A. Baldinger, pers. comm.). The other six specimens (catalog number YPM IZ 001136) may still be at YPM, but they have not been located at the present time (E. Lazo-Wasem, pers. comm.). Photographs of the syntype of *H. gracilis* at the MCZ have been published (Clark 1915: pl. 9, figs. 7, 8). Type specimens of *H. affinis*, which are housed in the Swedish Museum of Natural History (Stöhr 2001), have never been illustrated.

Information provided in the original descriptions did not demonstrate that *H. gracilis* and *H. affinis* are different. Consequently, Verrill (1871:573), whose unintentionally ironical remarks constitute the epigraph of the present

report, contended that “Ljungman’s species from Guayaquil appears to be identical with *H. gracilis*,” and he asserted that “Judging from the date ... our name has priority of actual publication.” Verrill’s claim of priority was not contested in Ljungman’s later publications, but it promptly was challenged by Lyman who, initially disputing Verrill’s claim based on the priority of publication, referred to the Eastern Pacific *Hemipholis* species as *H. affinis* (compare Lyman 1869, 1882). H.L. Clark (1910: 341, 1915, 1955) on the contrary, upheld Verrill’s contention that *H. affinis* is a junior synonym, and he used the name *H. gracilis*, noting that it “has been generally accepted.” However, the order of publication of the species’ names has remained unresolved until now.

It was evident that Verrill’s report on *H. gracilis* was published in March, 1867, which is the date printed on the second page of the species description (Verrill 1867:263). Irregularities in the paper’s publication and dissemination were accounted for by Verrill in a preface to the reprints of Volume 1, Part 2 of Transactions of the Connecticut Academy of Arts and Sciences, which is dated 15 November, 1869 (an example may be viewed at <http://www.archive.org/stream/notesonradiatain00verr#page/n3/mode/2up>, accessed 1 June 2011). However, Ljungman’s publication on *H. affinis* simply was dated as the year 1867 (on page 358 in Öfversigt af Kongliga Vetenskaps-Akademiens Förhandlingar, 1866, Årgang 23). Seeking to establish the priority of *H. gracilis*, Verrill made a questionable claim that the date of the publication was precisely 18 May, 1867, basing it on Lovén’s inscription on the fly-leaf of an off-print of Ljungman’s (1867) paper that he sent to Verrill (Lyman 1869, Verrill 1871). Fortunately, May 1867 can be corroborated as the actual month of publication of *H. gracilis* because an invoice bound in an accounting ledger of the Swedish Academy of Sciences shows that Ljungman’s contribution was delivered from the bindery and ready for distribution on May 29, 1867 (M. Asp, pers. comm.). Thus, H.L. Clark (1910:341) correctly stated that “Verrill’s name has about two months’ priority,” as is shown by the actual dates of publication.

H.L. Clark (1910, 1915, 1955) mentioned that a sizeable gap separated the only localities, Panama and Ecuador, from which at that time specimens of *H. gracilis* had been collected. Although *H. gracilis* has recently been reported from El Salvador, Nicaragua, Costa Rica and Panama (Alvarado *et al.* 2010), the authors’ anomalous record of *H. elongata* from the Pacific coast of Panama calls into question the stated distributions. However, there are collections of *H. gracilis* in the Natural History Museum of Los Angeles County from the Pacific coast of the Panamanian provinces of Darien and Panama, the Department of La Union, El Salvador, and the Mexican states of Baja California Sur, Jalisco, Sinaloa, and Sonora, which extend the northern limit of *H. gracilis* to Punta Rocosa, Sonora, Mexico, at 31° 19.16’ N, 113° 39.16’ W (LACM 1940-044.019). In addition, there are two specimens of *Hemipholis* at the Smithsonian Institution (USNM E6603, E6569) from Punta Pizarro, Peru, which are indistinguishable from specimens of *H. gracilis* from Central America, and which extend the southern limit of its range to 3° 29’ S, 80° 24’ W. Propitiously, the Peruvian collecting site of *H. gracilis* was within the Gulf of Guayaquil, which is the type-locality of *H. affinis* (Ljungman 1867). And since the geographic range of *H. gracilis* encompasses the only known locality of *H. affinis*, and Ljungman’s (1867) description of *H. affinis* does not distinguish it from *H. gracilis*, it appears that *H. affinis* is indeed a junior synonym of *H. gracilis*. The sole congener of *H. gracilis* is the geminate, western Atlantic species *H. cordifera*, which occurs from North Carolina, USA (USNM E25362) to southern Brazil and northern Uruguay (Tommasi 1970, Lucchi 1985, Martínez 2008).

Contrasting geographic distributions of *H. cordifera* and *H. gracilis*

The range of *H. gracilis* spans approximately 28° of latitude and a straight line distance of > 5,000 km, and that of *H. cordifera* spans approximately 63° of latitude and a straight line distance of > 7,000 km. Both species inhabit ubiquitous soft bottom habitats, and each occupies an extensive geographic range encompassing several zoogeographic provinces and ecoregions (*sensu* Spalding *et al.* 2007). However, Martínez (2008) characterized *H. cordifera* as a warm water species with a southern distribution that may be restricted by the cold Falkland Current or by a hyposaline barrier produced by the Rio de la Plata fresh water discharge. In that regard, it is noteworthy that minimum annual sea surface temperatures are roughly comparable at the northern and southern limits of each species’ range, although it appears that *H. cordifera* experiences comparatively lower winter temperatures than *H. gracilis* at the edges of its distribution (Ortega & Martínez 2007, Locarnini *et al.* 2010, Miles & He 2010). The broader range of *H. cordifera* relative to that of *H. gracilis* may result from its superior cold tolerance, coupled with the influence of the Gulf Stream and Brazil currents that warm a vast swath of the central Western Atlantic coast. Assuming that is correct, the contrasting lengths of the species’ ranges appears to be causally related to the distribution of suitably warm surface waters and to each species’ capacity to tolerate low temperatures, rather than to its

tolerance for low salinity or for high turbidity. However, bearing in mind that the distributional limits of both *H. cordifera* and *H. gracilis* coincide with the confluence of cold and warm-water current systems, it is possible that the divergent ocean currents, alone or in conjunction with water temperature, limit the species' ranges.

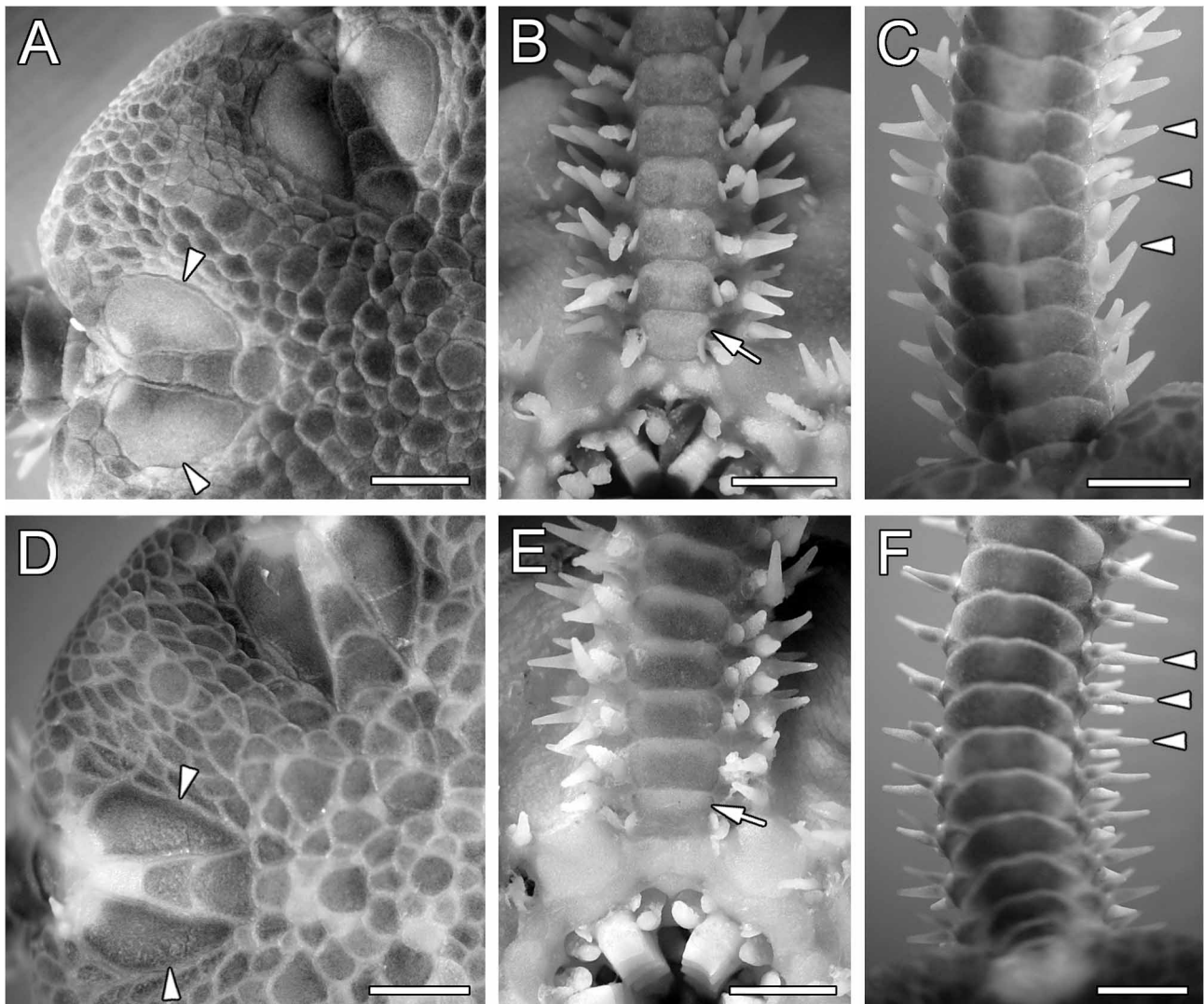


FIGURE 1. *Hemipholis cordifera* and *Hemipholis gracilis*. A–C, *H. cordifera*, LACM 1999-26.2, 7.8 mm disk diameter, from South Carolina; D–F, *H. gracilis*, LACM 1997-224.001, 7.8 mm disk diameter, from Panama; specimens preserved in ethanol. For each specimen, shown from left to right are: portion of disk in dorsal view, arrowheads indicating pairs of radial shields; basal arm joints on ventral side of disk, arrow indicating second ventral arm plate; basal arm joints in dorsal view, arrowheads indicating middle arm spines. Dorsal arm plates of both species are sometimes fragmented as is the case in Figure C. Scale bars = 1.0 mm.

Distinguishing *H. cordifera* from *H. gracilis*

Small individuals of *H. gracilis* and *H. cordifera* look alike, which could account for a record of “*H. elongata*” from the Eastern Pacific (in Alvarado *et al.* 2010). Although large individuals of both species also are quite similar, several external features can be used to distinguish them (Figs. 1, 2). Large individuals of *Hemipholis gracilis* have radial shields that are more constricted proximally than the shields of *H. cordifera* (Fig. 1A,D). The basal ventral arm plates of *H. gracilis*, particularly the second ventral arm plate, are relatively shorter and wider than those of *H. cordifera* (Figs. 1B,E & 2). Although there is an overlap in the width/length ratios of the second ventral arm plates of both species, animals larger than 7 mm disk diameter have plates that distinctly differ in their proportions (Fig. 2). In addition, the arm spines of large *H. gracilis* tend to be more tapered than those of *H. cordifera* (Fig. C,F).

The Pacific and Atlantic populations of *Hemipholis* are little differentiated morphologically, and dissimilarities

in their external structures only arise late in ontogenesis. This is not surprising since geminate species separated by the Panamanian Isthmus are typically “in the initial, allopatric stage of speciation,” and they can even be reproductively compatible (Lessios 2008:84). Consistent differences between individuals of *Hemipholis* from opposite sides of the Isthmian barrier, similarities among individuals throughout their range in each ocean, and the species’ broad ranges in the western Atlantic and Eastern Pacific respectively, all suggest that differences between *H. cordifera* and *H. gracilis* are not merely ecophenotypic. However, there is a dearth of comparable data on genotypic, phenotypic, and phenological characteristics of populations from both oceans, which are needed to elucidate the evolution and phylogeny of *H. gracilis* and *H. cordifera*.

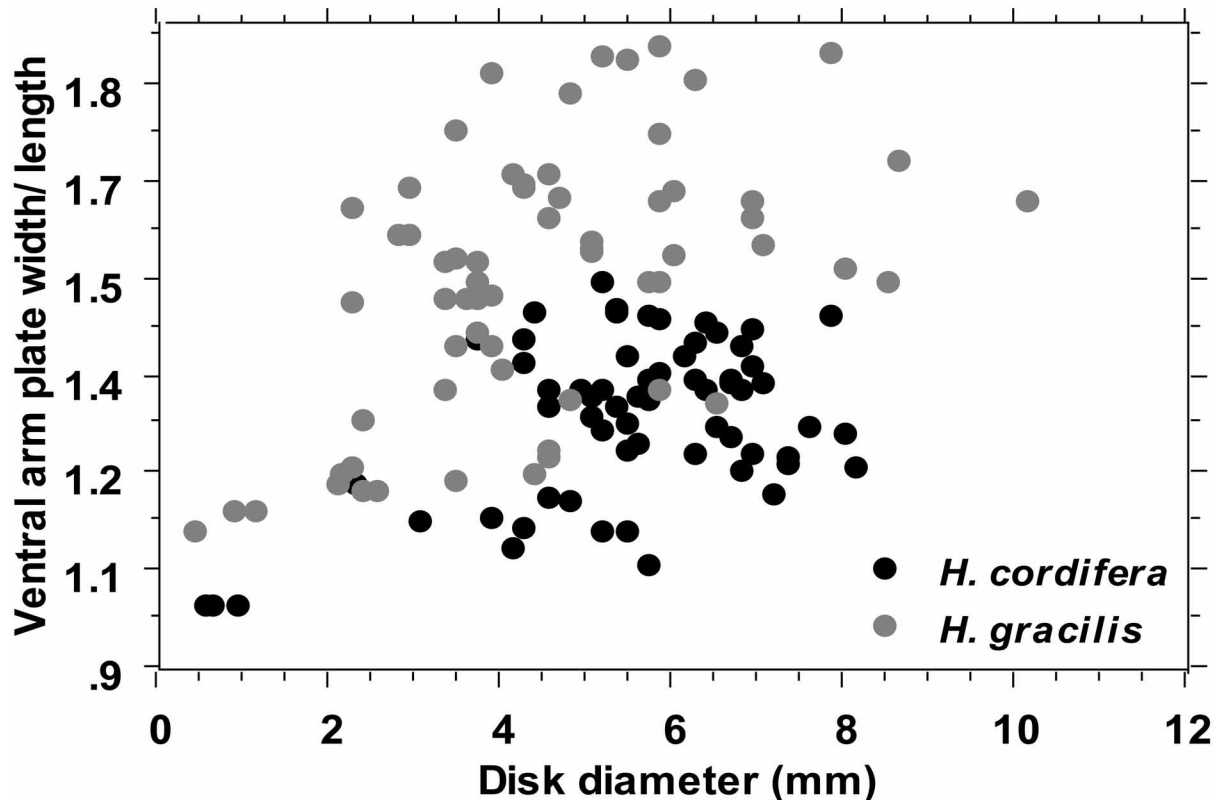


FIGURE 2. Scatter plot for *Hemipholis cordifera* and *Hemipholis gracilis*, showing the relationship between the body size in terms of disk diameter, and shape of the second ventral arm plate characterized by the ratio between the ossicle’s width and length.

Species misclassified in the genus *Hemipholis*

Two ophiuroids have been erroneously described as new species of *Hemipholis*. Duncan unjustifiably “modified” the genus *Hemipholis* to classify a new species from the Korean Straits as *Hemipholis microdiscus* Duncan, 1879 (Duncan 1879:447). The species had infradental and distal oral papillae characteristic of Amphiuroidae, and it was transferred to the genus *Amphiura* by Matsumoto (1917:201). The resultant combination, *Amphiura microdiscus* (Duncan, 1879), was a junior homonym of *Amphiura microdiscus* Lütken, 1856, an Eastern Pacific species that Nielsen (1932:282) eventually determined “must be abandoned as not recognizable.” H.L. Clark (1915:235) composed a *nomen novum*, *Amphiura microdiscoidea* H.L. Clark, 1915, to replace the preoccupied name. That the repository of the holotype of *A. microdiscoidea* is the Natural History Museum, London, catalog number (18) 80.1.3.3, has recently been confirmed (A. Cabrinovic, pers. comm.).

Hemipholis wallichii Duncan, 1881, from Agulhas Bank off South Africa, was placed by Duncan (1881:141) in what he considered “the most convenient” genus. He did not designate a repository for the holotype, which may be lost as it has not been located in the Natural History Museum or in the collections of the Linnean Society (A. Cabrinovic; K. Way, pers. comm.). Duncan insisted that the specimen, only three mm in length, “...is young, [but] it is not immature, except in regard to the ends of the arms” (Duncan 1881:140). However, based on our present

knowledge of ophiuroid skeletal ontogenesis (e.g. Hendler 1978, 1988, Sumida *et al.* 1998, Stöhr, 2005) the original specimen of *H. wallichii* must have been a juvenile individual. Its lack of structures that develop in mature ophiuroids, such as the oral papillae and tentacle scales (Hendler 1978, 1988), precludes its identification even to family (Lyman 1882, H.L. Clark 1915). Furthermore, *H. wallichii* does not have the diagnostic features found in juvenile *H. cordifera* of an equivalent size, including toothed arm spines, carinate first ventral arm plate, and adoral shields linked in a continuous series encircling the mouth (compare Duncan 1881, Turner & Miller 1998). Toothed arm spines like those in *H. cordifera* occur in some other juvenile Ophiactidae including post-larval *Ophiactis* and *Ophiopholis* species (Ludwig 1899, Sumida *et al.* 1998, Hendler, pers. obs.). Thus, *H. wallichii* is not a *Hemipholis* species and may well not be an Ophiactidae; rather, it appears to be a juvenile ophiuroid *incertae sedis*.

Conclusions

- (1) Bosc (1802) described *Asterias cordifera*, which by monotypy became the type species of *Hemipholis* Lyman, 1865. In recent years the name *H. cordifera* has been used less frequently than *H. elongata* for the Western Atlantic species of *Hemipholis*. However, *H. cordifera* cannot be set aside as a *nomen oblitum* because the name was used after 1899, and therefore in accordance with the Principle of Priority it remains the correct name for the species.
- (2) Nothing in Say's (1825) description of *Ophiura elongata* suggests that it is a species of *Hemipholis*. In fact, the name cannot unambiguously be assigned to a known species of ophiuroid. Therefore, *O. elongata* and equivalent combinations such as *H. elongata* should be regarded as *nomina dubia*, names of unknown application.
- (3) Of the two names used for the Eastern Pacific species of *Hemipholis*, *H. affinis* and *H. gracilis*, the latter name has priority by virtue of its date of publication.
- (4) The only ophiuroids in the genus *Hemipholis* that are recognized herein, *H. cordifera* and *H. gracilis*, are geminate species occurring on opposite sides of the Isthmus of Panama.
- (5) The range of *H. gracilis* extends from Sonora, Mexico to northern Peru, and that of *H. cordifera* from North Carolina, USA, to Uruguay. It is hypothesized that there is a causal relationship between sea surface temperature, possibly in conjunction with divergent ocean currents, and the ranges of both species, and that the latitudinal distribution of *H. cordifera* is wider than that of *H. gracilis* due to its superior cold tolerance and to the broad reach of warm-water boundary currents in the central Western Atlantic.
- (6) It is difficult to distinguish small individuals of *H. cordifera* and *H. gracilis* based on their external morphology, but larger specimens can be identified according to the shape of their radial shields, arm spines, and ventral arm plates.
- (7) Two species of *Hemipholis* described by Duncan (1879, 1881) were incorrectly classified. *Hemipholis microdiscus* was transferred to the Amphiuroidae by Matsumoto (1917), who proposed the new combination *Amphiura microdiscus*. But as the name was preoccupied, H.L. Clark (1915) assigned the *nomen novum*, *Amphiura microdiscoida*, as a replacement. *Hemipholis wallichii*, which was described based on a single specimen that may be lost, was manifestly not a species of *Hemipholis*, and it should be treated as a juvenile ophiuroid *incertae sedis*.

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