

A REVISED CLASSIFICATION OF THE AUSTRALIAN AMPHIURIDAE (OPHIUROIDEA).

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Synopsis.

The Australian Amphiuridae are regrouped in 16 genera, which are keyed.

INTRODUCTION.

Since the appearance of H. L. Clark's valuable work *The Echinoderm Fauna of Australia* (1946) a considerable revision of the genera of Amphiuridae has become necessary. Details of the changes proposed are given elsewhere (Fell, 1962), and the present contribution is intended to explain the implications for the nomenclature of the Australian species. The following checklist of species shows the names under which the species appear in Clark's work cited above, together with the genera to which the species are referred in the classification here adopted.

REVISED CHECKLIST OF AUSTRALIAN AMPHIURIDAE.

H. L. Clark (1946).	Genera here adopted.
<i>Amphiura trisacantha</i> H.L.C., 1928	<i>Monamphiura</i>
<i>catephes</i> H.L.C., 1938	"
<i>phrixa</i> H.L.C., 1938.	"
<i>microsoma</i> H.L.C., 1915	<i>Amphinephthys</i> .
<i>stictacantha</i> H.L.C., 1938.	<i>Amphiura</i>
<i>brachyactis</i> H.L.C., 1938	<i>Pandelia</i>
<i>septemspinosa</i> H.L.C., 1915	<i>Monamphiura</i>
<i>constricta</i> Lym., 1879	"
<i>leucaspis</i> H.L.C., 1938	"
<i>magnisquama</i> H.L.C., 1938	"
<i>micra</i> H.L.C., 1938	"
<i>ptena</i> H.L.C., 1938	"
<i>velox</i> Koehler, 1910	"
<i>diacritica</i> H.L.C., 1938	<i>Amphinephthys</i>
<i>ambigua</i> Klr., 1905	<i>Amphiura</i>
<i>multiremula</i> H.L.C., 1938	"
<i>bidentata</i> H.L.C., 1938	"
<i>dolia</i> H.L.C., 1938	"
<i>nannodes</i> H.L.C., 1938	"
<i>acrisia</i> H.L.C., 1938	"
<i>poecila</i> H.L.C., 1915	"
<i>Ctenamphiura maxima</i> (Lym., 1879)	<i>Ctenamphiura</i>
<i>Ophiocentrus verticillatus</i> (Dod., 1896)	<i>Ophiocentrus</i>
<i>fragilis</i> H.L.C., 1938	"
<i>dilatatus</i> (Klr., 1905)	"
<i>pilosus</i> (Lyman, 1879)	"
<i>asper</i> (Klr., 1905)	"
<i>Ophionephthys octacantha</i> H.L.C., 1915	<i>Ophiopeltis</i>
<i>decacantha</i> H.L.C., 1938	"
<i>perplexa</i> (Stimpson, 1855)	<i>Icalia</i>
<i>tenuis</i> H.L.C., 1938	<i>Ophionema</i>

<i>Amphipholis squamata</i> (D. Chiaje, 1828)	<i>Amphipholis</i>
<i>Amphistigma minuta</i> H.L.C., 1938	<i>Ophiostigma</i>
<i>Amphiodia ochroleuca</i> (Brock, 1888)	<i>Diamphiodia</i>
<i>Ophiocnida echinata</i> (Ljg., 1867)	<i>Ophiocnida</i>
<i>Amphioplus lucidus</i> Klr., 1922	<i>Ophionephthys</i>
<i>depressus</i> (Ljg., 1867)	<i>Amphioplus</i>
<i>parviclypeus</i> H.L.C., 1915	"
<i>lobatus</i> (Ljg., 1867)	"
<i>didymus</i> H.L.C., 1938	"
<i>stenaspis</i> H.L.C., 1938	"
<i>Amphiacantha sexradia</i> (Duncan, 1887)	<i>Amphiacantha</i>

Key to the Australian Genera of Amphiuridae.

- 1 (18) A conspicuous diastema separates the first (i.e., infradental) oral papilla from the second oral papilla. Usually only these two oral papillae on each side, but a third one may occur on or near the adoral plate.
- 2 (3) Numerous spines carried on the disc OPHIOCENTRUS.
- 3 (2) No spines on disc.
- 4 (9) Disc naked above and below, save for the radial shields and an adjoining narrow zone of scales bordering the radial shields.
- 5 (6) Infradental papilla large, second oral papilla more or less vestigial. No tentacle-scales OPHIONEMA.
- 6 (5) Infradental and second oral papillae both well-developed.
- 7 (8) No tentacle-scales OPHIOPELTIS.
- 8 (7) One or two tentacle-scales AMPHINEPHTHYS.
- 9 (4) Disc not entirely naked, having at least a continuous clothing of scales on the upper surface.
- 10 (15) Disc scaled above, but partly or wholly naked below.
- 11 (12) Disc-scales coarse, chunky, arranged in an irregular mosaic. Infradental and second oral papillae both large, flat, broad; a third spiniform oral papilla at the distal end of the jaw. Tentacle-scales present CTENAMPHIURA.
- 12 (11) Disc-scales fine, flattened, imbricating, not chunky nor arranged in a mosaic.
- 13 (14) No tentacle-scales on most pores. ICALIA.
- 14 (13) One tentacle-scale on all or most pores PANDELIA.
- 15 (10) Disc scaled completely above and below.
- 16 (17) One tentacle-scale MONAMPHIURA.
- 17 (16) Two tentacle-scales AMPHIURA.
- 18 (1) Three or more oral papillae on each side of the jaw, with no diastema.
- 19 (26) Three oral papillae on each side of jaw.
- 20 (23) Outermost (i.e., third) oral papilla conspicuously larger than the other two.
- 21 (22) No spines on disc. Two tentacle-scales AMPHIPHOLIS.
- 22 (21) Spines carried on some disc-scales OPHIOSTIGMA.
- 23 (20) Three subequal oral papillae, the outermost not conspicuously larger than the others. Disc scaled above and below.
- 24 (25) Numerous scattered spines on disc OPHIOCNIDA.
- 25 (24) No spines on disc. Two tentacle-scales DIAMPHIODIA.
- 26 (19) Four or five oral papillae on each side of jaw, often rather irregularly arranged, or overlapping, the outermost usually placed on or near the adoral plate. Tentacle-scales present.
- 27 (28) Disc bearing spines or spiniform processes. Tentacle-scales leaf-like, not spiniform .. AMPHIACANTHA.
- 28 (27) No spines on disc.
- 29 (30) Disc naked above and below, save for the radial shields and an adjoining zone of scales bordering the radial shields. One or two tentacle-scales OPHIONEPHTHYS.
- 30 (29) Disc scaled completely above and below. Two tentacle-scales AMPHIOPHUS.

MONAMPHIURA Fell, 1962.

Type species: *Amphiura alba* Mortensen, 1924.

Monamphiura is a large cosmopolitan genus to which more than 60 species may be referred. It is represented in Australian seas by ten nominal species.

Key to the Australian species of Monamphiura.

- 1 (2) Arms 6 (rarely 5). Arm-spines 4 or 5, short, flat, blunt *velox* (Koehler).
- 2 (1) Arms normally 5.
- 3 (4) Tentacle-scale as long as ventral arm-plate, and attached to it for its full length *ptena* (H. L. Clark).

- 4 (3) Tentacle-scale attached only at its proximal end.
- 5 (6) Radial shields elongate, not contiguous, separated by intervening elongate scales. Arm-spines normally 3, but 4 or 5 on basal arm-joints .. *trisacantha* (H. L. Clark).
- 6 (5) Not so.
- 7 (10) Ventral arm-plates broader than long.
- 8 (9) Arm-spines erect, 8-10 at base of arm *catephes* (H. L. Clark).
- 9 (8) Arm-spines more or less adpressed, 6-7 at base of arm *phriza* (H. L. Clark).
- 10 (7) Ventral arm-plates longer than broad.
- 11 (14) Radial shields elongate, disc-clothing of very numerous fine minute scales.
- 12 (13) Upper arm-spines acuminate *septemspinosa* (H. L. Clark).
- 13 (12) Upper arm-spines wide, blunt *constricta* (Lyman).
- 14 (11) Radial shields short and broad, disc-clothing of coarse scales.
- 15 (18) Basal arm-spines 5-6. Outer oral papilla subcircular, flat.
- 16 (17) Tentacle-scale elongate, almost as long as the ventral arm-plate *leucaspis* (H. L. Clark).
- 17 (16) Tentacle-scale small, about one-third of the length of the ventral arm-plate *magnisquama* (H. L. Clark).
- 18 (15) Basal arm-spines 3-4. Outer oral papilla longer than broad .. *micra* (H. L. Clark).

AMPHINEPHTHYS Fell, 1962.

Type species: *Amphiura crossota* Murakami, 1943.

Amphinephthys includes at least three Pacific littoral species, and it is possible that two other species should be included, one from South Africa and one from the Caribbean. Two of the included species are Australian, the third being the type, from the Caroline Islands.

Key to the Australian species of *Amphinephthys*.

- 1 (2) Single tentacle-scale *microsoma* (H. L. Clark).
- 2 (1) Two tentacle-scales *diacritica* (H. L. Clark).

AMPHIURA Forbes, 1842. (Restricted.)

Type species: *Amphiura chiajei* Forbes, 1842.

Amphiura, as now restricted on the basis of the type species, comprises some forty species, both shallow- and deep-water forms being represented. The genus is cosmopolitan and is represented in Australian seas by eight species.

In his work on the Echinoderm fauna of Australia, H. L. Clark (1946, pp. 191-192) includes a number of statements which appear to be in error. The species *Amphiura stictacantha* is stated to have one tentacle-scale, whereas the type material was recorded as having two scales (H. L. Clark, 1938).

Two species, *A. ambigua* and *A. multiremula*, are keyed by Clark (1946) as having the disc naked below; the former species has been taken on a number of occasions, and all material (like the type) was fully scaled; the latter species was originally recorded as fully scaled, and its subsequent inclusion in the group with a naked underside seems to have been accidental. In the following key the records of the type material have been used as the basis of the classification.

Key to the Australian species of *Amphiura*.

- 1 (2) Arm-spines 3. A third (distal) oral papilla *bidentata* H. L. Clark.
- 2 (1) Arm-spines 5 or more.
- 3 (6) Arm-spines 8-9.
- 4 (5) Radial shields elongate, narrow *stictacantha* H. L. Clark.
- 5 (4) Radial shields short, divergent, barely one-sixth diameter of disc *multiremula* H. L. Clark.
- 6 (3) Arm-spines 5-7.
- 7 (8) Disc-scales coarse. Outer oral papilla flat, thick, opercular *dolia* H. L. Clark.
- 8 (7) Disc-scales fine. Outer oral papilla erect.
- 9 (12) Primary plates not differentiated.
- 10 (11) Arm-spines with a glassy recurved distal hooklet, directed towards the extremity of the arm *ambigua* Koehler.
- 11 (10) Arm-spines with no distal glassy hooklet *nannodes* H. L. Clark.
- 12 (9) Primary plates more or less evident.
- 13 (14) Radial shields long, narrow, 3 or 4 times longer than broad *poecila* H. L. Clark.
- 14 (13) Radial shields small, inconspicuous, about twice as long as broad *acrisia* H. L. Clark.

PANDELIA Fell, 1962.

Type species: *Amphiura hinemoae* Mortensen, 1924.

Pandelia comprises about a dozen species, mostly Pacific forms. The single known Australian species, *Pandelia brachyactis* (H. L. Clark), has 5-7 arm-spines, the arms relatively short, about four times the disc-diameter.

OPHIOPELTIS Düben & Koren, 1846.

Type species: *Ophiopeltis securigera* Düben & Koren, 1846.

Ophiopeltis is a small cosmopolitan genus of some nine species, mostly from shallow water. Two species are recorded from Australia.

Key to the Australian species of Ophiopeltis.

- 1 (2) Arm-spines 10, the series from either side of the arm meeting on the dorsal surface of the arm, where the uppermost spines are slender, not conspicuously short *decacantha* (H. L. Clark).
- 2 (1) Arm-spines 8 (occasionally 9), the lateral series not meeting on the dorsal side of the arm, the uppermost spines short and thick, not slender *octacantha* (H. L. Clark).

ICALIA Fell, 1962.

Type species: *Amphiura denticulata* Koehler, 1896.

Icalia comprises about eighteen species, mostly from the Atlantic. The single species in Australian waters, *I. perplexa* (Stimpson), has extremely elongate arms and up to six arm-spines.

OPHIONEMA Lütken, 1869.

Type species: *Ophionephthys limicola* Lütken, 1869.

Ophionema comprises five known species, all from tropical littoral waters. Only one species is known from Australia, *Ophionema tenuis* (H. L. Clark), from north-west Australia. The arms are stated by Clark to be about 25 times the disc-diameter, and there are about six arm-spines.

AMPHIPHOLIS Ljungman, 1866.

Type species: *Ophiolepis gracillima* Stimpson, 1852.

The genus is represented in Australia by the cosmopolitan and well-known species, *Amphipholis squamata* (D. Chiaje).

OPHIOSTIGMA Lütken, 1856.

Type species: *Ophiostigma tenue* Lütken, 1856.

Amphistigma H. L. Clark, 1938 was founded on a single juvenile specimen of the only known species, *A. minuta* H. L. Clark, from Lord Howe Island. It is probably to be referred to *Ophiostigma*.

DIAMPHIODIA Fell, 1962.

Type species: *Amphiura violacea* Lütken, 1856.

Diamphiodia is a cosmopolitan genus of more than thirty species, of which only one is recorded from Australia. This is *D. ochroleuca* (Brock, 1888), also occurring in Indonesia.

OPHIONEPHTHYS Lütken, 1868.

Type species: *Ophionephthys limicola* Lütken, 1869.

Although H. L. Clark (1946) recorded four species of this genus from Australia, none of the species he included can be regarded as congeneric with the type species, and they are here assigned to other genera. However, *Ophionephthys* is represented in Australia by the species *O. lucida* (Koehler), which has hitherto been included under *Amphioplus*. The species can be sufficiently identified by the key to the genera. Apart from the Australian representative, five (possibly six) other species are known mainly Indo-Pacific littoral forms.

OPHIOCNIDA Lyman, 1865.

Type species: *Ophiolepis hispida* Le Conte, 1851.

H. L. Clark (1946) believes that the genus is represented in Australian waters by *O. echinata* (Ljungman).

AMPHIOPLUS Verrill, 1899.

Type species: *Amphiura tumida* Lyman, 1878.

As now restricted, *Amphioplus* comprises about 56 nominal species, of which five occur in Australian waters.

Key to the Australian species of Amphioplus.

- 1 (2) Radial shields contiguous along the radial mid-line *depressus* (Ljg.).
- 2 (1) Radial not contiguous along the mid-line, usually elongate and separated by intervening scales.
- 3 (8) Radial shields reaching one-third to one-half of the distance to the centre of the disc.
- 4 (5) Arm-spines 6 *lobatus* (Ljg.)
- 5 (4) Arm-spines fewer than 6; 4-5 at the arm-base, fewer beyond.
- 6 (7) Adoral plates contiguous proximally to the oral shield *didymus* H. L. Clark.
- 7 (6) Adoral shields not contiguous proximally to the oral shield *stenaspis* H. L. Clark.
- 8 (3) Radial shields small, reaching only about one-fifth of the distance from the ambitus to the centre of the disc *parviclypeus* H. L. Clark.

AMPHIACANTHA Matsumoto, 1917.

Type species: *Amphioplus acanthinus* H. L. Clark, 1911.

Amphiacantha comprises about five (possibly seven) described species, mainly Pacific in distribution. The species listed by H. L. Clark (1946), *A. sexradia* (Duncan, 1887), is dubiously reported from Western Australia.

CTENAMPHIURA Verrill, 1899.

Type species: *Amphiura maxima* Lyman, 1879.

Ctenamphiura probably comprises two known species, one from New Zealand, and the type species from Australia. A third nominal species (*A. sinensis* A. H. Clark) would appear rather to fall in *Diamphiodia*. The single Australian species can be recognized by the generic characters in the foregoing key.

OPHIOCENTRUS Ljungman, 1867.

Type species: *Ophiocentrus aculeatus* Ljg., 1867.

Eleven species are at present included in the genus, which is exclusively Pacific, mainly littoral and sublittoral. There has been no change in the status of the five Australian species since H. L. Clark's key to them was published (1946), and reference may be made to that source.

OPHIACTIS and OPHIODAPHNE.

These genera, included in the Amphiuridae by H. L. Clark, are now usually regarded as forming a distinct family (Ophiactidae), together with *Ophiopholis* and *Ophiopus*.

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