Medusae (Cnidaria) of Moreton Bay, Queensland, Australia

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ABSTRACT

The medusae (Scyphozoa, Cubozoa, Hydrozoa, including Siphonophora) of Moreton Bay are reviewed based on recent collections and literature records. Seven new species are described. *Euphysora juliephillipsi* sp. nov. differs from its congeners in having a long narrow apical projection with complete apical canal, moniliform main tentacle with a terminal knob, opposite tentacle longer than the other two, and lacking aboral papillae. *Euphysa scintillans* sp. nov. is distinct in having a pear-shaped body distinctly thickened aborally, one long main tentacle with 20–30 abaxial nematocyst clusters and an enormous globular bulb, and three rudimentary tentacles. *Aequorea kurangai* sp. nov. differs from its northern counterpart *A. australis* in having a fixed number of radial canals (16) but multiple tentacles per canal. *Cirrholovenia violacea* sp. nov. is closest to *C. polynema* but differs in having more statocysts with more concretions, fewer tentacles and cirri, and a gelatinous peduncle. *Orchistoma mauropoda* sp. nov. is most similar to *O. collapsa* but differs in maturing at half the size, having a more rounded body, and ungrouped radial canals. *Cyanea barkeri* sp. nov. is most similar to *C. nozakii* but differs in having T-shaped muscle septa, with resultant different sizes of muscle bands, the tentacle groups are considerably longer than wide and have well over 300 tentacles per group, and it lacks gastro-vascular intrusions into the muscles. *Cassiopea maremetens* sp. nov. is most similar to *C. ndrosia* but differs in having four square lappets per paramere, few to no vesicles between the mouths, lack of conspicuous exumbrellar colouration, and the oral arms terminate in a bifurcation. Numerous new distribution records are presented for Moreton Bay, as well as for other states and regions. The following species are revalidated and redescribed based on examination of new material: *Turritopsis lata* von Lendenfeld, 1884; *Proboscidactyla tropica* Browne, 1905; *Eutima australis* Mayer, 1915; *Physalia utriculus* (Gmelin, 1791); and *Crambione cookii* Mayer, 1910. The nomenclature of *Physalia physalis sensus lato* is discussed; a simulteous neotype is erected for *Physalia utriculus*, and *Physalia meglista* Péron & Lesueur, 1807. ❑ *Cnidaria, Scyphozoa, Hydrozoa, Cubozoa, Siphonophora, jellyfish, marine stingers, new species, new records.*

In Australia, the jellyfishes of tropical North Queensland have attracted the most attention, primarily because of the alarming health effects associated with box jellies and Irukandjis (Williamson *et al.* 1996). However, outside the tropics, the medusae have been poorly studied, partic-

ularly so the smaller, inconspicuous and non-harmful species. Moreton Bay has attracted a surprising number of medusan studies, given that the medusae are not generally associated with economic impacts (Pennycuik 1959; Payne 1960; Stephenson 1962; Hamond 1971; Greenwood 1980; Gorman 1988; Davie 1998). Even so, some of the larger and more conspicuous species have been erroneously identified, shedding some doubt on the accuracy of identification of some of the smaller, harder-to-identify species.

This work focuses on the medusae of Moreton Bay, i.e., the hydrozoans (including the siphonophores), scyphozoans, and cubozoans; the ctenophores are treated in a companion paper elsewhere in this volume. The well-known 'Morbakka', or 'Moreton Bay Carybdeid' was earlier formally described as a new genus and species, *Morbakka fenneri* by Gershwin (2008); this species has been associated with symptoms similar to Irukandji syndrome that may be life-threatening.

The present paper brings together the results of previous work on Moreton Bay medusae in light of new knowledge, and describes several new species that were collected during the Thirteenth International Marine Biological Workshop, in Moreton Bay, in February 2005. We have attempted to gather as much comparative information as possible on other Australian records for each taxon treated herein, in order to convey some measure of the spatial distribution and relative commonness of each species. We had originally intended this paper as a review of the medusae of Australia or the medusae of Queensland; however, it became clear that both of those projects are massive undertakings, and thus the present study has been restricted to the Moreton Bay fauna only. However, as part of our long-term commitment to monographing the group, we would appreciate receiving any specimens or information that others may have relating to Australian medusae.

MEDUSAE OF MORETON BAY

Table 1 gives an outline classification of medusae known from Moreton Bay, annotated with state records. For those species known from Moreton Bay and also from elsewhere in Australia, other records are noted in order to convey a measure of relative distribution and commonality.

MATERIALS AND METHODS

The collections of preserved medusae held in the Queensland Museum were examined. New material was collected by hand-trawl from jetties and anchored boats using a 0.5 m wide plankton net with a 500 mm mesh.

Live material was relaxed in MgCl (added dropwise) prior to examination and photography, then fixed in 5–10% formalin. Measurements of larger specimens were made to the nearest mm; on specimens under 15 cm, Max-Cal digital calipers were used to measure to the nearest 0.01 mm. Every effort was made to obtain true dimensions across the widest points; however, some specimens were too brittle to be spread out, in which case absolute measurements were taken across the two farthest available points, and indicated by a '+' following dimensions. In hydromedusae and scyphomedusae, bell diameter (BD) and stomach diameter (SD) were measured with the specimen lying exumbrella-down, and bell height (BH) was measured with the specimen lying on its side. In cubomedusae laying on their side, BH was measured from the apex to the velarial turnover; diagonal bell width (DBW) was measured between opposite pedalia at the upper point of insertion; interrhopalial width (IRW) was measured between adjacent rhopalia; tentacle base width (TBW) was measured across the widest points of the tentacle at the point of pedalial insertion. It must be borne in mind that DBW represents approximately twice the width.

Morphological examinations were made under a variety of dissecting microscopes, depending on what was available at the institution where the specimens were studied. Microscopic and macroscopic digital images were made of all observable structures with Fujifilm MX-700 and MX-2700 cameras, Nikon CoolPix 995, and Sony DVD-201e in JPG format. While it was not possible to publish all photographs made of each taxon, we have compiled a large image library of Australian specimens; images from this library are available upon request.

Abbreviations. Australian states: South Australia (SA), Western Australia (WA), Northern Territory (NT), Tasmania (TAS), Queensland (QLD), Victoria (VIC), New South Wales (NSW). Great Barrier Reef = GBR. Specimen numbers prefixed

Table 1. List of all species so far recorded from Moreton Bay, with an indication of earlier records and wider Australian distributions. Nomenclatural notes are given in parentheses, where appropriate. Abbreviations used: Queensland (QLD), New South Wales (NSW), Victoria (Vic), Tasmania (Tas), South Australia (SA), Western Australia (WA), Northern Territory (NT), Great Barrier Reef (GBR), Australia 'Unspecified' (AU), Southern Australia (SO), Northern Australia (NO); Taxa highlighted in **bold** are dealt with in more detail in the present work.

Family	Species	Moreton Bay References	Endemic/Australian Distribution
Class HYDROZOA Owen, 1843 Subclass ANTHOMEDUSAE Haeckel, 1879 Order FILIFERA Kühn, 1913			
Bougainvilliidae	*Bougainvillia muscus* (Allman, 1863).	Gorman (1988) [as *B. ramosa*].	VIC (Southcott 1971)
	***Bougainvillia* spp.** [Widespread and speciose in Australia; see text for discussion].	Greenwood (1980).	Endemic: NSW, WA; also found in QLD, VIC, SA, and TAS.
Oceanidae	***Turritopsis lata*** von Lendenfeld, 1884d	Present work.	Endemic: NSW, TAS, QLD, NT, WA and SA; New records for QLD, NT, WA and SA
Pandeidae	*Leuckartiara octona* (Fleming, 1823).	Pennycuik (1959).	GBR (Kramp 1953).
Proboscidactyl-idae	***Proboscidactyla tropica*** Browne, 1905a	Present work; new record.	New family record for WA.
Order CAPITATA Kühn, 1913 Suborder TUBULARIIDA Fleming, 1828			
Corymorphidae	***Euphysora juliephillipsi* sp. nov.**	Present work; new record.	Only known from QLD.
Euphysidae	***Euphysa scintillans* sp. nov.**	Present work; new record.	New family records for QLD, Tas, and SA.
Suborder ZANCLEIDA Russell, 1953			
Porpitidae	***Porpita porpita*** (Linnaeus, 1758).	Hamond (1971); Davie (1998).	NSW (Bennett 1860, as *P. chrysocoma*; Dakin & Colefax 1933; Whitelegge 1889; Pope 1953a). WA (Hamond 1974). Australia-wide (Bennett 1966, as *Porpita pacifica*). New state record for NT.
	Velella velella (Linnaeus, 1758)	Davie (1998); Present work.	NSW (Bennett 1860, as *V. limbosa* and *V. scaphidea*; Dakin & Colefax 1933, as *V. spirans*; Whitelegge 1889, as *V. cyanea* and *V. pacifica*; Pope 1953a). WA (Hamond 1974). Australia-wide (Bennett 1966, as *V. lata*; Coleman 1981; Edgar 1997, 2000, 2008). New state record for NT.
Subclass LEPTOMEDUSAE Haeckel, 1879 Order CONICA Broch, 1910			
Aequoreidae	*Aequorea australis* Uchida, 1947	Greenwood (1980); Gorman (1988).	Endemic: NT, QLD (Kramp 1953, 1961a, 1965b), WA (Goy 1990).

Family	Species	Moreton Bay References	Endemic/Australian Distribution
Aequoreidae (cont.)	*Aequorea macrodactyla* (Brandt, 1838)	Hamond (1971)	QLD (Mayer 1915; Kramp 1953, 1961a, 1965b). TAS (Hamond 1974). SO (Kramp 1965b; Southcott 1982).
	Aequorea pensilis (Eschscholtz, 1829)	Gorman (1988)	Endemic: WA (Hamond 1974). QLD (Kramp 1953, 1965b).
	***Aequorea kurangai* sp. nov.**	Present work	Endemic: NSW, QLD.
	Aldersladia magnificus Gershwin, 2006c	Gershwin, 2006c	Endemic: NT, QLD, WA. Reported by Kramp (1961a) as *Aequorea pensilis*
Cirrholoveniidae	***Cirrholovenia violacea* sp. nov.**	Present work	Endemic: new family record for QLD.
Dipleurosomatidae	*Dipleurosoma* sp.	Gorman (1988)	Not reported elsewhere in Australia.
Eirenidae	***Eirene ceylonensis*** Browne, 1905b	Kramp (1965); Hamond (1971); Gorman (1988).	Not reported elsewhere in Australia.
	Eirene hexanemalis Goette, 1886	Hamond (1971)	QLD (Kramp 1953, 1961a, 1965).
	Eirene menoni Kramp, 1953	First record for Moreton Bay	QLD (Kramp, 1953). NSW (Kramp, 1965b). SA (Kramp, 1965a; Southcott, 1982). New record for NT and WA.
	Eirene palkensis Browne, 1905b	Hamond (1971)	QLD (Kramp 1953).
	Eutima australis Mayer, 1915	New record; present work	Endemic: QLD. New records for sub-tropical Queensland and Tasmania.
	Eutima curva Browne, 1905b	Greenwood (1980)	QLD (Kramp 1953; Kramp 1961a).
	Helgicirrha malayensis (Stiasny, 1928)	Hamond (1971)	QLD (Kramp 1953).
Malagazziidae	*Octophialucium medium* Kramp, 1955	Gorman (1988)	Not reported elsewhere in Australia.
	Octophialucium sp.	Greenwood (1980)	Not reported elsewhere in Australia.
Orchistomatidae	***Orchistoma mauropoda* sp. nov.**	Present work	Endemic: new family record for Australia.
Phialellidae	***Phialella* sp.**	Present work	New family record for QLD.
Order PROBOSCOIDA Broch, 1910			
Campanulariidae	*Obelia australis* von Lendenfeld, 1884d	Pennycuik (1959); Gorman (1988)	NSW (von Lendenfeld 1887). VIC (Blackburn 1937). TAS (Hodgson, 1950). Considered unrecognizable by Kramp (1953).
	Obelia spp.	Greenwood (1980)	NSW (Whitelegge, 1889; Dakin & Colefax 1933).
	Clytia lomae (Torrey, 1909)	Hamond (1971) [as *Phialidium*]	Not reported elsewhere in Australia.
	Clytia rangiroae (A. Agassiz & Mayer, 1902)	Hamond (1971) [as *Phialidium*]	QLD (Kramp 1953).

Family	Species	Moreton Bay	Endemic/Australian Distribution
Campanulariidae (cont.)	*Clytia simplex* Browne, 1902	Hamond (1971) [as *Phialidium*]	QLD (Kramp 1953). WA (Hamond 1974). VIC (Watson & Chaloupka, 1982).
Malagazziidae	*Malagazzia carolinae* (Mayer, 1900a)	Hamond (1971) [as *Phialidium*].	QLD (Kramp 1953, 1961a, 1965b).
Subclass SIPHONOPHORA Eschscholtz, 1829 Order CYSTONECTAE Haeckel, 1888			
Physaliidae	***Physalia utriculus*** (Gmelin, 1791) [Widely misidentified as *Physalia physalis* (Linnaeus 1758), see text for discussion].	Gorman (1988); Davie (1998) [as *Physalia physalis*]; present work	Australia-wide [see text for extensive references].
	***Physalia* sp.** (multi-tentacled form). [Previously misidentified as *Physalia physalis* (Linnaeus, 1758), see text for discussion].	Exton (1988); present work	Central QLD [see text for references].
Order CALYCOPHORAE Leuckart, 1854			
Diphyidae	*Muggiaea* sp.	Gorman (1988)	Not reported elsewhere in Australia.
	Diphyes chamissonis Huxley, 1859	Greenwood (1980)	Endemic: QLD (Huxley 1859; Totton 1932).
Subclass TRACHYLINA Haeckel, 1879 Order TRACHYMEDUSAE Haeckel, 1866			
Geryoniidae	***Liriope tetraphylla*** (Chamisso & Eysenhardt, 1821)	Hamond (1971); Greenwood (1980); Gorman (1988); present work	Reported from QLD, WA, TAS [see text for references]. New records for SA and NT from present study.
Rhopalonematidae	*Aglaura hemistoma* Péron & Lesueur, 1810	Hamond (1971)	QLD (Mayer 1915; Kramp 1953). SE Aus (Blackburn 1955; Kramp 1965b; Watson & Chaloupka, 1982). WA (Hamond 1974; Goy 1990; Gaughan and Fletcher, 1997).
	Rhopalonema velatum Gegenbaur, 1856	Hamond (1971)	QLD (Mayer 1915; Kramp 1953). WA (Hamond 1974). SE Australia (Blackburn, 1955; Kramp, 1965b, 1968c; Hamond, 1974; Southcott, 1982; Watson & Chaloupka, 1982).
Order NARCOMEDUSAE Haeckel, 1879			
Solmarisidae	*Solmaris* sp.	Hamond (1971)	*Solmaris flavescens* (Kölliker, 1853): WA (Hamond, 1974). *Solmaris lenticula* Haeckel, 1879: QLD (Kramp, 1965b). WA (Hamond, 1974; Goy, 1990). *Solmaris rhodoloma* (Brandt, 1835): QLD (Kramp, 1953). NSW, TAS (Blackburn, 1955; Southcott, 1982). WA (Hamond, 1974). (Continued ...)

Family	Species	Moreton Bay	Endemic/Australian Distribution
			Solmaris spp.: SA (Gershwin & Zeidler, 2003).
Class SCYPHOZOA Goette, 1887 Order SEMAEOSTOMEAE L. Agassiz, 1862			
Pelagiidae	***Chrysaora* sp.**	Kramp, 1968b; present work.	QLD (Payne 1960; Dawson 2004).
	Pelagia noctiluca (Forsskål, 1775)	Greenwood (1980); Davie (1998); present work	Widespread around Australia; see text for discussion.
Cyaneidae	***Cyanea capillata*** (Linnaeus, 1758) Probably erroneous ID (see text for discussion)	Greenwood (1980); Gorman (1988)	Widely reported around Australia (see references in text).
	Cyanea nozakii Kishinouye, 1891 Probably erroneous ID (see text for discussion)	Davie (1998)	Australia-wide (White *et al.* 1998).
	Cyanea* cf. *rosea Quoy & Gaimard, 1824a, b, sensu Dawson, 2005c. New record for Moreton Bay	New record; present work	Endemic: NSW.
	***Cyanea barkeri* sp. nov.**	Present work	Endemic: QLD-wide.
Ulmaridae	*Aurelia aurita* (Linnaeus, 1758). Probably erroneous ID: recent studies elsewhere on this genus have revealed a far more diverse group than has been inferred throughout most of the 20th century (Gershwin 2001; Dawson & Jacobs 2001; Schroth *et al.* 2002)	Payne (1960); Davie (1998)	AU (Bennett 1966; Edmonds 1975; Coleman 1979; Marsh & Slack-Smith 1986; Williamson *et al.* 1996; White *et al.* 1998). QLD (Kramp 1965a). NSW (Cleland & Southcott 1965). VIC (Fancett 1986). SA (Kramp 1965a). WA (Kramp 1965a). SE (Gillett & Yaldwyn 1969). SO (Southcott 1982; Edgar 1997, 2000).
	Aurelia coerulea von Lendenfeld, 1884b	Gorman (1988)	Endemic: NSW (Stiasny 1924, 1931a; Whitelegge 1889; Dakin & Colefax 1933, 1940, as *A. caerulea*). AU (Kramp 1968b; Dakin & Bennett 1987).
	Aurelia labiata Chamisso & Eysenhardt, 1821. Probably erroneous ID: Native to coast of California (Gershwin 2001); all other records considered doubtful.	Payne (1960); Greenwood (1980)	QLD (Mayer 1915).
	Aurelia spp.		NSW (Pope 1947; Pacy 1957; Dawson 2004). WA (Backhouse 1843; Dawson 2004). QLD (Barnes notes, unpublished; Dawson 2004).

Family	Species	Moreton Bay Records	Endemic/Australian Distribution
Order RHIZOSTOMEAE Cuvier, 1817 Suborder KOLPOPHORAE Stiasny, 1921a			
Cassiopeidae	*Cassiopea andromeda* (Forsskål, 1775)	Stephenson (1962)	QLD (Stephenson *et al.* 1931; Stiasny 1931a).
	***Cassiopea maremetens* sp. nov.**	Present work	
Cepheidae	***Cephea octostyla*** (Forsskål, 1775)	Payne (1960)	
	***Cephea* spp.**	Present work (including Gold Coast)	
Thysanostomatidae	*Thysanostoma thysanura* Haeckel, 1880	Payne (1960)	Endemic: AU (Stiasny 1922a; examined Haeckel's original specimen).
Versurigidae	***Versuriga anadyomene*** (Maas, 1903)	Present work; new record	QLD.
Suborder DAKTYLIOPHORAE Stiasny, 1921a			
Catostylidae	***Catostylus mosaicus*** (Quoy & Gaimard, 1824a)	Agassiz & Mayer (1898); Mayer (1915); Payne (1960); Greenwood (1980); Gorman (1988); Davie (1998); Coleman (1999); Dawson (2004)	Endemic: NSW, southern QLD.
	Crambione cookii Mayer, 1910	Present work; new record	Endemic: QLD (Kramp 1970). First report since original description, range extension to non-tropical Australia.
Class CUBOZOA Werner, 1973 Order CARYBDEIDA Gegenbaur, 1856 (sensu Werner, 1984)			
Carybdeidae	*Carybdea rastonii* Haacke, 1886	Payne (1960); Greenwood (1980)	Endemic: SA; WA (Marsh & Slack-Smith 1986). Southern Australia, NSW to WA (Southcott 1958, 1982; Gillett 1968; Coleman 1977; Edgar 1997, 2000; Gershwin 2005a). Reports N. of Cape Leeuwin are erroneous (= *C. xaymacana* Conant, 1897).
Tamoyidae	*Morbakka fenneri* Gershwin, 2008 [mis-identified in previous works *Tamoya virulenta* Kishinouye, 1910, or *Tamoya gargantua* Lesson, 1829]	Fenner *et al.* (1985); Southcott (1985); Fenner (1987, 1997) [as 'Morbakka']. Payne (1960) [as *T. gargantua*]. Davie (1998) [as *T. virulenta*]	Endemic: QLD.

with SAM-H = spirit collection of South Australian Museum, Adelaide, SAM-PH = the photo index collection at SAM, and those prefixed with an 'X' indicate analytical-grade EtOH-preserved tissues for DNA analysis. Those prefixed with an 'A' are from the collection of the late Ronald V. Southcott (RVS), now housed at the SAM; those prefixed with a 'J' are from the collection of the late Jack Barnes (JHB), now housed at the Museum of Tropical Queensland, Townsville (MTQ); both collections correspond to valuable notes made by those authors. In cases where specimens are referable to more than one number, the institution number is given first, with the other numbers in parentheses. Other institutional abbreviations used: Australian Museum, Sydney (AM); Museum and Art Gallery of the Northern Territory, Darwin (NTM); Museum of Victoria, Melbourne (MV); Queensland Museum, Brisbane (QM); Tasmanian Museum and Art Gallery, Hobart (TMAG); and Western Australian Museum, Perth (WAM). Lots consist of single specimens, unless otherwise noted.

Latin and Greek names were derived using Brown (1956). German and French text was translated with the help of Globalink Power Translator v. 6.02 for Windows.

Taxonomic classification of the Hydrozoa is modified from Bouillon *et al.* (2004); Scyphozoa follows Calder (2009), and the Cubozoa follows Gershwin (2005a). Classification of the Siphonophora follows that of Daniel (1974). Genera and species within families are alphabetised.

SYSTEMATIC ACCOUNT

Phylum CNIDARIA Verrill, 1865,
sensu Hatschek 1888
Subphylum MEDUSOZOA Petersen, 1979
Class HYDROZOA Owen, 1843
Subclass ANTHOMEDUSAE
Haeckel, 1879
Order FILIFERA Kühn, 1913
BOUGAINVILLIIDAE Lütken, 1850

Bougainvillia Lesson, 1829

Bougainvillia Lesson, 1829: 102.

Remarks. Only a single identified species of *Bougainvillia*, *B. muscus* (Allman, 1863), has been previously reported from Moreton Bay by Gorman (1988) [as *B. ramosa*]. Otherwise Greenwood (1980) has mentioned *Bougainvillia* spp. as being present. In general, numerous species of *Bougainvillia* are common in Australian waters (Table 2); however, most have wider distributions. The taxonomy of this genus needs revision, and until such time as a thorough study is undertaken we maintain some reserve regarding the veracity of many of the records. Table 2 also summarises available information on characters so far being used to separate the Australian species.

The record of '*Bougainvillia ramosa*' from Port Philip Bay, Victoria by Southcott (1971: 5) was based on an incorrect identification and these specimens correctly belong to *Rathkea octopunctata* (M. Sars, 1835).

Bougainvillia sp.

(Fig. 1A)

Material examined. QM-G329002, 3 specs, c. 2–3 mm BD, Amity Jetty, Stradbroke I., 23.02.2005, L. Gershwin. Gershwin private collection, 1 specimen, Amity Jetty, Stradbroke I., 16.02.2005, L. Gershwin.

Description. (Moreton Bay material). Bell spherical, to about 3 mm diameter. Manubrium slender, tapering, with four oral tentacles twice bifurcated. Gonads arranged in a distinct cross at the base of the manubrium where it connects to the bell, extending along edges of manubriums a short distance, not along subumbrellar surface. Tentacle bulbs 4, globular, with up to five tentacles each; with ocelli. Tentacles very fine, with fine rings of nematocysts, with ends conspicuously thickened.

Remarks. We were unable to confidently identify these specimens to species, without comparison to overseas material. They do not seem to be identical to any of the species previously reported in Australian waters.

It is intriguing to us that we found *Bougainvillia* only on the outer, exposed side of Stradbroke I., rather than on the more protected, Moreton Bay side. Our experience in collecting *Bougainvillia* medusae at other locations around Australia (e.g., Port Lincoln (South Australia), Palm Cove (Queensland), numerous locations around Tasmania, and Broome, Port Hedland and Esperence (Western Australia)), has led us to infer that they are most abundant in protected waters.

OCEANIDAE Eschscholtz, 1829

Turritopsis McCrady, 1857

Turritopsis lata von Lendenfeld, 1884
(Fig. 1B)

Turritopsis lata von Lendenfeld, 1884d: 588, pl. 22, fig. 36; Kramp, 1953: 310 (discussion of type specimens).

Material examined. QLD: QM-G322308, 9 specs, Dunwich fishing jetty, North Stradbroke I., 10.02.2005. QM-G322309, 29 specs, Dunwich fishing jetty, North Stradbroke I., 21.02.2005. SAM-XH00434, numerous specs in EtOH, same data as QM-G322309. SAM-H1029, 2 specs (? female, 2.38 mm BH, 38 tentacle bulbs; ? female, 1.81 mm BH, 46 tentacle bulbs), Pumicestone Passage, Moreton Bay, A. Scivyer and P. Petersen, 13–20.12.1999. SAM-H1030, 2 specs (1 immature, 1.20 mm BH, 23 tentacles; 1 immature, 1.09 mm BH, c. 20 tentacles), same locality as SAM-H1029, 6.01.2000. SAM-H1594, 2 young specs, Pumicestone Passage, Moreton Bay, P. Petersen, Underwater World, 6.01.2000. SAM-H1611, 6 specs, Palm Cove, Cairns region, L. Gershwin, 20.12.1999. Numerous unregistered lots, c. 100 specs, Palm Cove, Cairns region, summers of 2003–2008. **NT**: NTM-C014620, numerous specs, Cullen Bay Marina, Darwin, L. Gershwin, 28.03.2004; (Fig. 1B). SAM-H1250 (= GZ0011), 1 spec., Mandorah, 12°26.577'S, 130°456.098'E, off jetty, 0–3 m, L. Gershwin & W. Zeidler, 12.11.2000. **SA**: SAM-XH00430 (=GZ 0075), 10 in EtOH, 1 on slide, numerous specs in formalin, max. 3 mm BH, Ceduna, 15.12.2000. **TAS**: GZ0112, 2 specs, St. Helens Waterfront, NE Tasmania, 41°19' 36.0'S, 148°14'56.3'E, W. Zeidler & L. Gershwin, 24.01.2002. **WA**: Broome, Western Australia, numerous specs collected by lifeguards during routine water monitoring 2004–2008; examined and returned to Surf Life Saving collection.

Diagnosis. Tentacles 30–50, in single row. Peduncle gelatinous, with vacuolated cells on proximal portions of radial canals. Oral nematocyst knobs stalked or sessile.

Revised description. Body minute, to about 3 mm tall, bell-shaped, with rounded sides and flat to domed top, mesoglea thin though fairly rigid. Peduncle gelatinous, c. one-quarter length of subumbrellar cavity. Tentacles in single crowded row, with short, tapered bulbs; with conspicuous terminal dilation; typically held 'up' in life. Abaxial side of tentacle bulb with a pigment spot of dark red cells, which could be mistaken for ocellus without high magnification. Velum broad, thin but stiff. Ocelli red, adaxial, singular on clear portion of base of tentacle rather than on translucent portion of tentacle bulb. Statocysts lacking. Stomach quadrate to nearly cruciform in cross section, with the main radii drawn outward somewhat; longitudinally flask-shaped, narrower at mouth than at base of peduncle. Gonads upon interradial sides of stomach walls. Radial canals with vacuolated cells in the proximal portions, extending along entire length of peduncle from canal arch to base of stomach. Manubrium about half as long as stomach. Mouth drawn out into four short rounded lips; with many nematocyst knobs in single row along entire outline of mouth, most appearing sessile. Colour: Mostly transparent, with red ocelli and tentacular pigment spots, and orange gonads.

Remarks. Kramp (1928) thought that *Turritopsis lata* might be identical with *T. pacifica*, stating 'the description and figures are, however, so bad that nothing can ever be stated with certainty as the identity of *T. lata*, which ought, therefore, to be altogether cancelled from the system as an apocryphal species.' However, 25 years later, Kramp (1953) re-examined von Lendenfeld's original specimens in the British Museum, and concluded that the species is valid, and that the original description is correct. Comparative genetics of species in the genus *Turritopsis* were recently studied by Miglietta *et al.* (2007); however, *T. lata* was not included in the analysis.

In some regions, we have found both *T. lata* and a larger *Turritopsis* sp. (previously reported as *T. nutricula*, and again most recently as *T. rubra* by Miglietta *et al.* (2007)). Therefore it is possible that some of our small specimens are young *Turritopsis* sp. rather than *T. lata*. However, their morphology matches *T. lata* perfectly, rather than what might be expected for a young *Turritopsis* sp. Nevertheless it is possible that the two species may occur sympatrically in some locations. However, we also found *T. lata* repeatedly at numerous locations where *Turritopsis* sp. has never been reported despite extensive

Table 2. Comparison of diagnostic characters of species of *Bougainvillia* medusae reported from Australian waters. The description of *Bougainvillia balei* Stechow (1924) was based on an immature specimen, and therefore useful morphological comparisons can not be made at this time.

Species	Bell height, shape	No. of tentacles per bulb	No. of oral tentacle branches	Gonads	Manubrium shape	Type locality	Australian Records
B. balei Stechow, 1924	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Shark Bay, WA (Stechow, 1924: 58-59)	Watson, 1996: 78 (Shark Bay to Exmouth, WA); only known from hydroid).
B. brittanica (Forbes, 1841)	12 mm, walls thick	30, with red ocelli in a fine transverse line; bulbs half as broad as intervals	With long basal trunk, divided 4–6 times with terminal knob	Cruciform, on sides of manubrium	No peduncle; cruciform	Cornwall, southern England	Goy, 1990: 110 (Shark Bay, WA).
B. fulva Agassiz & Mayer, 1899	14 mm, cylindrical with flatly rounded top; bell walls thick	15–20 tentacles; ocelli black; bulbs epaulette shaped	Divided 8 times	8, adradial	Wide, half as long as bell cavity, no peduncle	Fiji	Kramp, 1953: 264–265 (Great Barrier Reef, QLD); Kramp, 1965b: 14–18 (QLD, NSW, including Brisbane and Sydney); Kramp, 1968a: 153 (SE Australia); Hamond, 1974: 551 (WA); Southcott, 1982: 131–132, fig. 4.19b (SE Australia); Goy, 1990: 110 (Shark Bay, WA).
B. platygaster (Haeckel, 1879)	12 mm BH & BD, with flat apex and vertical sides	10–12, with triangular bulbs; with crescentic ocelli	Divided 5–6 times immediately from base; short	Interradial	Quadrangular, very flat, without a peduncle; with medusa buds	Cape Verde; Canary Is.; Trinidad	Hamond, 1974: 551 (WA).
B. prolifera (von Lendenfeld, 1884d)	3 mm BH, 2.5 mm BD, semispherical or ovate higher than broad	5, on broad bulbs, with ocelli	Not branched	Medusa buds produced on gonads at every stage of development	Stomach nearly cubic, small	Port Jackson, NSW (von Lendenfeld, 1884d): 589–590, pl. 23, figs 38, 39)	Goy, 1990: 110; (Shark Bay, WA).

Table 2 continued ...

Species	Bell height, shape	No. of tentacles per bulb	No. of oral tentacle branches	Gonads	Manubrium shape	Type locality	Australian Records
B. muscus Allman, 1863 [earlier records refer to this species (van Beneden, 1844), an invalid name replaced by *B.muscus* by Calder (1988)]	Up to 3 mm, thicker apically	Variable, 4–9 (usually 3–5) per group, with round black ocelli	1–2, or up to 4, branches; with medium to long basal trunk	Interradial, but reaching perradius; bulging	Bulbous, half subumbrellar height; sometimes with slight peduncle	Monaco	Gorman, 1988: 16, pl. 9 (Moreton Bay) [as *B. ramosa*].
B. trinema (von Lendenfeld, 1885a)	2–3 mm BD, semi-spherical, higher than broad	3, curving upward terminally	Each oral tentacle with 3 equal branches	Four pair of oblique folds, ascending toward primary radii	Short, cylindrical, half as long as umbrella	Port Jackson, NSW (von Lendenfeld, 1885a: 918, pl. 41 fig. 13)	von Lendenfeld, 1887: 33 (summary).

collecting, particularly in the Great Barrier Reef and Moreton Bay regions, as well as Broome, WA, and Darwin, NT.

This is the first time that new material has been examined and reported since the original specimens of von Lendenfeld. Our material provides new information regarding their smaller size at maturity, and smaller number of tentacles. Many individuals also lack an apical projection, being flat across the top or evenly rounded. Most of the oral nematocyst knobs appear sessile, but some are unmistakably stalked. The vacuolated cells are transparent and exclusive to the proximal portions of the radial canals, with the gelatinous peduncle being clearly visible between the main radii. Finally, von Lendenfeld illustrated his medusae without terminal tentacular swellings, but such swellings are quite conspicuous in many of the individuals we studied. These specimens also broaden the range of *Turritopsis lata* to include Queensland, South Australia, Western Australia, and the Northern Territory.

PROBOSCIDACTYLIDAE Hand & Hendrickson, 1950

Proboscidactyla Brandt, 1835

Proboscidactyla tropica Browne, 1905 (Fig. 1C, D)

Proboscidactyla sp. — Huxley, 1877: 132–133, fig. 17.
Proboscidactyla tropica Browne, 1905a: 727–728.

Material examined. QM-G329003, 1 spec. (1.63 mm BD), Harald Walker Jetty, Dunwich, North Stradbroke I., Qld, 11.02.2005. QM-G329004, same data as QM-G329003; 2 specs (1.43 & 1.16 mm BD). Unreg. Gershwin personal collection, 1 spec. (slide mount), same data as QM-G329003.

Diagnosis. (Based on Moreton Bay material). *Proboscidactyla* with a hemispherical to shallowly conical umbrella, with a slight apical projection; with a well developed gelatinous peduncle, bearing a short, cruciform stomach. Radial canals 4, trifurcated, with each branch leading to a tentacle bulb; a small, globular gonad just proximal to each trifurcation, each bearing about 3 medusa buds on well defined stolons. Tentacles 12, filiform, in correspondence with radial canals.

Description. (Moreton Bay material). Bell dome-shaped to shallowly conical, somewhat wider than high; with a well-developed, gelatinous peduncle extending about halfway through the bell cavity, quadrilobate in cross section, incised by radial canals. Exumbrella with sparsely scattered, tiny clusters of nematocysts.

Radial canals 4, trifurcated at the gonads, each branch leading to a tentacle bulb. Canals fine, barely visible. Stomach cruciform, extending out along radial canals to gonads. Gonads 4, small, globular, located midway on radial canals just proximal to branch-point. Numerous (1–4, typically 3) medusa buds arise from each gonad, in different stages of development.

Tentacles 12, all alike, filiform, held coiled in life, about 1x BD when relaxed. Tentacle bulbs small, globular, without excretory pores. Tentacles arise from the apical-most abaxial point of the bulbs, somewhat adherent to the exumbrellar wall. Velum narrow, delicate. Statocysts and ocelli lacking. Cnidothylacies appearing as a small cluster of nematocysts located on exumbrellar surface, above margin between adjacent tentacles, connected to margin by a fine line.

Manubrium short, tapered, with a cruciform mouth. Lips crenulated, with a thickened margin.

Colour in life: body transparent and colourless, gonads and stomach pale yellowish, mouth green, medusa buds and tentacle bulbs brown.

Remarks. The present form seems most closely similar in overall morphology to *Proboscidactyla tropica* Browne, 1905. This species was first figured by Huxley (1877) from material from the Louisiade Archipelago, off the southeastern tip of Papua New Guinea, but only later formally described by Browne (1905a) based on Huxley's description. However, the Moreton Bay material bears one major structural difference from *P. tropica* as described, namely, the branching pattern of the radial canals. In *P. tropica*, the canals bifurcate, then each branch bifurcates again; thus, each of the four branches leads to the margin and a tentacle, but the primary stem branch does not. In contrast, the radial canals of the present specimens branch only once into a trifurcation, with the primary stem branch continuing on to meet the margin and a tentacle. Another similar species, *Proboscidactyla ornata* McCrady, 1859, with which *P. tropica* has been considered synonymous, typically has 4–5 branches per primary canal, and the stem canal does not lead to a tentacle.

Three other *Proboscidactyla* species have been described with medusa buds: *P. gemmifera* (Fewkes, 1882), *P. stolonifera* (Maas, 1905), and *P. varians* Browne, 1905a, all of which were synonymised with *P. ornata* by Hartlaub (1917) Fewkes (1882b) described *P. gemmifera* as an equivocal juvenile of *P. ornata*; each radial canal has a trifurcation, and a single stolon arises from each corner of the stomach, bearing several medusa buds; this is unlike the present material, with trifurcated canals, and *P. tropica*, in which the medusa buds arise from very near the branchpoint. Maas (1905) described *P. stolonifera* as a variety of *P. ornata*; each canal is twice bifurcated, and the medusa buds arise from the second and third branch-points rather than from the first, as in the present collection and *P. tropica*. Browne (1905a) described *P. varians* from a single badly contracted specimen; there are six primary canals, each with 1–3 branches, and the medusa buds arise close to the stomach; this is unlike the characters of the Moreton Bay specimens and *P. tropica*.

It appears that the true *P. ornata* does not possess medusa buds, and mistakes have probably been made in synonymising other species with it that do possess medusa buds. Fewkes (1882b) suggested that the younger stages of *P. ornata* have medusa buds (e.g., the *P. gemmifera* stage), and they are later outgrown. Bigelow (1909: 218) noted gonadal, tentacular, and budding differences between Pacific and Atlantic forms, but still regarded *P. gemmifera*, *P. stolonifera*, and *P. tropica* as identical to *P. ornata* from both oceans. Mayer (1910: 192) commented that the common *P. ornata* does not have medusa buds, and the budding variety is not known north of Beaufort, North Carolina. Kramp (1961b) considered all those bearing medusa buds as junior synonyms of *P. ornata*. The life cycle of *Proboscidactyla ornata* from Naples was described by Brinckmann & Vannucci (1965); the life cycle of *P. ornata* from Virginia was described by Calder (1970); neither involved medusa buds at any stage.

We have studied approximately 25 specimens of *Proboscidactyla* from Dampier and Port

Hedland (Western Australia) that perfectly match the descriptions given for *P. ornata*; the Moreton Bay material is unlike the Western Australian material in overall morphology.

Huxley (1877) illustrated *P. tropica* with two sets of visible radial canals: one, with the primary stem canal bifurcating, then each of the branches bifurcating again; the other, with the primary stem canal giving rise to two lateral branches, but the stem canal continuing, then subsequently bifurcating. Curiously, *P. varians* Browne (1905a) has this same pattern. Hand (1954) used the branching patterns as key characters in separating eastern North Pacific species. The significance of two types of branching in the type specimens of *P. tropica* and *P. varians* is not well understood at this time, but is not exhibited by specimens in the present collection.

Hand (1954) commented that the description of *P. occidentalis* by Fewkes (1882b) with three equally branching parts from each primary canal was 'nearly an impossibility' (Hand 1954: 60). Hand went on to describe the primary canal of each quadrant as bifurcating 'rather symmetrically'. However, the pattern that Fewkes illustrated is exactly the pattern we see in the Moreton Bay specimens. It is possible that the specimens on which Hand based his redescription do not belong to the same species that Fewkes originally described. Further evidence suggesting this possibility is in comparison of the illustrated bell shapes: Fewkes drew a medusa with a bell-shaped body and absolutely no indication of a peduncle, whereas Hand drew a medusa with a rather rounded body and a pronounced peduncle.

It seems unlikely that the Japanese form of *P. ornata* described in detail by Uchida & Sugiura (1975) could be considered identical to the present form, if one were to wish to persist in keeping *P. ornata* and *P. tropica* united. Uchida & Sugiura (1975) described and figured medusae in which the primary radial canals bifurcated; this is unlike the Australian specimens, in which the primary canals trifurcate, such that the extension of the primary canal reaches the margin. Furthermore, it is interesting that Uchida & Sugiura described medusa buds arising from the stomach in smaller medusae, but medusa buds arising from the radial canals in larger medusae; whether this represents different local sub-species, or some unidentified ontogenetic feature is unknown. However, the size range of the smaller Japanese specimens with stomach-buds is similar to the Australian size range of specimens with canal-buds. Finally, Uchida & Sugiura (1975) make a point that in their largest specimens, the medusa buds arise directly from the radial canals and 'not from the blastostyle'; in the present collection, the medusae arise from a well defined stolon.

Whichever way one wishes to consider the medusa buds of the Japanese *Proboscidactyla ornata* or the radial canals of the Californian *P. occidentalis*, the Moreton Bay form is nonetheless unlike the Western Australian *P. ornata*, and is quite similar to published descriptions of *P. tropica*. Rather than propose a new species for the Moreton Bay form simply because of the branching pattern of the canals, we have decided to be conservative at this time and refer them to *P. tropica* Browne, 1905, and consider this species to be distinct from *P. ornata*.

Proboscidactyla ornata was previously reported by Kramp (1953) from the Great Barrier Reef; however, this is the first record of the family in Moreton Bay, as well as the first record of the family in Western Australia.

Order CAPITATA Kühn, 1913
Suborder TUBULARIIDA Fleming, 1828
CORYMORPHIDAE Allman, 1872

Euphysora Maas, 1905

Euphysora juliephillipsi sp. nov.
(Fig. 1E, F)

Material examined. HOLOTYPE. QM-G322313, male (2.97 mm total BH), Amity Jetty, North Stradbroke I., Qld, 23.02.2005. PARATYPES. QM-G322314, 1 male (3.09 mm total BH [1.87 mm not including apical projection], 1.49 mm BD), Dunwich fishing jetty, North Stradbroke I., Qld, 10.02.2005. QM-G322301, 1 specimen (1.61 mm BH, missing apical projection), Dunwich fishing jetty, North Stradbroke I., Qld, 12.02.2005.

Diagnosis. *Euphysora* with a very long, narrow apical projection, with an off-centre long, narrow apical canal emitting up into the

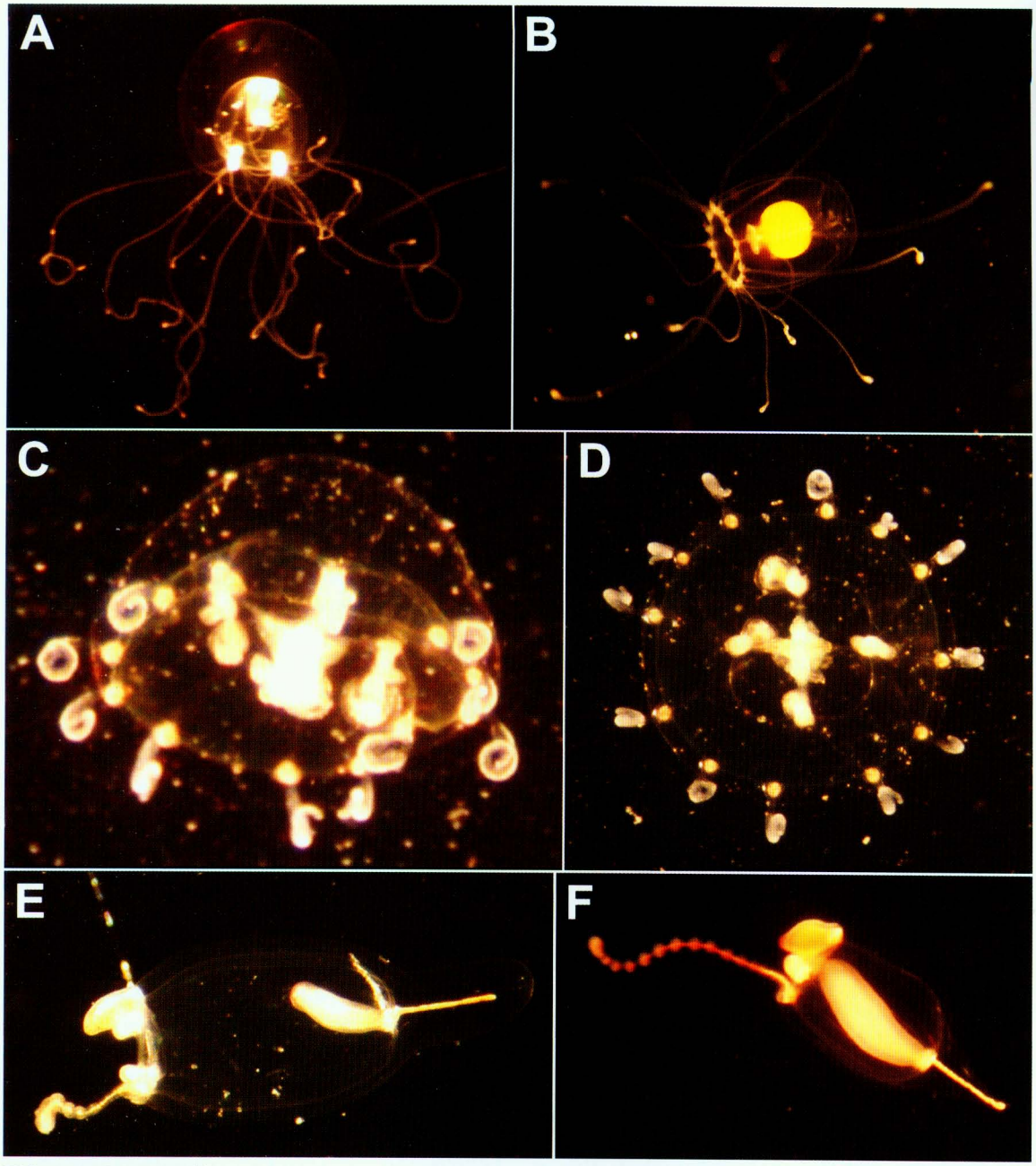


FIG. 1. **A**. *Bougainvillia* sp., live, from Moreton Bay (unregistered) (note 5 marginal tentacles per bulb, oral tentacles twice bifurcated). **B**. *Turritopsis lata* von Lendenfeld, live, from Cullen Bay, Darwin, NT, 28.03.2004. **C, D**, *Proboscidactyla tropica* Browne, from Moreton Bay (QM-G329003); both images taken while specimen was alive. C. Semi-lateral view. D. Aboral view. Note medusa-buds on radial canals. **E, F**, *Euphysora juliephillipsi* sp. nov., from Moreton Bay; both images taken while specimens were alive. E. Holotype, QM-G322313. F. Paratype QM-G322314.

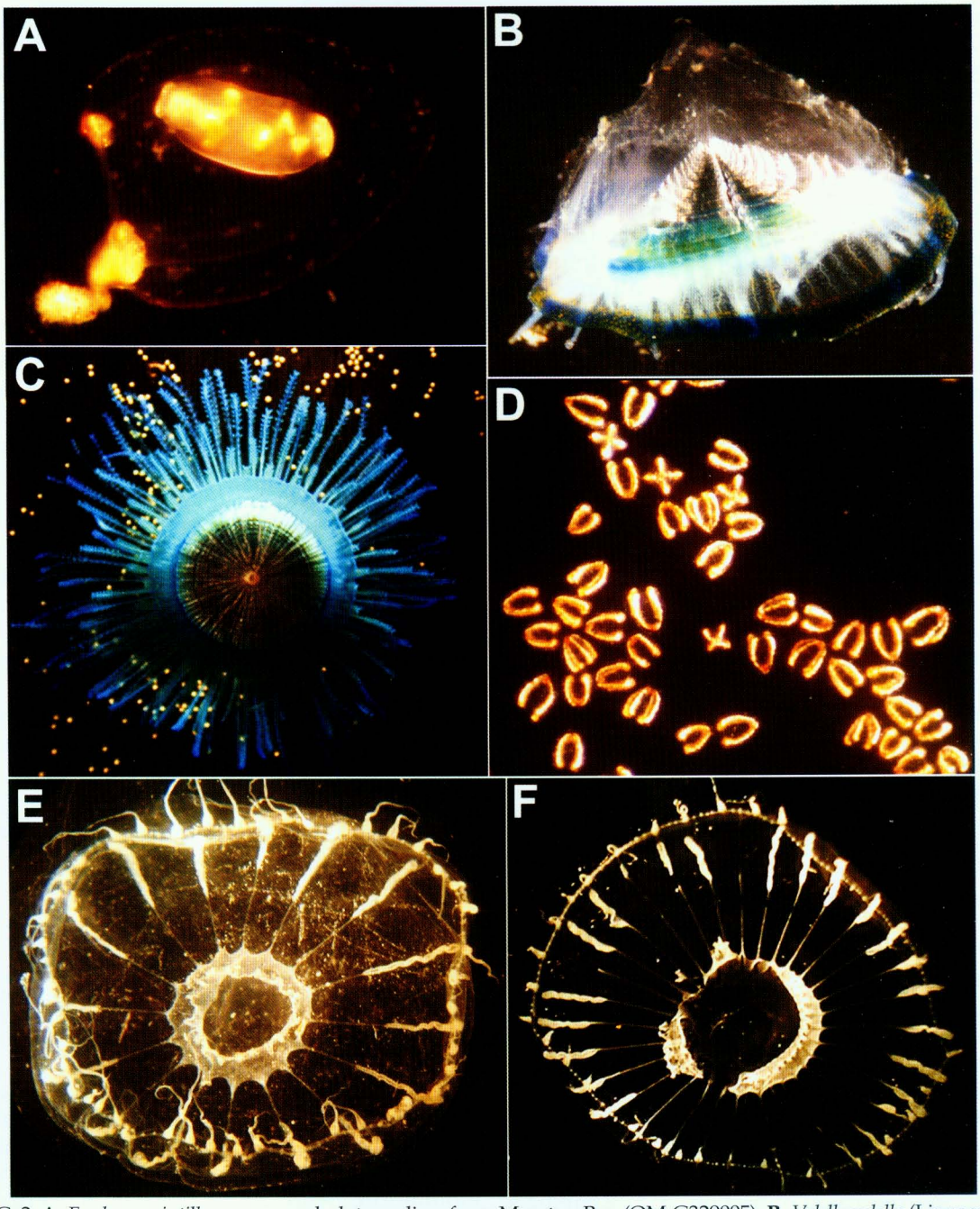


FIG. 2. **A**. *Euphysa scintillans* sp. nov., holotype, live, from Moreton Bay (QM-G329005). **B**. *Velella velella* (Linnaeus), live, from Moreton Bay (QM-G329010). **C, D**, *Porpita porpita* (Linnaeus), from Moreton Bay; both images taken while specimens were alive. C. Colony, from dorsal surface. D. Medusae. Note medusae being released by colony in Fig. C, resembling sand grains. **E, F**, *Aequorea* spp. E. *Aequorea kurangai* sp. nov., holotype, preserved. F. *Aequorea australis* Uchida, preserved, WAM-Z2921, Fremantle, Western Australia. Note 16 radial canals with numerous tentacles in *A. kurangai*, compared to numerous radial canals with only one tentacle per canal in *A. australis*.

projection; main tentacle moniliform, with up to 12 rings plus a teardrop-shaped terminal knob; opposite tentacle about twice as long as other two; exumbrella lacking nematocyst clusters or tracks.

Description of holotype. Body taller than wide, barrel-shaped in life, hourglass-shaped when preserved, with a long, narrow apical projection approximately 2/3 BH. Exumbrella without nematocyst clusters or radial sculpturing. Subumbrellar musculature not conspicuous. Tentacles 4, of two different forms; three cylindrical simple tentacles, with one opposite main tentacle about twice as long as other two; main tentacle longer, with 10 distinct swellings and a terminal teardrop-shaped knob. Three simple tentacles and swellings of main tentacle frosted with nematocysts. Tentacle bulbs lacking. Peduncle lacking. Manubrium cylindrical, reaching to about 0.5 BH, with a simple pore-like mouth. Apical canal long, narrow, extending about ¾ the height of the apical projection, off-centre, arising closest to largest unadorned tentacle. Radial canals 4, straight, simple, extremely narrow. Velum narrow. Marginal bulbs lacking. Ocelli lacking. Statocysts lacking. Colour in life: body transparent and colourless; radial canals nearly invisible; manubrium, apical canal, and tentacles with ochre yellow core; mouth and main tentacle tipped with magenta.

Variation. Specimen QM-G322301 is missing the apical projection due to damage, but the apical canal is still intact and held coiled above the apex of the bell; the main tentacle is contracted, and possesses about 12 rings. Specimen QM-G322314 has only about 5 swellings on the main tentacle, but appears otherwise mature.

Etymology. Named to honour Dr Julie Phillips, A co-organiser of the Thirteenth International Marine Biological Workshop, and a dedicated scientist who has contributed much to our knowledge of the biota of Moreton Bay.

Remarks. *Euphysora juliephillipsi* most closely resembles *E. annulata* and *E. bigelowi* in having a long, narrow apical projection, and by having a terminal knob on the main tentacle. *E. juliephillipsi* is also similar to *E. annulata* in having the tentacle opposite the main tentacle longer than the other two, but differs in having the manubrium mounted upon a short cone, and by the apical canal extending to the top of the apical projection. Compared to *E. bigelowi*, *E. juliephillipsi* lacks the aboral patch of papillae, and in *E. bigelowi* the tentacle opposite the main tentacle is reduced compared to the other two, versus longer in *E. juliephillipsi*. A comparison of primary diagnostic characters of medusae in the genus *Euphysora* is given in Table 3.

EUPHYSIDAE Haeckel, 1879

Euphysa Forbes, 1848

Euphysa Forbes, 1848: 71.

Remarks. In addition to the above, another form was found at Moreton Bay, as described below. At least five additional new species of *Euphysa* have also been identified in Tasmania, the eastern and western coasts of South Australia, and southern Western Australia, all of which are beyond the scope of this paper. It thus appears that there is a *Euphysa* cluster in temperate Australian waters, and it is possible that additional species will be found with further collecting.

The following *Euphysa* species have been previously reported from Australia:

Euphysa australis von Lendenfeld, 1884d: 586, pl. 21, fig. 33 [Port Jackson, NSW]; von Lendenfeld, 1887: 32 [summary].

Euphysa aurata Forbes, 1848 — Goy, 1990: 110 [oceanic and metahaline waters, Shark Bay, WA].

Euphysa scintillans sp. nov.

(Fig. 2A)

Material examined. HOLOTYPE. QM-G329005, 1 male (1.30 mm BD), Dunwich fishing jetty, North Stradbroke I., Qld, 12.02.2005. PARATYPE. QM-G329006, male, Dunwich fishing jetty, North Stradbroke I., Qld, 10.02.2005.

Diagnosis. *Euphysa* with a small, dome-shaped bell, 1.5–2 mm in height, taller than wide; with one main tentacle on an enormous globular bulb, and three rudimentary bulbs; main tentacle not moniliform, with 20–30 abaxial nematocyst clusters; manubrium reaching bell margin, without peduncle; gonad encircling whole length of stomach.

Description of holotype. Bell dome-shaped, slightly higher than wide, with smoothly

Table 3. Comparative characters of medusae in the genus *Euphysora*. Literature used: all original descriptions, plus Kramp (1961b). Abbreviations: bell height (BH), bell cavity (BC).

Species	Apical projection	Apical canal	Principal tentacle form	Manubrium	Exumbrella	Other three tentacles	Locality
E. abaxialis Kramp, 1962	Slightly conical, with patch of papillae	Low apical chamber in young specimens	Mounted on large bulb, with many abaxial nematocyst clusters	Globular, voluminous, almost filling bell cavity	Lacking nematocyst clusters	Bulbs only, with the one opposite main tentacle a bit larger than other two	Vietnam
E. annulata Kramp, 1928	Distinct apical projection, pointed at top	Narrow, extends to top of apex	17 distinct rings and a terminal knob	Globular, voluminous, mounted on short cone	No nematocysts visible	Short, stout, cone-shaped; tentacle opposite main is ½ BH, other two are ¼ BH	Sunda Strait
E. apiculocu-lifera Xu & Huang, 2003	Well defined conical-rounded	Spherical-oval apical chamber	Bulb swollen on inner side, nearly spherical	Stomach very large, almost entirely filling bell cavity	Smooth	Bulbs only; the one opposite the main tentacle larger than other two	China
E. bigelowi Maas, 1905	Conical, about 0.25–0.33 BH; sometimes w/apical patch of papillae	Narrow, extending about ½ height of projection	Moniliform, with c. 30 nematocyst rings	Cylindrical to barrel-shaped, about ¾ BC	Lacking nematocyst clusters	Short, pointed; the one opposite the main tentacle smaller than other two	Malay Archipelago
E. brunnescentis Huang, 1999	Very slight, bell almost spherical	Rounded apical chamber; canal lacking	Long, with 50–60 large abaxial nematocyst knobs and a bulb-like terminal knob	Cylindrical, large, about 2/3 as long as bell cavity, with irregular processes	Smooth, lacking nematocyst clusters	Bulbs only; with sickle-shaped 'pedalia' and 6–8 brown pigment spots	Datan Bay, Hong Kong, and Taiwan Strait, China
E. crassocanalis Xu & Huang, 2003	Evenly rounded, short	Slightly protruding apical chamber, with vacuolated cells as in radial canals	Bulb similar to others; tentacle with 5 adaxial knobs and a large terminal knob	Long, tapered, nearly as long as bell cavity	Smooth	All alike, with short conical bulbs, without tentacle	China
E. furcata Kramp, 1948	Shallowly conical	Shallowly conical	Terminally bifurcate, each branch with two capitate knobs	Globular barrel-shaped, voluminous, with narrow protruding mouth; 2/3 BC	Lacking nematocysts	Opposite tentacle slender, filiform; other two short, thicker, conical	Newfoundland

Table 3 continued ...

Species	Apical projection	Apical canal	Principal tentacle form	Manubrium	Exumbrella	Other three tentacles	Locality
E. gemmifera Bouillon, 1978	Absent	Absent	With a dozen or more abaxial clusters	Cylindrical, tapered, protruding from bell cavity	Lacking nematocyst clusters	Reduced to bulbs, with medusa buds on bell margin	Papua New Guinea
E. gigantea Kramp, 1957	Absent; body globular	Absent	Long, thin, several bifurcated lateral branches	Cylindrical to barrel-shaped; 05–0.66 BC	Nematocysts unknown	Completely absent	Antarctic
E. gracilis (Brooks, 1882)	Long, pointed, sharply conical	Long, undulating	Ringed, with spherical enlargement	Tapered on both ends; ¾ to >1 x BC	Not described	Opposite 3x longer than two rudimentary	North Carolina
E. interogona Xu & Huang, 2003	Absent; smoothly rounded	Very short dome-shaped apical chamber	Very long, with over 60 abaxial knobs	Quadrate, large bulbous gonads along sides	Smooth	All alike, very small, without tentacles	China
E. knides Huang, 1999	Thick, bluntly conical	Lacking canal or apical chamber	Very long, nearly spherical bulb, over 30 abaxial knobs; without enlarged terminal knob	Spindle-shaped, about 2/3 length of bell cavity	With scattered nematocyst clusters	All alike, rudimentary bulbs	Hong Kong and Taiwan, China
E. macrobulbus Xu & Huang, 2003	Lacking, or barely perceptible nipple	Lacking	With large, oval bulb and 3–6 very small spherical lateral abaxial knobs, and large oval terminal knob	Cylindrical, longer than bell cavity	Smooth	Opposite main tentacle with very small bulb only; other two with longer cone-shaped bulbs and filiform tentacles	China
E. normani (Browne, 1916)	Conical, pronounced	Endedermal cellular prolongation	Long, hollow sac-like basal bulb, ending in large armed globular ball and 3 other globular clusters	Massive, cylindrical, protruding from bell cavity	12 longitudinal streaks of nematocysts; lateral branches; anastomosed in lower part of bell	Reduced to bulbs	N. of Chagos, Indian Ocean

Table 3 continued ...

Species	Apical projection	Apical canal	Principal tentacle form	Manubrium	Exumbrella	Other three tentacles	Locality
E. pseudo-abaxialis Bouillon, 1978	Absent	Slightly bulged	With a dozen abaxial spherical capitations	Slim barrel- to teardrop-shaped, about ¾ BC	Lacking nematocyst clusters	All 3 greatly reduced to bulb-like swellings	Papua New Guinea
E. russelli Hamond, 1974	Spherical knob	Absent	Moniliform, with 9 globular rings plus a terminal knob	Barrel-shaped, voluminous, 2/3 as long as BC	Lacking nematocysts	Tentacle opposite main reduced to a protuberance, other two filiform, as long as BH	Indian Ocean between Australia and Indonesia
E. solidonema Huang, 1999	Lacking; bell smoothly rounded	Lacking canal or apical chamber	Short and stiff, with over 10 rings of nematocysts and a large terminal knob	Flask-shaped, longer than half the bell cavity	Smooth, lacking nematocyst clusters	Lateral two short and pointed; opposite main cone-shaped, smaller than other two	Taiwan Strait, China
E. taiwan-ensis Xu & Huang, 2003	Broad, short, bluntly conical	Lacking	Moniliform, with over 16 nearly elliptic nematocyst knobs	Conical, tapered, about 2/3 length of bell cavity	Lacking nematocyst clusters	All alike, rudimentary bulbs	China
E. valdiviae Vanhöffen, 1911	Bluntly conical	Low conical, well developed	Twice bifurcated, lacking nematocyst clusters	Globular, nearly spherical; massive	With anasto-mosing tracks	Tapered conical, relatively short, all alike	Siberut I., Indian Ocean
E. verrucosa Bouillon, 1978	Absent	Absent	Semi-monilifor m, with c. 30 bands plus a terminal knob	Truncate barrel-shaped, about ½ BC	With nematocyst clusters	All reduced to sessile knobs	Papua New Guinea
E. julie-phillipsi sp. nov.	Long, narrow conical, 2/3 BH	¾ apical height, narrow, off-centre	Up to 12 rings, plus tear-drop-shaped terminus	Cylindrical	Lacking nematocyst clusters	Tentacle opposite main about 2x as long as other two	Moreton Bay, QLD

Table 4. Comparison of primary diagnostic characters of medusae of the genus *Euphysa*. *Euphysa ruthae* Norenburg & Morse (1983) is not included due to lack of information of the mature medusa. Literature used: all original descriptions listed below, plus Mayer (1910), Kramp (1928, 1961b), and Russell (1953). Abbreviations used: radial canals (RC), bell height (BH), tentacle (T).

Species	Bell height & shape	Tentacle No.	Tentacle nematocyst arrangement	Manubrium length	Gonad development	Colour	Type locality
E. aurata Forbes, 1848	4–6 mm, bell-shaped, fairly thick, apically rounded	1 long and 3 short & cirrus-like (? or 3 small bulbs); with ocelli	Moniliform	Shorter than bell cavity	Encircling almost whole length of stomach	Ocellus bright golden yellow in the upper half, vivid scarlet in the lower; tentacles golden; stomach yellow, mouth red	Shetland Is.
E. australis von Lendenfeld, 1884d	2.5 mm, half-egg-shaped	1, with large basal bulb; 3 rudimentary with nematocyst knob; with ocelli	Moniliform	Cylindrical, half bell cavity	(Not described)	Mouth deep violet, gonad and manubrium with brown patches, ocellar bulbs and tentacle brown with violet spots	Port Jackson, NSW; regarded as unrecognisable by Kramp (1953).
E. brevia (Uchida, 1947)	0.7 mm, globoid, with thick jelly	4, alike, with abaxial pigment fleck	Not moniliform, 4 abaxial clusters	Bulged and voluminous	Completely surrounding stomach	Unknown	Iwayama Bay, Palau
E. flammea (Linko, 1905)	15 mm, thin walls; height slightly greater than width; apical mass thick	4, added successively	Scattered groups of nematocysts	2/3 bell cavity, very thick	4 interradial, long & pointed in upper part of manubrium (or whole length of stomach, as per Kramp, 1961)	Bell transparent, manubrium and tentacle bases orange-red, tentacles orange-yellow, RC whitish; ocelli lacking.	Barents Sea
E. japonica (Maas, 1909)	12–15 mm, cylindrical with thick walls	4, equally developed; bulbs large, triangular, with abaxial spurs	Moniliform	Broad, barrel–shaped or cylindrical, as long as bell cavity	Entire length	RC narrow, smooth to jagged; ocelli lacking	Japan
E. monotentaculata Zamponi, 1983	3 mm, rounded, slightly higher than wide	1, with large basal bulb; 2 rudimentary bulbs	?Filiform	Half bell cavity; broad	Completely surrounding stomach	(Not described)	Argentina; regarded as unrecognizable by Brinckmann-Voss & Arai

Table 4 continued ...

Species	Bell height & shape	Tentacle No.	Tentacle nematocyst arrangement	Manubrium length	Gonad development	Colour	Type locality
E. problematica Schuchert, 1996	1 mm, almost spherical	4, all alike, rather short, with broad perradial bulbs	About 10 nematocyst clusters plus larger terminal cluster	Cylindrical, bell cavity, with small apical chamber	Completely surrounding stomach, restricted to distal 1/3 of manubrium	(Not described)	New Zealand
E. tentaculata Linko, 1905	6 mm, rounded, slightly higher than wide; widest in upper 1/2	1 long, 2 half as long, and 1 small bulb opposite the long one	Moniliform	Slightly < than bell cavity, on a small peduncle	Almost whole length, sometimes free on oral & aboral ends	Manubrium light orange	Barents Sea
E. tetrabrachia Bigelow, 1904	4 mm, pear--shaped, with blunt apical projection, with thin side walls	1 long (4x BH) with warts of nematocysts; 3 short (1/3 BH) all alike; with ocelli	Moniliform, 6–8 rings in long T, and 3 rings in short T's; [Brinckmann-Voss & Arai say not moniliform]	Spindle-shaped, as long as bell cavity	8 distinct rows of half-spherical masses, on upper half of stomach; not extending to mouth	Gonads brownish-yellow, manubrium pinkish, ocellar bulbs and nematocyst rings rose-pink	Indian Ocean
E. vervoorti Brinckmann -Voss & Arai, 1998	6 mm, dome-shaped, delicate	4 of different sizes, with the longest always on the largest bulb	Moniliform, with thick nematocyst pads and endodermal swellings on the basal bulbs	Slightly shorter than bell cavity	Entire length of stomach, leaving only mouth free	Manubrium and endoderm of marginal bulbs deep red; bell colourless	Juan de Fuca Strait, Eastern north Pacific
E. scintillans sp. nov.	1.5–2 mm, dome-shaped, higher than wide	1 long main tentacle on enormous globular bulb, plus 3 rudimentary bulbs	Not moniliform, 20–30 abaxial clusters	Reaching bell margin, without peduncle	Encircling whole length of stomach	Bell transparent and colourless; manubrium whitish with ochre nuclei, mouth black, tentacles with white, orange, yellow, black and red	Moreton Bay, QLD

rounded apex, lacking any indentations or protrusions. Exumbrellar nematocysts scattered but a pattern cannot be discerned due to wear of bell surface. Radial canals 4, unbranched, fine. Main tentacle held coiled in life, with about 20–30 abaxial nematocyst clusters; with enormous globular basal bulb protruding into substance of bell. Other three tentacles reduced to mere rudimentary bulbs, with pigmented core. Stomach cylindrical, enormous sausage-shaped, almost entirely filling subumbrellar cavity, with a constricted, simple mouth protruding through velum. Peduncle lacking, stomach attached directly to subumbrellar surface of bell wall. Gonad compeletely encircling entire length of stomach, leaving only mouth free, with 12 solid, pigmented granulations scattered inside. Velum relatively broad, but quite flimsy. Excretory and sensory structures lacking. Colour in life: Bell transparent and colourless; manubrium translucent whitish with yellow ochre nucleii; mouth black; main tentacle with a ring of whitish granules at base, orangish abaxially, whitish-yellowish adaxially, with mustard yellow nematocyst clusters ringed with black below; other three tentacle bulbs with bright red centre mass. Ocelli lacking.

Etymology. The specific name, *scintillans*, is from the finely dusted appearance of the exumbrellar surface; here used as a noun in apposition.

Remarks. *Euphysa scintillans* is most similar to *E. brevia* (Uchida, 1947) and *E. problematica* Schuchert, 1996, in having abaxial clusters of nematocysts on the main tentacle, but differs from both in having more numerous abaxial clusters, and in the tentacle number, being only one in the Moreton Bay form, but four in the two others (Table 4).

Two species of *Euphysa* have been previously reported in Australian waters, but are morphologically dissimilar to *E. scintillans*: *E. australis* von Lendenfeld, 1885, described from Port Jackson, differs from *E. scintillans* in having a moniliform main tentacle and conspicuous ocelli on all four bulbs; and *E. aurata* Forbes, 1848, reported by Goy (1990) from Shark Bay, differs from *E. scintillans* in being about twice the size and having a moniliform main tentacle and three short cirrus-like tentacles with ocelli.

Suborder ZANCLEIDA Russell, 1953

PORPITIDAE Goldfuss, 1818

Porpita Lamarck, 1801

Porpita porpita (Linnaeus, 1758)
(Fig. 2C, D)

Medusa porpita Linnaeus, 1758: 659.

Porpita chrysocoma – Bennett, 1860: 49–54, text figs 4, 5 (NSW).

Porpita pacifica – Bennett, 1966: 38–41, pl. 22 (Sydney); Gillett & Yaldwyn, 1969: 36 (NSW, QLD).

Porpita porpita – Dakin & Colefax, 1933: 198 (NSW); Hamond, 1971: 27 (Brisbane); Hamond, 1974: 551 (110°E between Perth, WA, and Java); Dakin & Bennett, 1987: 167–168 (NSW); Davie, 1998: 12 (Moreton Bay).

Porpita sp. – Whitelegge, 1889: 196 (Coogee Bay, NSW); Dakin & Colefax, 1940: 210 (NSW); Pope, 1953a: 18 (NSW); Barnes, 1964a: 5, 8 (QLD); Southcott, 1982: 129–130, fig. 4.19a (southern Australia).

[Synonymy restricted to Australian records]

Material examined. QLD: QM-G322307, 1 spec. (c. 6 mm disk diameter); numerous additional specimens examined in the field and released, Main Beach, North Stradbroke I., B. Morton, 24.02.2005. SAM-H1032, numerous intact specs, Trinity Beach, Cairns, 29.01.2000, washing up at high tide. SAM-H1033, numerous fragmented specs with other pleuston, same data as H1032. SAM-XH435, numerous specs in EtOH, same data as SAM-H1032. JHB-J674, 1 spec. c. 2 cm BD, Mourilyan Harbour, A. Healey, 16.03.1961. SAM-H1593, medusae and tentacles from *Porpita* colonies, Palm Cove, L. Gershwin, 29.01.2000. **NT**: NTM-C10000, 9 specs (3–4 cm BD), Mindil Beach, Darwin, Oct. 1989. NTM-C10001, 7 specs (2–3 cm), same data as NTM-C10000. NTM-C10002, 3 specs (2–4 cm BD), same data as NTM-C10000. NTM-C12107, 10 specs (2–3 cm), Casuarina Beach, Darwin, R.C. Willan, 8.11.1993. **WA**: WAM-Z1364, 5 specs on display, Houtman Abrolhos, J. Fromont. SAM-H1591 (=GZ-0020), many specimens, formalin, EtOH, and liquid nitrogen, Cable Beach, Broome, 23.11.2000, 17 55.228'S, 122 12.558'E, W. Zeidler and L. Gershwin. SAM-H1592, 2 specs perfectly preserved with tentacles intact, same data as SAM-H1591. **NSW**: AM-G15928, 6 specs, Dee Why Beach, G. Carter, 22.01.1999, at surface over 0–1 m depth.

Remarks. *Porpita* is commonly blown ashore in Queensland waters. This is the first report of *Porpita* in the waters of Western Australia, where it is apparently quite common (Surf Life Saving WA, pers. com.), and the Northern Territory,

where it is said to be rare (P. Alderslade, NTM, pers. com.). Outside Australia, it is commonly blown ashore in tropical regions. A fossil relative of *Porpita*, namely *Eoporpita*, was originally described from the Ediacaran formation of the Flinders Range, South Australia (Wade 1972).

Porpita appears to have an imperceptable sting for humans – when tested by the senior author, no sensation could be felt even when applied to the inner lip and tongue.

Preservation of intact specimens is problematical, for in formalin (added dropwise or all at once) they typically drop their appendages quickly from the disk. Relaxation in $MgCl_2$ was incomplete, and did not stop disarticulation. However, with great patience we were able to duplicate the procedure of Jane Fromont (WAM) with beautiful results: relax whole specimens floating in Petri dishes by adding 1–2 drops $MgCl_2$ every 30 minutes for about 1½ to 2 hours; after letting them sit undisturbed an additional hour or so, add 1 drop of concentrated formalin every 30–45 minutes for about 4 hours. Then let them sit undisturbed overnight; in the morning add several more drops of formalin to make a 5–10% solution. Do not attempt to move them for at least a week. After that time, they are able to withstand a surprising amount of jostling.

Velella Lamarck, 1801

Velella velella (Linnaeus, 1758)
(Fig. 2B)

Medusa velella Linnaeus, 1758: 660.
Velella limbosa – Bennett, 1860: 54 (NSW).
Velella scaphidea – Bennett, 1860: 54 (NSW).
Velella cyanea – Whitelegge, 1889: 196 (Coogee Bay, NSW).
Velella ? pacifica – Whitelegge, 1889: 196 (Coogee Bay, NSW).
Velella spirans – Dakin & Colefax, 1933: 198 (NSW).
Velella velella – Bennett, 1966: pl. 7.2; Coleman, 1979: 64; Coleman, 1981: 20, 65–66 (all states except NT); Southcott, 1982: 128, pl. 13.6 (southern Australia); Dakin & Bennett, 1987: 167–168 (NSW); Edgar, 1997: 123 (circum-Australian); Edgar, 2000: 123 (circum-Australian).
Velella lata – Bennett, 1966: 38–41, pl. 21 (Sydney); Gillett & Yaldwyn, 1969: 36, fig. 20, pl. 17 (NSW and QLD).
Velella sp. – Dakin & Colefax, 1940: 210 (NSW); Pope, 1953a: 18 (NSW); Barnes, 1964a: 5–8, fig. 1, 2 (QLD); Southcott, 1958: 54–56 (SA, WA); Davie, 1998: 13 (Moreton Bay).

[Synonymy restricted to Australian records]

Material examined. QLD: QM-G329010, 1 specimen (11.37 mm diameter of long axis), plus numerous small specimens examined in the field and released, Main Beach, North Stradbroke I., L. Gershwin, 16.02.2005. **TAS**: TMAG-K29, Shoal Bay, Maria I., A. Powell, Jan. 1936. 976, Spring Beach, near Orford, J. Steane, 2.12.1985, beached. TMAG, numerous specs, Eaglehawk Neck, Tasman Peninsula, L. Gershwin and L. Turner, Nov. 1999. **WA**: WAM-Z1373, numerous display specimens.

Southcott material. The following collections were catalogued by Ron Southcott, and are held in the South Australian Museum: **QLD**: RVS A448, Bell's Beach, near Daintree River, Cairns, 7.07.1960; sky overcast but bright, tide rising, wind strong SE for three days, still blowing 20+ knots; accompanied by *Physalia* varying from ¼ to 1 ½ inches float length. **SA**: RVS A375, Ocean Beach, Beachport, 26.12.1958; 'washed up on beach. Profuse numbers.' RVS A449, same data as A448. RVS A860, numerous specs, Beach near 'Graham's Castle', Goolwa; 14.03.1965; 'discussed with Scorsby Shepherd 15-3-65 who says that *Velella* is seen in Jan–Feb along coast between Goolwa and Port Elliott each year.' RVS A1105, 3 specs, Middleton Beach, 4.01.1969 – stranded [Note added 7.09.1987: Decomposed and of no value, discarded]. RVS A1374, 10 specs, Aldinga Beach SA, 27.12.1972. RVS A2260, St. Vincent's Gulf, no date. RVS A2262, 3 specs, Encounter Bay, Jan. 1973.

Distribution. Collection records exist for *Velella* in all states except NT. Despite this, its presence in Australian waters has rarely been mentioned in the scientific literature. Outside Australia, *Velella* is found worldwide in tropical and temperate regions.

Remarks. The *Velella* that washed up on North Stradbroke I. beaches during the Workshop was peculiar from most other forms, in having a primarily silvery colour with blue only around the margin of the disk and on four 'tentacles'. The taxonomic significance of these differences, if any, is not currently known, and is beyond the scope of this paper.

Subclass LEPTOMEDUSAE Haeckel, 1879
Order CONICA Broch, 1910

AEQUOREIDAE Eschscholtz, 1829

Perhaps more than any other family within the Hydrozoa, the Aequoreidae is in serious need of revision. Within Australian waters, numerous distinct forms can be discerned by casual inspection alone. Péron & Lesueur (1810)

also noted a large number of *Aequorea* species, but many of their descriptions were insufficient for proper identification today.

Species recognition criteria have differed amongst authors, but have generally focused on or included the radial canal-to-tentacle ratio, or the tentacle bulbs. Browne (1905a) stated that all species differed in the shape of their tentacle bulbs, and that the shape was constant at all stages of development. Some authors have used the tentacle-to-canal ratio as a primary means of species recognition (Vanhöffen 1911; Bigelow 1909; Russell 1953; Pagès *et al.* 1992), while others found that these characters were insufficient (Bigelow 1919; Arai & Brinckmann-Voss 1980), and still others thought they were of no use whatsoever (Claus 1880, cited in Bigelow 1909). Mayer (1910) used overall morphology, as did Haeckel (1879) and Kramp (1961b). Curiously, however, Kramp (1961a) ignored other obvious characters, such as the conspicuous subumbrellar papillae that separate the Australian *Aldersladia magnificus* Gershwin (2006c), from all other aequoreids.

Aequorea Péron & Lesueur, 1810

Aequorea kurangai sp. nov.

(Fig. 2E, 3A)

Material examined. HOLOTYPE: AM-G16011, Hawksbury River, NSW, 4.01.1972; male, 26.97 mm BD, 7.53 mm SD, 16 canals, 52 tentacles. PARATYPES: **QLD**: QM-G329001, Harold Walker Jetty, Dunwich, N. Stradbroke I., Moreton Bay, L. Gershwin, 15.02.2005; 1 spec., 16.88 mm BD, 5.20 mm SD, 16 canals, 39 tentacles. SAM-H1537, Bribie I., 200 m offshore in Moreton Bay, P. Petersen, c. 21.12.1999; 19.54 mm BD, 6.18 mm SD, 16 canals, 51 tentacles. **NSW**: AM-G16010, data as for holotype; 2 specs: 1) male, 25.94 mm BD, 8.39 mm SD, 16 canals, 51 tentacles; 2) female, 23.52 mm BD, 7.83 mm SD, 16 canals, 43 tentacles. AM-G16023, data as for holotype, 9 specs, sex undetermined: 1) 17.70 mm BD, 4.39 mm SD, 16 canals,? tentacles; 2) 18.84 mm BD, 6.85 mm SD, 16 canals, 51 tentacles; 3) 18.22 mm BD, 6.22 mm SD, 16 canals, 49 tentacles; 4) 16.91 mm BD, 5.46 mm SD, 16 canals, 45 tentacles; 5) 17.95 mm BD, 5.15 mm SD, 16 canals, 43+ tentacles (damaged); 6) 17.81 mm BD, 6.23 mm SD, 16 canals, 40 tentacles; 7) 10.62 mm BD, 3.63 mm SD, 17 canals, 50 tentacles; 8) 13.23 mm BD, 5.56 mm SD, 16 canals, 40 tentacles; 9) 13.36 mm BD, 4.43 mm SD, 16 canals, 37 tentacles. SAM-H1542 same data as holotype; 4 specs. **SA**: SAM-H1231, Smoky Bay jetty, 32°22'44.3'S, 133°55'59.7'E, T. Laperousaz & L. Gershwin, 19.02.2002; 1 spec. SAM-H1538, Ceduna town jetty, 32°07'35.9'S, 133° 40'19.5'E, T. Laperousaz & L. Gershwin, 19.02.2002; numerous specs. SAM-H1539, Ceduna town jetty, T. Laperousaz & L. Gershwin, 19.02.2002; numerous specs. SAM-H1540, Ceduna town jetty, T. Laperousaz & L. Gershwin, 19.02.2002; numerous specs. SAM-H1541, Port Augusta, main wharf, 32° 29'19.9'S, 137° 45'41.9'E, T. Laperousaz & L. Gershwin, 27.02.2002; 1 specimen. SAM-H1588, Whyalla Marina, L. Gershwin, 14.05.1999; 25.04 mm BD, 5.90 mm SD, 16 canals, c. 36 tentacles. SAM-H970, Adelaide outer harbor jetty pilons, S.J. Edmonds & J. Window, 27.10.1977. **WA**: SAM-H1589 (= GZ0036), Port Hedland, town jetty, L. Gershwin & W. Zeidler, 27.11.2000; 7 specs, 1–3 cm BD. OTHER MATERIAL. **QLD**: SAM-XH00433, Harold Walker Jetty, Dunwich, N. Stradbroke I., Moreton Bay, L. Gershwin, 18.02.2005; 1 specimen in EtOH. *Bribie I., 200 m offshore in Moreton Bay, P. Petersen,* 25.11.1999; tissues retained in EtOH for DNA analysis. Harold Walker Jetty, Dunwich, N. Stradbroke I., Moreton Bay, L. Gershwin, 18.02.2005; numerous specimens examined then released or discarded. **SA**: SAM-XH0120, Whyalla Marina, L. Gershwin, 14.05.1999; 1 specimen in EtOH.

Diagnosis. Bell mostly flat, thin, with small stomach, lacking peduncle. Radial canals typically 16, with linear gonads on distal ½ to 2/3 of all canals. Tentacles 2–3 times as numerous as canals, with narrow, elongate bulbs. Rudimentary tentacle bulbs 1–3 times as numerous as tentacles. Excretory papillae prominent. Statocysts as numerous as tentacles plus bulbs, with one concretion.

Description. Bell to about 30 mm, flat to shallowly conical, with thin jelly, somewhat evenly thickened at center. Radial canals almost invariably 16, typically straight, slightly wavy in some specimens. Gonads linear, not noticeably compressed; on distal ½ to 2/3 of all radial canals, stopping short of margin. Tentacles outnumbering radial canals by more than 2:1; fine, coiled, with those nearest to radial canals not necessarily in radial correspondence; length approximately 1x BD in life. Tentacle bulbs narrow, elongate. Rudimentary tentacle bulbs small, 1–3 between adjacent tentacles. Excretory papillae prominent behind all tentacles and tentacle bulbs. Statocysts typically one between adjacent tentacles and bulbs, with two concretions; apparently easily lost. Stomach small, approximately 1/3 BD, mounted upon a very shallow gelatinous peduncle; with cobweb-like extensions leading to radial canals; circular

musculature lacking; radial musculature poorly developed. Mouth with crenulated margin, slightly projecting on radii of canals; lips short, blunt, corresponding radially and numerically to canals. Colour in life: Body transparent and colourless; radial canals, stomach, and tentacles translucent whitish; mouth emerald green.

Etymology. The specific name is from Kurangai, the name of the aboriginal tribe that inhabited the coastal region of New South Wales, including the Hawksbury River (Reed 1977). We first became aware of *Aequorea kurangai* from this location, where it is common.

Behaviour and appearance in life. *Aequorea kurangai* is quite active in life, most often pulsing upward at the surface of the water, and occasionally coming to rest on the bottom, subumbrella up. When at rest, the medusa constantly twitches the muscles at the base of the radial canals, causing the mouth to pull in the direction of the twitch. The muscles tug in succession, such that the mouth is pulled progressively around the stomach region.

This species is extremely transparent, except for the mouth, which is brilliant emerald green. The gonads upon the radial canals appear glassy, and the tentacles are somewhat whitish, though their fine texture makes them nearly impossible to see without the aid of a good side light. When disturbed at night, it exhibits dull blue flashes of bioluminescence; though the exact points of light origin could not be determined, it was noted at the time that light was not coming exclusively from the margin.

Type locality. Hawksbury River, Sydney area, New South Wales, Australia.

Distribution. This species was collected abundantly from Moreton Bay, Qld, and the Hawksbury River, NSW, as well as throughout South Australia. Whether its distribution extends around to Western Australia is not currently known. It does not appear to reach as far north as Cairns, as it is not present in extensive collections made from 1958–1985 (J.H. Barnes, collection and unpublished notes) and was not found in daily netting at Palm Cove, Cairns throughout the summer 1999–2000, or during summer Irukandji monitoring since.

Remarks. *Aequorea kurangai* bears a strong overall resemblance to *A. australis* and *A. conica* Browne, 1905, in the small number of radial canals, the elongate tentacle bulbs, and the small stomach. However, in *A. australis*, the tentacles match the number of radial canals and are on the same radii (Fig. 2F), whereas in *A. kurangai* the canals are outnumbered by tentacles more than 2:1, and they are not necessarily on the corresponding radii (Fig. 2E). It is also interesting to note that in *A. kurangai* the radial canals almost invariably number exactly 16, regardless of BD (type collection 10.62 mm to 26.97 mm preserved), whereas in *A. australis* the radial canal number increases with BD (type collection 11 mm to 31 mm preserved). *Aequorea australis* is apparently common in the warmer waters of northern Australia, whereas *A. kurangai* appears to replace *A. australis* in the cooler southern and transition waters.

Aequorea conica, while nearly always having exactly 16 radial canals, is immediately distinguishable from *A. kurangai* in the shape and size of the bell, which is small and very tall in *A. conica* but larger and considerably flatter in *A. kurangai*. In addition, the two are easily distinguished in the gonads of *A. conica* being upon the proximal portion of the canals and very much laterally compressed, whereas in *A. kurangai* they are distal and not compressed. Furthermore, the tentacles of *A. conica* are typically less than twice the number of the radial canals; thus, *A. kurangai* has the higher number of tentacles at all sizes. *A. conica* was reported in Queensland waters by Kramp (1953, 1965b), and was also found in abundance during the summer of 1999–2000 at Palm Cove north of Cairns.

CIRRHOLOVENIIDAE Bouillon, 1984

Cirrholovenia Kramp, 1959

Cirrholovenia Kramp, 1959 : 250.

Remarks. When Kramp (1959) proposed *Cirrholovenia*, he placed it in the Lovenellidae. Bouillon (1984b) moved the genus to its own family, the Cirrholovenidae, which is defined, in part, as lacking a peduncle (Bouillon & Boero 2000b). Indeed, the other species in the genus lack such a structure, but *C. violacea* sp. nov., described below, possesses one that is short and broad, but unmistakable.

Only two species have been previously recorded from Australia.

Cirrholovenia polynema Kramp, 1959, was reported off Qld and NSW by Kramp (1965b: 68). Southcott (1982: 135) appears to have reported it in error from southern Australia, based on Kramp (1965b), and it has not subsequently been reported from there.

Cirrholovenia tetranema Kramp 1959, by Goy (1990: 110) from oceanic and metahaline waters, Shark Bay, WA.

Cirrholovenia violacea sp. nov.

(Fig. 3C)

Material examined. HOLOTYPE. QM-G329000, Harold Walker Jetty, Dunwich, N. Stradbroke I., 16.02.2005; 1.34 mm BD.

Diagnosis. *Cirrholovenia* with 12 long, coiled tentacles, with fig-shaped, globular, tapered bulbs; with 2–5 statocysts between adjacent tentacles, each with two concretions; with cirri same number as, and in alternation with, statocysts, very short, coiled; with stomach on a short, broad peduncle; with gonads on radial canals midway between stomach and margin; with tentacle bulbs deep purple.

Description of holotype specimen. Bell subhemispherical, with a short, broad gelatinous peduncle. Exumbrellar nematocysts not observed. Radial canals 4, relatively broad, with gonads starting to develop about midway between stomach and margin. Ring canal difficult to discern. Tentacles 12, asymmetrically arranged; one each on main radii, with 1 to 3 others between main radii; extremely fine; coiled in life. Tentacle bulbs small, fig-shaped, with a globular base, tapered into tentacle. Ocelli and excretory pores lacking. Lateral cirri absent. Stomach broad, cruciform, with short, narrow manubrium; mouth simple, with a thickened ridge marking the lip, without defined cross-sectional shape. Statocysts numerous, 2–5 between adjacent tentacles, each with 2 concretions. Marginal cirri present, approximately 1 between adjacent statocysts; short, curled. Velum very broad, about ½ bell radius. Colour in life: Gelatinous substance of body transparent and colourless, subumbrellar epidermis translucent whitish; tentacle bulbs deep purple, with a faint green dot to either side; manubrium with a faintly purple hue near base; mouth, tentacles, and radial canals translucent whitish.

Type locality. Dunwich, North Stradbroke I., Moreton Bay, Qld, Australia.

Etymology. The specific name, *violacea* (Latin: like a violet, violet-coloured), is given in regard to the deep purple tentacle bulbs.

Remarks. *Cirrholovenia violacea* differs from its congeners in possessing a peduncle. It is most similar to *C. polynema*, in having multiple tentacles per quadrant, but even in the apparently immature stage, differs from *C. polynema* in having more statocysts with more concretions, fewer tentacles, fewer cirri, and a gelatinous peduncle between the stomach and bell surface (Table 5).

A second specimen was caught and examined during the workshop, but has since been lost. Both specimens are apparently juvenile, based on the rudimentary development of the gonads, but the morphology is so distinctive that the species uniqueness is at once obvious.

It is possible that the specimens reported by Kramp (1965b: 68) as *C. polynema* are, in fact, referable to *C. violacea*, given the similar localities. However, it seems unlikely that Kramp would have overlooked the conspicuous differences between these two species.

EIRENIDAE Haeckel, 1879

Eirene Eschscholtz, 1829

Eirene Eschscholtz, 1829: 94.

Remarks. At least seven different species of *Eirene* have been found in Australian waters (Table 6). Of these, three have been reported from Moreton Bay, and are detailed below. Medusae of the genus *Eirene* comprise a significant component of the coastal gelatinous zooplankton community, being the most abundant species present in water samples taken by Surf Life Savers when monitoring for Irukandji jellyfishes in the tropical north.

Eirene ceylonensis (Browne, 1905)

Irene ceylonensis Browne, 1905b: 140-141, pl. 3, figs. 9-11.

Eirene ceylonensis. – Kramp, 1953: 285–286 (numerous localities along the GBR); Kramp, 1965: 74–75 (mouth of Moreton Bay); Hamond, 1971: 27 (Moreton Bay); Gorman, 1988: 15, pl. 5 (Moreton Bay). [Synonymy restricted to Australian records]

Table 5. Comparison of characters of *Cirrholovenia* medusae, based on Kramp (1959, 1961), and Bouillon & Boero (2000). Abbreviations used: radial canals (RC).

Species	**Bell shape**	**No. tentacles**	**No. of statocysts**	**No. of cirri**	**Stomach and mouth**	**Gonads**
C. polynema Kramp, 1959	Sub-hemispherical, with slightly thickened apical jelly	24, with bulbs broadly conical or pear-shaped	Twice as numerous as tentacles, with 1 concretion	Up to 8 between tentacles, coiled, as long as tentacle bulbs	Small and narrow; mouth slightly crenulated	Linear along middle half of RC
C. tetranema Kramp, 1959	Umbrella cuboid, with evenly thin jelly	4, with broad basal bulbs	4 interradial or 8 adradial, large	7–8 per quadrant, coiled, as long as tentacle bulbs	Small with cruciform base; mouth tube short, with simple lips	Thick and cylindrical, occupying length of RC
C. violacea sp. nov.	Flatter than a hemisphere, with moderately thick jelly	12, long, coiled, with fig-shaped globular tapered bulbs	2–5 between adjacent tentacles, with 2 concretions	1 between adjacent statocysts, coiled, much shorter than tentacle bulbs	Stomach on broad peduncle; mouth short, simple	Midway between stomach and margin

Material examined. QM-G322306, Dunwich jetty, North Stradbroke Is., Qld, 21.02.2005; 1 spec., 15 mm BD. SAM-H1606, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Feb. 2000; 2 specs, c. 20 mm BD. SAM-H1607, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Feb. 2000; 2 specs, c. 20 mm BD. SAM-H1609, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Feb. 2000; 1 spec, c. 10 mm BD. SAM-H1610, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Feb. 2000; 2 specs, c. 20 mm BD.

Remarks. The specimens in the present collection most closely match the description of *E. ceylonensis*; the Stradbroke specimen appears to be a juvenile, with many of the tentacles not yet developed. This species was also recorded from Moreton Bay by Hamond (1971) and Gorman (1988). Furthermore, it was found in numerous places and times along the Great Barrier Reef by Kramp (1953). Thus, it appears to be fairly common in Queensland waters.

Eirene hexanemalis (Goette, 1886)

Irenopsis hexanemalis Goette, 1886: 832-833.
Eirene hexanemalis — Kramp, 1953: 281–283, fig. 5 (255 specs from the GBR); Kramp, 1961a: 201 (Green I., GBR); Kramp, 1965: 77–80, fig. 5 (NE Australia and Moreton Bay); Hamond, 1971: 27 (Moreton Bay).
[Synonymy restricted to Australian records]

Material examined. SAM-H1604, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Feb. 2000; 1 spec., c. 10 mm BD.

Remarks. Previously recorded from Moreton Bay by Kramp (1965) and Hamond (1971), and has been found in numerous places along the Great Barrier Reef by Kramp (1953, 1961a, 1965). We have found it frequently at Palm Cove, north of Cairns, during December and January when the northerlies bring in the Irukandjis, as well as in Western Australia and Northern Territory waters. Thus, the species appears to be relatively common along the tropical Australian coastline.

Eirene menoni Kramp, 1953

Eirene menoni Kramp, 1953: 286, pl. 2, fig. 6 (Low Isles, GBR); Kramp, 1965a: 272 (South Australia); Kramp, 1965b: 76 (near Sydney).
[Synonymy restricted to Australian records]

Material examined. QM-G329009, Dunwich jetty, North Stradbroke Is., Qld, L. Gershwin, 18.02.2005; 1 spec. SAM-H1605, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Feb. 2000; 1 spec, c. 15 mm BD.

Table 6. Comparison of diagnostic characters of *Eirene* medusae found in Australian waters. *Eirene troglodyta* Watson (1998) from Victoria is not included, due to lack of information on the medusa stage. Literature used: all original descriptions, plus Kramp (1953, 1961b), and Mayer (1910). Abbreviations used: bell diameter (BD), bell height (BH), radial canals (RC).

Species	Body size	Peduncle	Gonads	Tentacles	Rudimentary bulbs	Excretory papillae	Statocysts	Reported
E. ceylonensis (Browne, 1905b)	25 mm BD, watchglass-shaped	Long, cylindrical	Linear, from base of peduncle to near margin	About 100	Lacking	Probably no excretory papillae	1 between tentacles, with 1 concretion	QLD (Kramp, 1953; Hamond, 1971; Gorman, 1988).
E. hexanemalis (Goette, 1886)	15–20 mm BD	Low and broad	Linear, short, on distal portion of RC	Highly variable, up to about 50	Usually 3 between tentacles, the median one somewhat larger than the others	Distinct	Usually 4	QLD (Kramp, 1953; Kramp, 1961a; Kramp, 1965; Hamond, 1971).
E. kambara Agassiz & Mayer, 1899	8 mm BD, flat	Short, broad	Occupying the lower portions of the RC	32 small, with well developed basal bulbs	(Not described)	(Not described)	2 between tentacles, with 1 concretion	QLD (Kramp, 1953).
E. menoni Kramp, 1953	12 mm BD, 5 mm BH, evenly rounded	Slender, slightly widened at base; less than height of bell cavity	Linear, somewhat sinuous, from base of peduncle almost to ring canal	46, with conical bulbs, plus two young bulbs	(Not described)	Absent	1–3 between tentacles	QLD type locality. NSW (Kramp, 1965b). SA (Kramp, 1965a; Southcott, 1982).
E. palkensis (Browne, 1905b)	20 mm BD, watchglass-shaped	Long, cylindrical	Linear, from base of peduncle to near margin	About 50, with cone-shaped to globular bulbs	2–3 between tentacles	With excretory pores	2–4 between tentacles, with about 2 concretions	QLD (Kramp, 1953; Hamond, 1971).
E. sp.	4–5 mm high and wide, with globular apical jelly	Short, conical, very broad at base; not protruding from bell cavity	Linear, on central portion of RC	16, filiform, short, fine, with spherical bulbs, in two size classes	Lacking	Conspicuous papillae	3–4 per quadrant	TAS and SA.

Remarks. *Eirene menoni* has been reported from quite far north and south of Moreton Bay (Kramp, 1953, 1965a, 1965b), but surprisingly, none of the Moreton Bay workers reported its presence. This report, therefore, represents the first record of the species in southern Queensland. In the Cairns region, it is one of the dominant members of coastal gelatinous zooplankton blooms. We have also found this species in great abundance in Darwin Harbour (Northern Territory) and Broome (Western Australia), representing first records for those states as well.

Appears widespread throughout the Indo-Pacific, having been reported from India (Menon, 1932; Kramp, 1958), Papua New Guinea (Bouillon, 1984), New Zealand (Bouillon, 1995), and Korea (Park, 1996).

Eutima McCrady, 1859

Eutima australis Mayer, 1915
(Fig. 3B)

Eutima australis Mayer, 1915: 201–202, pl. 3 (type locality Murray I., Torres Strait).

Eutima curva – Kramp, 1953: 289, 311 (Great Barrier Reef; as *E. australis* probably identical to *E. curva*). [Synonymy restricted to Australian records]

Material examined. QM-G322304, Harold Walker fishing jetty, Dunwich, North Stradbroke I., Qld, L. Gershwin, 12.02.2005; 1 specimen. QM-G322305, same loc. as G322304, 21.02.2005; 1 immature specimen. Unregistered, same loc. as G322304, 10.02.2005. Palm Cove, Qld, L. Gershwin, 1999–2008; hundreds of specimens 3–10 mm BD, examined in the field and released or retained in unsorted collections. SAM-XH0432, same data as QM-G322305; 2 specs in EtOH.

Remarks. Kramp (1953) thought that this species is identical with *Eutima curva* Browne, 1905 from Ceylon. However, all specimens we have seen from Qld have gonads extending well up onto the subumbrellar portion of the radial canals, and running the full length of the peduncle. Mayer (1915) described such a condition for *E. australis*, but speculated that the gonads reach maturity only on the peduncle. This was apparently incorrect, as the subumbrellar gonads and peduncular gonads are both mature in some of the examined specimens. In mature *E. curva*, the gonads are restricted to the peduncle. Furthermore, the peduncle in *E. curva* is about as long as the bell diameter, whereas in *E. australis* it is about 1.25 to 1.5x as long.

The Moreton Bay specimens are the first reported from sub-tropical Qld. We have also collected this species from Tasmania, representing the first temperate record for this species.

ORCHISTOMATIDAE Keller, 1884

Orchistoma Haeckel, 1879

Orchistoma mauropoda sp. nov.
(Fig. 3D–F)

Material examined. HOLOTYPE. QM-G329574, Horseshoe Bay, Magnetic I., Qld, Surf Life Saving lifeguard during Irukandji closure, 1.11.2005; female, 7.06 mm BD, 18 radial canals. PARATYPES. QM-G329007, Harold Walker fishing jetty, Dunwich, North Stradbroke I., Qld, L. Gershwin, 21.02.2005; 1 mature male, 4.34 mm BD, 16 radial canals. QM-G329008, Harold Walker fishing jetty, Dunwich, North Stradbroke I., Qld, L. Gershwin, 21.02.2005; 1 immature specimen, 1.81 mm BD, 8 radial canals.

Diagnosis. *Orchistoma* maturing at a very small body size; with 16–18 radial canals, each corresponding to a tentacle; tentacle bulbs flask-shaped, with blackish endodermal core; with about 12 tentaculites between adjacent tentacles, each bearing one or more black ocelli at the base; gonads bilamellar on proximal portion of radial canals; lips not well defined.

Description of holotype. Bell slightly less than hemispherical, with soft, thick jelly; apparently lacking exumbrellar nematocysts; with massive, broad peduncle, about as long as bell is tall. Stomach branched irregularly into four major lobes, each branching dendritically into 4–6 lobes, leading to radial canals, 18 in all. Radial canals extending to ring canal, simple, narrow, straight. Gonads on proximal portion of radial canals from stomach to distal edge of peduncle; bilamellar, with gonadal products on both sides of radial canals. Lips sinuous sheet-like, along proximal half of gonads, without crenulated margin; not drawn out into lobes. Margin with one flask-shaped tentacle bulb at terminus of each radial canal, plus a couple more that do not correspond to radial canals; flexible portion of tentacles lacking, probably as an artifact of collection. Typically about a dozen, rarely as few as five, filiform, cordyli-like structures between adjacent tentacles, lacking bulbs, adherent to exumbrellar wall, with free end just above bell margin. Adaxial side of velum with

Table 7. Comparison of primary diagnostic characters for medusa species in the genus *Orchistoma*. Literature used: All original descriptions, plus Mayer (1910), and Kramp (1955b). Abbreviations used: Radial canals (RC).

Species	Diameter	RC	Lips	Tentacles	Tentaculites	Ocelli	Gonads	Locality
O. agariciforme Keller, 1884	20 mm	19 or more	7	1x canals	6 per section	19 per section	Diverticula from stomach that extend outward along canals	Naples, Italy
O. collapsa (Mayer, 1900b)	7 mm	16	8, slightly crenulated	16	112, very small	1 at base of each tentacle	Linear, on proximal portion of each canal	Tortugas, Florida
O. manam Bouillon, 1984	5 mm	8	8	4	16–20	20 per octant	Pouch-like	Papua New Guinea
O. nubiae Bouillon, 1984	25–30 mm	33–38	32	Twice as many as RC	2–3 between tentacles	600–800	Linear, on peduncle portion of RC	Papua New Guinea
O. pileus (Lesson, 1843)	?	32	Many, tufted	32	?	?	Sausage-shaped, on peduncle against lips	West Africa
O. steenstrupii Haeckel, 1879	30–40 mm	32	32	64 short	100	600–800	Sausage-shaped, on peduncle against lips	Antilles
O. mauropoda sp. nov.	a few mm	16–18	Not well defined	16–20	5–12 between tentacles	1 or more at base of each tentaculite	Bilamellar, on proximal part of radial canals	Queensland

16–20 small pin-prick-sized ocelli between adjacent tentacles, not always in correspondence with tentaculiform structures. Colour in life: Bell transparent and colourless; lips, gonads, and tentaculiform structures slightly translucent whitish; tentacle bulbs with black cores; ocelli black.

Variation. In the paratype, the lips are less damaged, and it is apparent that they are drawn out into lobes resembling scyphozoan pelagiid oral arms, i.e., folded in half, and ruffly and somewhat pleated.

Etymology. The specific name, *mauropoda*, dark-footed, is from the Greek *mauros* (= dark) and *podos* (= foot), is in reference to the black tentacle bulbs that are one of the most noticeable features of this species in life. Feminine.

Type locality. Horseshoe Bay, Magnetic I., off Townsville, North Qld, Australia.

Remarks. *Orchistoma mauropoda* is most similar to Mayer's (1900b) adult *O. collapsa* from Florida, both in their incredibly small size at maturity and in overall structural similarity; however, *O. mauropoda* is only half the size of *O. collapsa* at the same stage of maturity. Mayer also described and figured a half-grown stage, i.e., at the same size as *O. mauropoda*; however, the two bear numerous dissimilarities, and it is clear from Mayer's drawings that our *O. mauropoda* specimens represent the adult form.

Mayer's *O. collapsa* is relatively taller than our *O. mauropoda*; in *O. collapsa* the side walls are straight, whereas in *O. mauropoda* the whole aboral surface is evenly rounded and subhemispherical, without straight sides. Mayer described and figured the radial canals clustering into four quite symmetrical palmate groups of four as the animal grows; in *O. mauropoda*, the canals cluster quite irregularly and dendritically, through a series of dichotomous branchings, into more or less four groupings of four; the highly irregular branching pattern in *O. mauropoda* would be unlikely to be mistaken for the simpler pattern in *O. collapsa*. Curiously, Mayer described the gonads as being distal, although he figured them as swollen pockets on the proximal half of the peduncle; whichever

mauropoda, extending to the edge of the peduncle, and they are bilamellar, i.e., the gametes are along both sides of the midline.

Mayer figured a half-grown medusa (presumably this would correspond in bell diameter to our larger specimens of *O. mauropoda*); our Queensland species is so different from Mayer's half-grown specimen at the same size, that one would be unlikely to match them up based on peduncle, gonads, body mass, tentaculite-to-tentacle ratio, or colour. The only features in which *O. mauropoda* resembles the half-grown *O. collapsa*, are the types (but not numbers) of marginal structures, and the number and arrangement of radial canals (which differ from the adult *O. collapsa*). Furthermore, our smallest specimen, which is about half the size of the others, and thus half the size of Mayer's juvenile, resembles the adult specimens in all respects, but with only eight radial canals and less well developed features in general, rather than the juvenile morphology with 16 radial canals as illustrated by Mayer.

The species recognition criteria have been confused. The oldest species, *O. pileus* (Lesson 1843), was originally described as a *Mesonema*, a genus typically associated with the Aequoreidae. Haeckel (1879) proposed the genus *Orchistoma*, thus re-classifying Lesson's *M. pileus* and adding *O. steenstrupii* as new. While the two species bear a striking similarity (Table 7), Haeckel distinguished them on tentacle number, i.e., 32 in *O. pileus* (opposite the 32 radial canals) and 64 in *O. steenstrupii* (opposite and between the 32 radial canals). Thus, they have a fundamental structural difference, in that the former has a 1:1 correspondence between radial canals and tentacles, whereas the latter has a 1:2 correspondence. However, this difference was ignored by Mayer (1910: 211–212, pl. 25, figs 1–4), who redescribed *O. pileus* based on Caribbean material, and synonymised *O. steenstrupii* in the process; and by Kramp (1955b: 157), who examined Haeckel's original specimens at the Copenhagen Museum and concluded that they were identical to Mayer's specimens of *O. pileus* (from nowhere near the type locality, it should be noted); and by Kramp (1961b: 144–145), who followed Mayer in treating *O. steenstrupii* as a junior synonym of *O. pileus*; and by Bouillon & Boero (2000b: 197), who did not include *O. steenstrupii*. In fact, the Caribbean form described by Mayer (1910) as *O. pileus* matches Haeckel's *O. steenstrupii* quite well, but not so well for Lesson's *O. pileus*; thus, it appears that Mayer made a mistake, and others followed.

The subsequently added species *O. agariciforme* Keller, 1884, *O. collapsa* (Mayer 1900), and *O. manam* Bouillon, 1984, are distinctive, bearing different radial canal and tentacle numbers (Table 7). *Orchistoma tentaculata* Mayer (1900) was moved to a new melicertid genus, *Orchistomella*, by Kramp (1959). However, the other species, *O. nubiae* Bouillon, 1984, bears a remarkable similarity to *O. steenstrupii*. Nonetheless, the two are found in different oceans, so it is quite possible that further structural differences may be found, and quite possibly, that genetics will support specific differentiation; it seems equally possible that one represents an exotic introduction of the other. Scientific understanding would be well served by fresh collection of multiple specimens of both species for comparison.

This is the first record for the family Orchistomatidae in Australian waters.

PHIALELLIDAE Russell, 1953

Phialella Browne, 1902

Remarks. Two species of *Phialella* have been reported from Australian waters, namely *P. hyalina* (von Lendenfeld, 1885a), described from Port Jackson, NSW, and *Phialella quadrata* (Forbes, 1848), reported from southern Australia by Southcott (1982). We have also found a form of *Phialella* from southern Tasmania that appears to be new to science; this shall be described elsewhere shortly.

The following *Phialella* species have been previously reported from Australia:

Phialella hyalina (von Lendenfeld 1885a): 920, pl. 42, figs 16–18, Port Jackson, NSW [originally described as a *Eucope*, Kramp (1953: 311) placed it in *Phialella* and provided a revised description based on examination of specimens in the British Museum.]

Phialella quadrata (Forbes, 1848) — Southcott, 1982: 135; southern Australia.

Phialella spp.

(Fig. 5A)

Material examined. QM-G322310, Dunwich Jetty, Dunwich, N. Stradbroke I., Qld, L. Gershwin, 23.02.2005; 1 spec, c. 4 mm BD. QM-G322311, Amity Jetty, Amity, N. Stradbroke I., L. Gershwin, 23.02.2005; 1 specimen, c. 2 mm BD.

Descriptive notes of Moreton Bay specimens. Bell flatter than a hemisphere. Tentacles 18, one on each canal radius, plus three in each of two quadrants, four each in the other two. Gonads 4, oval, on radial canals three quarters of the way toward margin. Statocysts 8, evenly spaced at one-third and two-thirds points in each quadrant, each with two concretions. Gonads and tentacle bulbs bright green.

Remarks. The specimens have eight statocysts, which is diagnostic for the genus *Phialella*; however, we were unable to identify them to species at this time. Collection of additional material would help with this endeavour.

Subclass SIPHONOPHORA Eschscholtz, 1829

Order CYSTONECTAE Haeckel, 1888

PHYSALIIDAE Brandt, 1835

Physalia Lamarck, 1801

Remarks. Totton (1960: 365) synonymised all *Physalia* species (23 available names) under *P. physalis* (Linnaeus, 1758) on the basis that they are merely ontogenetic stages of one another, i.e., that the young colonies have a single main fishing tentacle, subsequently developing additional tentacles as they grow; most authors have followed (however, see Halstead, 1965, and Bardi & Marques, 2007). Fenner and his colleagues (1993) questioned Totton's conclusion for Australian forms, on the basis that the nematocysts of the single-tentacled and multi-tentacled forms have different responses to inhibition tests. We would further add that the size and tentacle limits are consistently different, i.e., we have never observed nor seen any account of 30 cm *Physalia* in Australian waters, nor even 20 cm, nor of a *Physalia* with more than 5 or 6 main tentacles. Finally, the single-tentacled and multi--tentacled forms do not appear to mix, with flotillas being either one form or the other. Thus, these different Australian forms do not appear to be merely ontogenetic stages of one another.

At least four different forms of *Physalia* can be easily and reliably distinguished in Australian waters:

1) A single main fishing tentacle; and the float with a prominent anterior crest not continuing onto a marked posterior elongation (Fig. 4A-C). This form appears to be the one illustrated by La Martinière (1787) as an unnamed medusa (Fig. 4B)(= *Physalia utriculus* Gmelin, 1791, see following remarks) and by Péron & Lesueur (1807) as *P. megalista* (Fig. 4C). We do not believe that the continuance of the tentacles along the entire ventral margin of the float (as figured by La Martinière 1787) is accurate as it does not otherwise occur for species of this genus.

2) A single main fishing tentacle, and a prominent crest along the full length of the float (Fig. 4D). We believe that this form has not been previously recognised.

3) A single main fishing tentacle, and no crest (Fig. 4E). We believe that this form has also not been previously recognised.

4) Multiple main fishing tentacles; with or without a crest (Fig. 4F). This form has been associated with systemic illness similar to that of Irukandji syndrome (Fenner *et al.* 1993), and has been colloquially called 'the Pacific Man-o-War'.

A proper revision of the Australian *Physalia* species is beyond the scope of the present work, but is part of a separate ongoing study. At this time we are only confident to apply the name *Physalia utriculus* Gmelin, 1791, to the form diagnosed here, and to formally synonymise with it, *P. megalista*. It appears that the true *Physalia physalis, sensu stricto*, will be confined to the Atlantic, however, with the plethora of other available names we cannot at this stage be sure whether the other three Australian forms represent one of the already described species, or whether some, or all, will need new names. Unfortunately this means we must continue to use "*Physalia* sp." for non-*P. utriculous* specimens.

In the older literature, mostly prior to the late 1950s, there has been some confusion over identification. The following records do not refer to *Physalia* species but to either the Box Jellyfish (*Chironex fleckeri*) or other cubozoans.

RECORDS REFERABLE TO *CHIRONEX FLECKERI*:

Physalia pelargica - Flecker, 1952a: 35–38; fatal cases, N Qld. [Incorrect spelling].

Physalia sp. — McNeill & Pope, 1943a: 188–191; confusion over cause of fatalities; McNeill & Pope, 1943b: 127–131; comparison with fatal cases; Flecker, 1945c: 128–129; two fatal cases, Cairns region; Southcott, 1952: 273; not the fatal agent; Pope, 1953b: 114; not the fatal agent; Flecker, 1957a: 9; reference to fatal cases; Flecker, 1957b: 556 (in part); confusion over names; Southcott, 1958b: 282; not the fatal agent; Southcott, 1959: 572; confusion over fatal agent; Trinca & Schiff, 1970: 32; blamed for fatalities.

REFERABLE TO IRUKANDJI CUBOZOANS:

Physalia sp. — Tryon, 1895: 39–45; probable agent in Irukandji sting, Moreton Bay; Flecker, 1945a: 98; Irukandji envenomations, Cairns region; Flecker, 1952c: 89–91; confusion over agent of Irukandji stings; Flecker, 1957b: 556 (in part); confusion over names.

Physalia utriculus (Gmelin, 1791)

(Fig. 4A–C)

Méduse [un-named] — La Martinière, 1787: 365, pl. 2, figs 13, 14. (North Pacific Ocean, approx. SE of Wake Island).

Medusa utriculus Gmelin 1791: 3155–3156.

Physalia physalis — Dakin & Colefax, 1933: 198 (NSW); Totton, 1960: 362 (off NSW and Tas); Southcott, 1967: 337–342 (NSW) Southcott, 1968: 1–11 (NSW); Gillett & Yaldwyn, 1969: 34–38, pl. 15, 16, text fig. 18, 19 (NSW, QLD); Edmonds, 1975: 99–101 (Australia-wide); Coleman, 1979: 63 (NSW); Turner *et al.*, 1980: 394–395 (NSW, treatment); Coleman, 1981: 20, 65 (all states except NT); Sutherland, 1981: 92–93 (Australia-wide); Southcott, 1982: 124–125, pl. 13.5 (SA); Sutherland, 1983: 382–385 (Australia-wide); Edmonds, 1984: 70–72 (Australian region); Fenner, 1986: 100 (possibly two species); Marsh & Slack-Smith, 1986: 13–16, figs 9–10 (WA); Burnett *et al.*, 1987: 86–91 (in part) (Australia); Fenner, 1987: 97 (AU); Gorman, 1988: 13 (Moreton Bay); Williamson *et al.*, 1992: 427 (confusion with *P. utriculus*); Holmes, 1996: S26 (far north Qld); Edgar, 1997: 125 (circum-Australian and Tas); Hawdon & Winkel, 1997: 1371 (sting management, Australia); Davie, 1998: 12 (Moreton Bay); White *et al.*, 1998: 109–110 (Australia-wide); Sutherland & Sutherland, 1999: 90–91 (Australia-wide); Edgar, 2000: 125 (circum-Australian and Tas); Sutherland, 2001: 609–615, fig. 26.13, 26.14 (Australian stings). All considered as erroneous identifications. [Not *Physalia physalis* (Linnaeus, 1758)].

Physalia utriculus Eschscholtz, 1829 — Whitelegge, 1889: 196 (NSW); Pope, 1947: 164–166 (NSW); Barnes, 1960: 993–999 (N Qld, stings); Barnes, 1962: 7–10, figs 1–6 (North Qld); Southcott, 1963b: 20, fig. 2C (warm coastlines of Australia); Halstead, 1965: 300, 327, pl. 15, figs 2, 3, pl. 16, pl. 17, fig. 1, pl. 65, pl. 67, fig. 1, 2, pl. 74, fig. 2); Cochrane, 1968: 16, 17 (Australia); Brown, 1973: 16 (Magnetic I., Qld); Dakin & Bennett, 1987: 165–166 (Australia-wide); Williamson *et al.*, 1992: 427 (confusion with *P. physalis*); Burnett *et al.*, 1994: 71–76 (comparison with Atlantic *P. physalis*); Williamson *et al.*, 1996: 137–139, 192–198, 200, pls. 6.5, 8.31, 8.32 (comparison with multi-tentacled forms; stings); Davie, 1998: 12 (Moreton Bay); Sutherland & Nolch, 2000: 3–5 (Australia-wide, comparison to multi-tentacled form); Sutherland, 2001: 609 (discussion of difference from multi-tentacled form); Fenner, 2006: 4 (treatment controversies).

Physalia megalista Péron & Lesueur, 1807: pl. 29, fig. 1 — Whitelegge, 1889: 196 (NSW).

Physalia pelagica — G. Bennett, 1834: 8 (NSW); G. Bennett, 1860: 5–13, pl. II (NSW stings); Cleland, 1913: 46, 47 (Australia-wide); Cleland, 1924: 345 (NSW); Flecker, 1945b: 417 (Great Barrier Reef. [Not *Physalia pelagica* Lamarck, 1801]

Physalia sp. — McNeill, 1937: 223–226 (Australia; stings); Dakin & Colefax, 1940: 210 (NSW); Johnston, 1943: 308 (Eyre Peninsula, SA); Southcott & Powys, 1944, unpublished but widely cited manuscript: 1–37; stings); McNeill, 1945: 29 (Green I., GBR); McNeill & Pope, 1945: 334–335 (comparison with causal agent in fatal stings); Flecker, 1952b: 458 (common in Cairns); Pope, 1953a: 16–21 (discussion of stings, NSW); Southcott, 1958: 54–56, fig. 1B (SA); Kingston & Southcott, 1960: 373, 381, 383, fig. 12E (confusion over cause of fatalities, nematocysts from SA); Bloomfield, 1961: 44–45 (AU); Barnes, 1964a: 5–8 (North Qld; comparison with *Velella*); Bennett, 1966: 34–38, pls. 18–20 (NSW); Gollan, 1968: 973 (near-fatal sting, Cottesloe, WA); Gurry, 1992: 31, fig. 15 (Australia); Fenner & Williamson, 1996: 658 (over 10,000 stings per year in Australia - Loten *et al.*, 2006: 329–333 (heat treatment).

[Synonymy restricted to Australian records]

Material examined. NEOTYPE: QM-G3788, Scott's Point, Moreton Bay, 27°15'S 153°06'E, 20.10.1965, J.V. Mistlin on beach after NE winds (128.41 mm float TL; 55.51 mm float height; 96.27 mm crest length). **QLD**: Stradbroke I., Main Beach, Feb. 2005, dozens of specimens used for sting experiments, and hundreds more examined casually in the field and released. Trinity Beach, Cairns, 29.01.2000; dozens of specs examined in the field and released. JHB-J840.2, c. 20 specs 1–3 cm. SAM-H1595, Palm Cove, Dec. 1999; 2

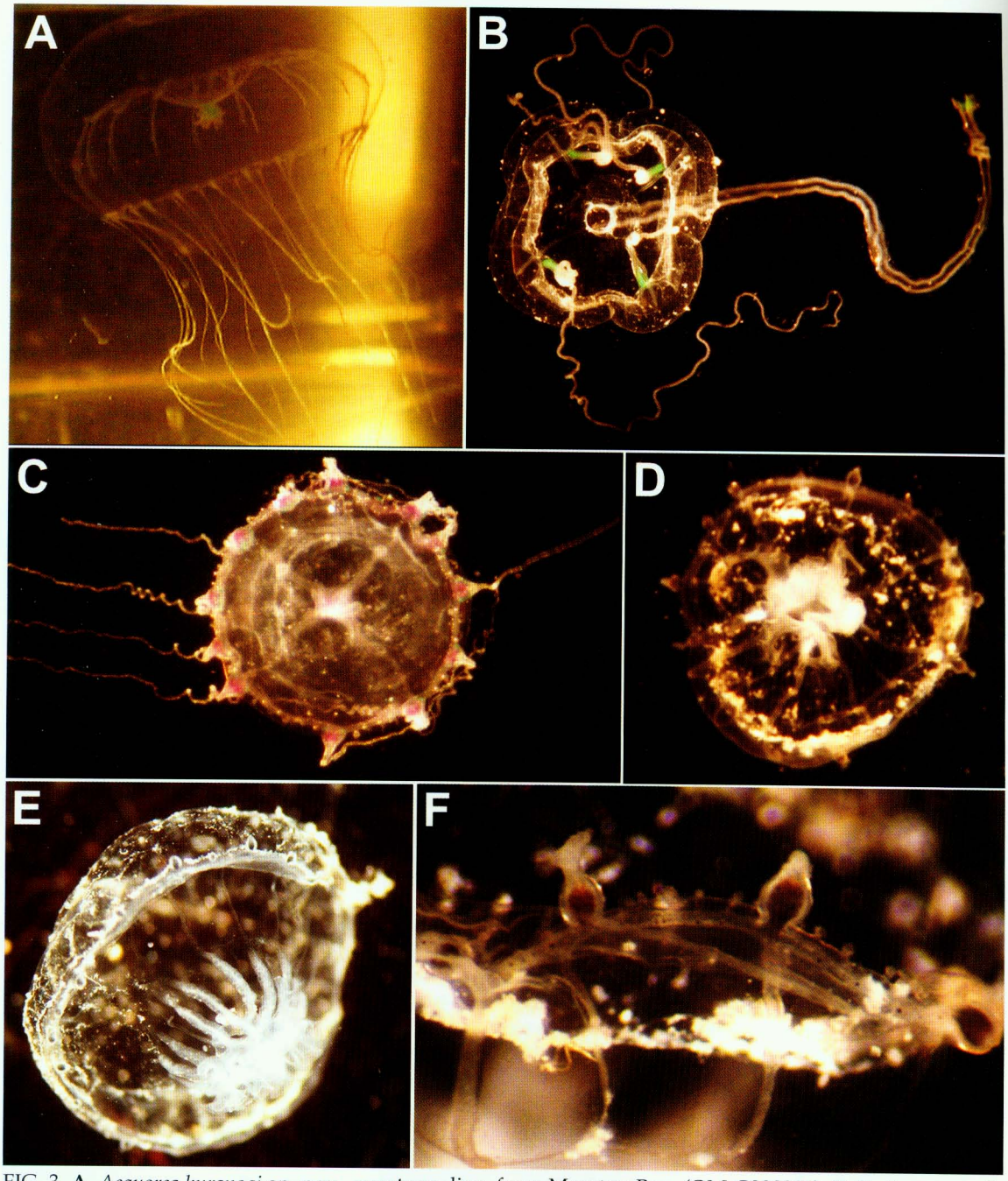


FIG. 3. **A**. *Aequorea kurangai* sp. nov., paratype, live, from Moreton Bay, (QM-G329001). **B**. *Eutima australis* Mayer, live, from Moreton Bay, QM-G322304. **C**. *Cirrholovenia violacea* sp. nov., holotype, live, from Moreton Bay (QM-G329000). **D–F**, *Orchistoma mauropoda* sp. nov., images taken while specimens were alive. D. Paratype, from Moreton Bay, (QM-G329007). E. Holotype, from Horseshoe Bay, Magnetic I., off Townsville, Qld (QM-G329574). F. Close up of marginal structures, paratype (QM-G329007), from Moreton Bay.

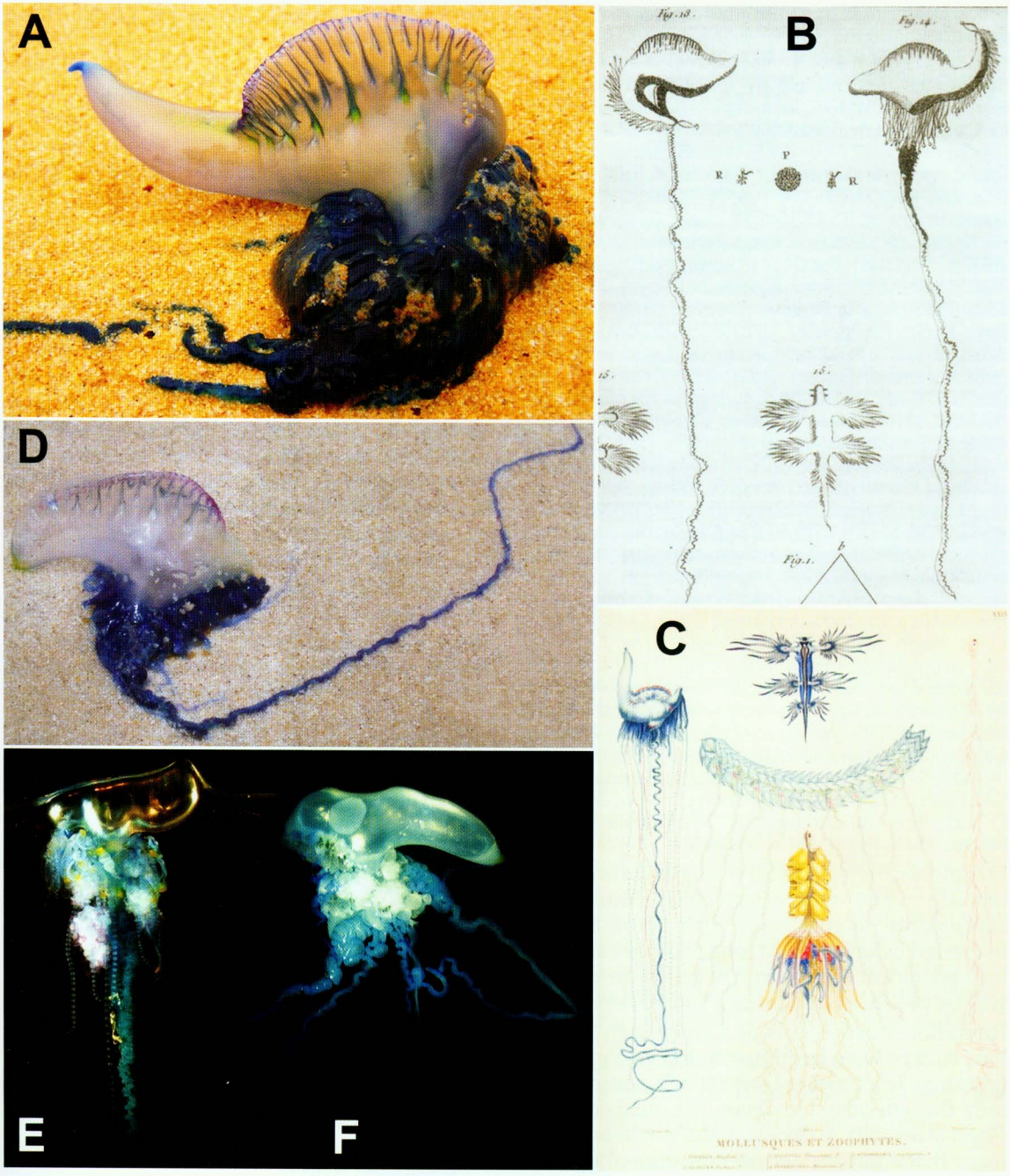


FIG. 4. **A–C**: *Physalia utriculus* (note shape of half-crest) , **A**. float length 6–7 cm, Sydney; **B**. Original figure of unnamed medusa in La Martinière (1787: Pl. II, figs. 13, 14). **C.** *Physalia megalista* (= *P. utriculus*) as figured by Péron & Lesueur (1807: pl. XXIX, fig. 1). **D**. *Physalia* sp. 1, common form with a full crest and no posterior prolongation of float; float length 6–7 cm; Stradbroke I., Feb. 2005. **E**. *Physalia* sp. 2, rarer form lacking obvious crest on float; float length 3–4 cm. **F**. *Physalia* sp. 3, non-crested multiple main fishing-tentacle form; float length 6–7 cm, preserved. (Photo A is copyright B. Curley; used with permission).

specs used in vinegar inhibition experiment, 1–2.5 cm float length. **WA**: WAM-Z4735, North I., Abrolhos, L. Marsh, 7.09.1976, float c. 4 cm.

Specimens determined by Dr Ronald Southcott (unpublished notes), and attributable to *Physalia utriculus*. South Australia: A253, *Physalia physalis*, Beachport, 27.07.1953. A996 *Physalia pelagica*, 1 spec, found opposite Cambridge Terrace, ¼ mile south of Brighton jetty, 18.21.1967. A997 *Physalia pelagica*, 6 specs, Brighton, 18.12.1967 [2 pages of sting notes]. A999 *Physalia physalis*, 1 spec, Tennyson, 20.12.1967. A1375 *Physalia physalis*, 1 spec, Aldinga Beach, 27.12.1972. A1929 *Physalia physalis*, 5 specs, Brighton, 28.12.1976. A2276 *Physalia physalis*, 1 spec., Marion Bay, Yorke Peninsula, 3.01.1976. **QLD**: SAM coll. A317, *Physalia*, Turtle Creek, N Qld, 14.12.1958 (scarce around Cairns). A319–322 *Physalia*, N Qld, Dec. 1958; see excellent drawings A322, SAM coll. A338 & 339 *Physalia utriculus*, Green I., 24.12.1958; 'collected on the sand of the southern beach at high tide ... These were the only *Physalia* found during a complete circuit of the island. Sky clear, water clear. Light easterly wind causing ripples only. (Northerly winds had blown 19th to 22nd inclusive, no breeze on 23rd.)', SAM coll. A407 *Physalia utriculus*, Ellis Beach, Cairns, 6.12.1959, depth 3' (i.e., at surface in water 3' deep), SAM coll. A408 same, Cairns region, found alive in bottle on back steps. A448 *Velella*, Bell's Beach, near Daintree River, Cairns, 7.07.1960, 'sky overcast but bright, tide rising, wind strong SE for three days, still blowing 20+ knots; accompanied by *Physalia* varying from ¼ to 1½ inches float length', SAM coll. A737 *Physalia utriculus*, Middle Point, nr Cape Northumberland, about middle Dec. 1963; 'hundreds of these were blowing to Middle Point', SAM coll. A1239 *Physalia physalis*, 1spec., Magnetic I., 5.11.1967. **Subantarctic**: A1043 *Physalia physalis*, Macquarie I., 20.08.1967, on beach.

Diagnosis. *Physalia* with a single main fishing tentacle. Float with high conspicuous crest confined to medial half, with short anterior uncrested extension, and long, cylindrical, tapering, posterior extension. [A fuller description will be provided as part of a future revision].

Remarks. Most reports of a *Physalia* in Australian waters have been attributed to *P. physalis* (presumably following Totton (1960) in recognising only this species). However, the most common *Physalia* around Australia is the single-tentacled form that more recent literature has begun to refer to *P. utriculus* (see synonymy). Based on morphological, molecular, biochemical, toxicological, and distributional data, it has become clear that *P. utriculus* is distinct from *P. physalis* and should therefore be recognised (Fenner 1993; Bardi 2007). See http://www.reef.crc.org.au/publications/ brochures/Bluebottles.htm. Because of the many names that have been confused and synonymised with *P. physalis*, and because no type material is believed to now exist, we hereby select as a neotype for *P. utriculus* a specimen from Moreton Bay, Queensland (QM-G3788) (see Material Examined). The original type locality of 20°N, 179°E, is in the North Pacific Ocean to the south-east of Wake Island, and would not be easily resampled.

Physalia megalista Péron & Lesueur, 1807 (see original illustration reproduced in Fig. 4C), was described from off New South Wales, and it is clear to us that this is the same species that was earlier described as *P. utriculus*. Type material is also no longer extant for this species. To prevent any future nomenclatural confusion, we here simultaneosly erect the neotype specimen of *P. utriculus* (specimen from Moreton Bay, QM-G3788) as the neotype for *P. megalista*, thus making them objective synonyms, with *P. utriculus* the oldest available, and senior name.

Collection records exist for *P. utriculus* in all Australian states except the Northern Territory (P. Alderslade, NTM, pers. com., Jan. 2000). Its absence from the Northern Territory is curious, and probably simply a collection artefact as another pleustonic form, *Porpita*, has been recorded in Darwin Harbour.

The name *Physalia utriculus* is generally attributed to La Martinière (1787: 365, pl. 2, fig. 13, 14); however, in his description of the species, he attributes it to a new genus, without naming either the genus or the species. This is most perplexing, because we are unable to determine how this species got its name. Gmelin (1791: 3155–3156) appears to be the first to use the species name *Medusa utriculus* in print, crediting the species to La Martinière (1787). It therefore appears that Gmelin is actually the true author of the name, and subsequent authors perhaps simply followed Gmelin in attributing it to La Martinière.

Physalia spp.
(Fig. 4D, E, F)

Physalia physalis — Exton, 1988: 54 (treatment, QLD); Fenner *et al.*, 1993: 498–501 (stings); Williamson *et al.*, 1996: 137–139, 192–199 (comparison with other Pacific and Atlantic forms; stings); Sutherland & Nolch, 2000: 4 (comparison to *P. utriculus*); Sutherland, 2001: 609 (discussion of difference from

single-tentacled form); Fenner, 2006: 4 (treatment discussion). [Not *Physalia physalis* (Linnaeus, 1758)]

Remarks. Diagnostic features separating the three Australian non-*Physalia utriculus* forms are given under Remarks for the genus. Of these three 'species', the multi-tentacled form and the full-crested single-tentacled form are both known to occur in the Moreton Bay region. The species discussed under the synonymy above is the form with numerous main fishing tentacles, the float with or without a conspicuous crest, and without a prominent uncrested aboral cylindrical extension; length typically reaching 10–15 cm. This larger, multi-tentacled form is less common than *P. utriculus*, and seems more like the true *P. physalis* of the Atlantic coasts of America and Europe. In Australian waters, the float only reaches about 10–15 cm in length, with up to four or five main fishing tentacles, whereas the Atlantic *P. physalis* is said to reach up to 30 cm with a dozen or more main tentacles. Whereas the Atlantic form has proven fatal, the multi-tentacled Australian form has not, but it has been linked with Irukandji-like symptoms (Fenner *et al.* 1993). In Queensland waters it is currently known from the Sunshine Coast (Exton 1988; Williamson *et al.* 1996: 187–198) to Townsville (M. Corkeron, pers. com., 2006). Many specimens have been collected from the Mackay region (P. Barker, Surf Life Saving, pers. com., 2008). Further details will be presented in a forthcoming paper by Fenner & Gershwin (in prep.).

Subclass TRACHYLINA Haeckel, 1879

Order TRACHYMEDUSAE Haeckel, 1866 (1879)

GERYONIIDAE Eschscholtz, 1829

Liriope Lesson, 1843

Liriope tetraphylla (Chamisso & Eysenhardt, 1821)

(Fig. 5B)

Geryonia rosacea Eschscholtz, 1829: 89.

Liriope rosacea. — Mayer, 1915: 160 (Torres Strait).

Geryonia tetraphylla Chamisso & Eysenhardt, 1821: 357.

Liriope tetraphylla. — Kramp, 1953: 301–302 (Great Barrier Reef); Blackburn, 1955: 410, 414 (SE Australia and Fremantle, WA); Kramp, 1961a: 203 (Green I., GBR); Kramp, 1965b: 135 (QLD and SE AUS, including Moreton Bay); Kramp, 1968c: 188 (SE AUS); Hamond, 1971: 27 (Moreton Bay); Hamond, 1974: 551 (WA, and eastern part of Bass Strait, Tasmania); Greenwood, 1980: 91 (Moreton Bay); Southcott, 1982: 143 (southwestern and southeastern Australia); Gorman, 1988: 14 and throughout, pl. 1 (Moreton Bay); Goy, 1990: 107–110 (Shark Bay, WA, at the front of haloclines).

[Synonymy restricted to Australian records]

Material examined. **QLD**: QM-G322312, Moreton Bay, L. Whale, Jan. 1981; 2.38 mm BD. QM-G4101, off Proserpine, A. Hansen, 25.04.1966. SAM-H1587 (=RVS-A323), Green I., J.H. Barnes, 20.12.1958. Palm Cove, Cairns region, approximately 500 specs collected during summers 1999–2008, examined and released, or preserved in unsorted lots. **NT**: SAM-H1246 (=GZ 0001), Stokes Hill Wharf, Darwin Harbour, 11.11.2000, W. Zeidler & L. Gershwin. SAM-H1251 (=GZ 0015), Stokes Hill Wharf, Darwin Harbour, 13.11.2000, W. Zeidler & L. Gershwin. **WA**: SAM-H1266 (=GZ 0026), mangroves north of Port of Broome jetty, Roebuck Bay, Broome, 25.11.2000, W. Zeidler & L. Gershwin. WAM-Z9943, 16 miles NW Rottnest, surface, P. Cawthorn on 'Lancelin', 9.01.1961, no. 47, 0605–0635, N 100 net at surface, over 45 fathom. WAM-Unreg., Woodman Point, Cockburn Sound, Fremantle; 6.03.1999, in plankton tow waist deep.

Remarks. Kramp (1953) noted that *Liriope* was extremely common at the Great Barrier Reef, and was taken in nearly every haul throughout the year, with a distinct peak in December–January; he also noted that he was initially inclined to divide his collection into two or three species, although he did not give further specific detail.

Other authors have also noted *Liriope* as a common species. In tropical Queensland, *Liriope* has been used in recent years as an indicator species for the presence of Irukandji jellyfishes (L. Gershwin, unpublished notes); along with salps and Narcomedusae, *Liriope* typically signals the presence an offshore water mass, which has been correlated with the influx of Irukandjis (Barnes 1964b; Kinsey 1988; Gershwin 2005a, 2005b).

CLASS SCYPHOZOA Goette, 1887

ORDER SEMAEOSTOMEAE L. Agassiz, 1862

PELAGIIDAE Gegenbaur, 1856

Chrysaora Péron & Lesueur, 1810

***Chrysaora* sp.**

(Fig. 5C)

?*Chrysaora* sp. — Payne, 1960: 9 (Qld waters); Kramp, 1968b: 83 (Moreton Bay, as *C. hysoscella*); Dawson, 2004: 249–260 (Noosa Heads, Qld).

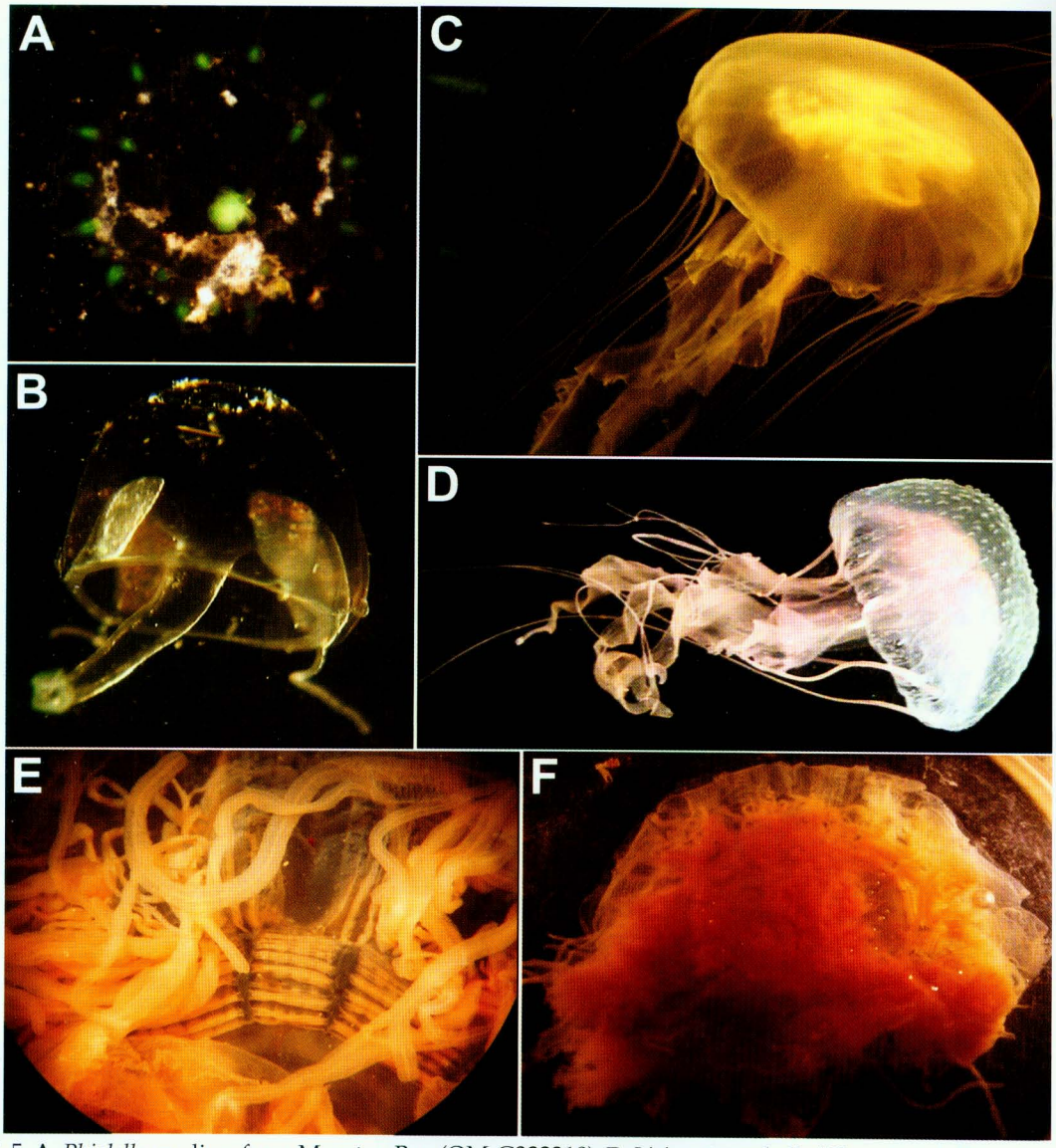
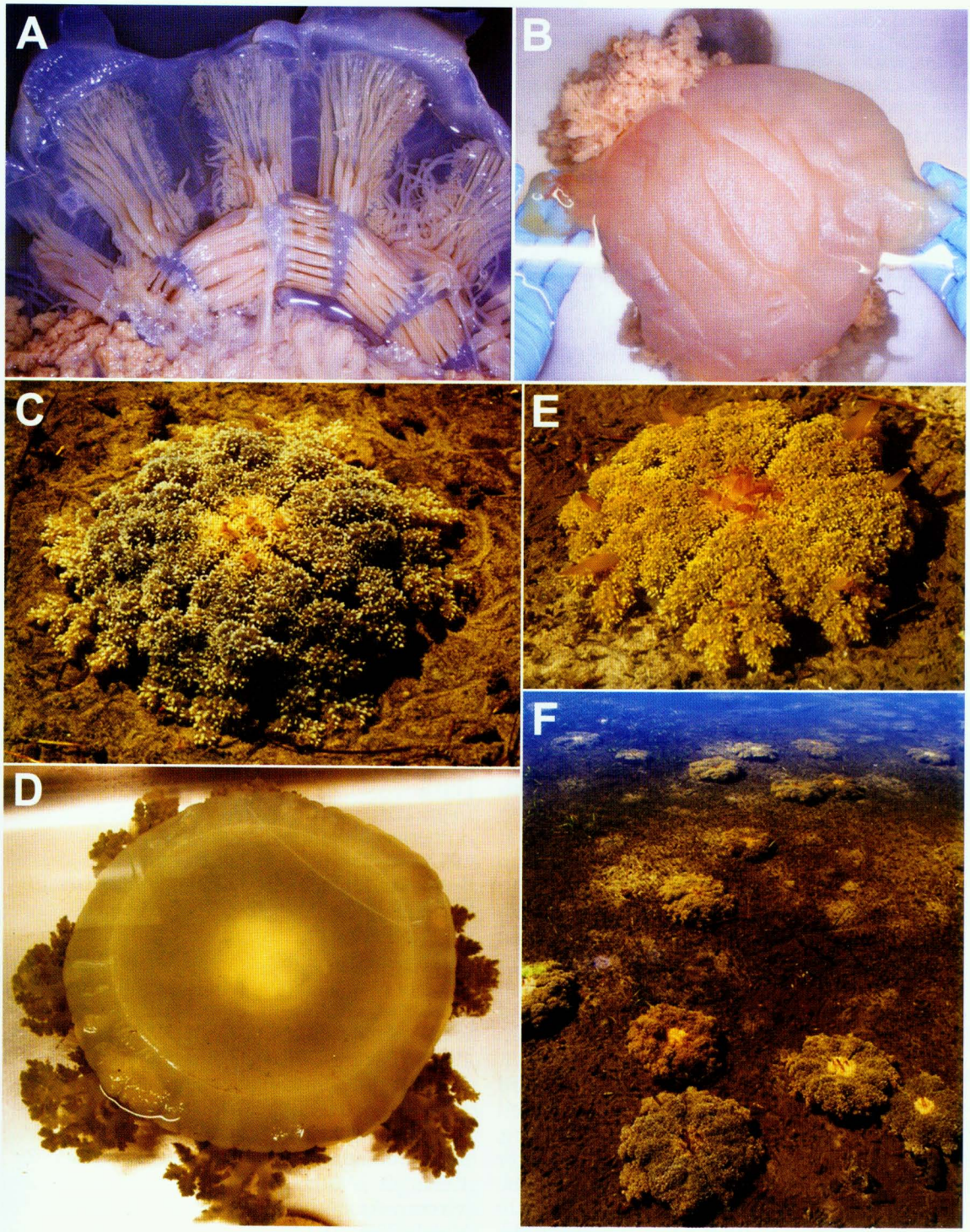


FIG. 5. **A.** *Phialella* sp., live, from Moreton Bay (QM-G322310). **B.** *Liriope tetraphylla* (Chamisso & Eysenhardt), live, from Palm Cove, Cairns region, Qld, 1999. **C.** *Chrysaora* sp., live, from Moreton Bay (Underwater World, Sunshine Coast). **D.** *Pelagia* cf. *noctiluca* (Forsskål), live, from Magnetic I., off Townsville, Qld, 2006. **E, F**, *Cyanea* cf. *rosea* Quoy & Gaimard, sensu Dawson; specimen from Myora, Moreton Bay, QM-G5299. E. Quadrant of subumbrellar surface; note intrusions into muscle bands. F. Exumbrellar view; note gelatinous warts.

FIG. 6. **A, B**, *Cyanea barkeri* sp. nov., holotype, from Moreton Bay (QM-G322752). A. Subumbrella; note heavy muscle bands lacking intrusions. B. Exumbrella; note lack of warts. **C, D**, *Cassiopea maremetens* sp. nov., holotype, from Moreton Bay (QM-G326486). C. Subumbrella, live (image copyright Queensland Museum, used with permission). D. Exumbrella, preserved; note lack of white pigment blotches. **E, F**, *Cassiopea maremetens* sp. nov. E. Live, note colour difference from holotype and similar distribution of appendages. F. Population in situ, at time of holotype collection. Both images copyright Queensland Museum, used with permission. ▶


A
B
C
E
D
F

Material examined. SAM-H1067, Pumicestone Passage, 27 May 2000; 1 specimen, raised by Puk Petersen (Underwater World, Sunshine Coast) from wild caught ephyra to approximately 8 cm BD; tissues preserved in EtOH [SAM-XH00438].

Remarks. This unusual species of *Chrysaora* from northern Moreton Bay resembles *Chrysaora kynthia* Gershwin & Zeidler, 2008, recently described from the Perth region, in having loosely coiled ribbon-like gonads, a colourless, somewhat cloudy body, and no star pattern or exumbrellar pigment of any sort. At 8 cm bell diameter, the specimen has 24 tentacles (i.e., 3 per octant) and the gonads are well developed. The precise relationship between the Qld and WA forms has not yet been established, but seems unlikely to be identical.

No descriptive notes were given by Payne (1960) or Dawson (2004), so it is impossible to determine whether they had the same form. This colouress, 24-tentacle form from Moreton Bay is easily distinguished from its closest geographical neighbor, *Chrysaora wurlerra* Gershwin & Zeidler, 2008, from NSW, because *C. wurlerra* has a conspicuous exumbrellar star pattern, and typically 40 tentacles.

Pelagia Péron & Lesueur, 1810

Pelagia Péron & Lesueur, 1810: 349.

Remarks. *Pelagia noctiluca* is often reported in Australian waters. However, these identifications appear to be erroneous. As noted by Gershwin & Zeidler (2008), it is apparent that there are at least two unique forms of *Pelagia* in Australian waters, neither of which matches the European form. Specifically, whereas the European form is relatively flat when relaxed, reaches about 100 mm in bell diameter, and has a transparent and colourless body with various colouration accents on the nematocyst warts, gonads, and oral arm edges (Russell 1970), the Australian form common along the east coast is smaller, uniformly translucent pink throughout, and has a more rigid, stiff, thick, helmut-shaped bell, even when preserved. Another type, found only rarely in the Sydney region, is larger and flatter, and has extremely fine tentacles; the body is colourless. A third form, found only once in the Bass Strait, is more similar to the European form, in having a larger, flatter, transparent body, with thick tentacles. The genus is in urgent need of revision.

Pelagia can deliver a painful sting, which may produce serious or ongoing health effects (Williamson *et al.* 1996). In December 2006, a massive swarm of *Pelagia* invaded Gold Coast beaches; many swimmers were treated for stings, but none life-threatening.

The following species have been reported from Australia:

Pelagia australis Péron & Lesueur, 1810: 350 (= p. 38) [Îles Joséphine, Great Australian Bight]; Goy, 1995: 284 [as 'indeterminable'].

Pink medusae — Bennett, 1860: 63–64 [bioluminescence, NSW].

Pelagia noctiluca (Forsskål, 1775) — Stiasny, 1931b: 31 [Port Jackson, NSW]; Dakin & Colefax, 1933: 198 [large numbers in Sydney Harbour]; Ranson, 1945: 315 [Port Jackson, NSW]; Payne, 1960: 9 [Moreton Bay region and Heron I.]; Kramp, 1961a: 204, 205 [Great Barrier Reef]; Southcott, 1963b: 21, fig. 3C [Pacific coastlines of Australia]; Thomas, 1963: 208 [Sydney region, NSW]; Cleland & Southcott, 1965: 156–157, text fig. 17, pl. 2, figs 16, 17 [QLD & NSW; stings]; Halstead, 1965: 304, pl. XLVIII, figs 1, 2; Kramp, 1965a: 259–260 [Sydney, NSW; Turu Cay, Qld]; Bennett, 1966: 49, pl. 26 [NSW]; Gillett & Yaldwyn, 1969: 42 [eastern Australia]; Edmonds, 1975: 97–98 [medical effects]; Coleman, 1979: 61 [VIC]; Greenwood, 1980: 91 [Moreton Bay]; Coleman, 1981: 20, 67 [NSW, VIC, TAS, SA, WA]; Sutherland, 1981: 94 [Australia-wide]; Southcott, 1982: 155–156, fig. 4.46 [south-eastern Australia]; Sutherland, 1983: 385–387, fig. 26.11 [Australia-wide]; Edmonds, 1984: 87 [twice been the cause of cancellation of Australian Surfing Championships]; Fancett, 1986: 379–384 [Port Phillip Bay, VIC]; Fenner, 1986: 100 [Hamilton I., Qld]; Marsh & Slack-Smith, 1986: 35–38, fig. 26 [WA]; Dakin & Bennett, 1987: 171 [NSW]; Fenner, 1987: 97 [rare in Qld]; Williamson *et al.*, 1987: 223 [sting effects and treatment, N Qld]; Edgar, 1997: 146 [circum-Australian and Tas]; Davie, 1998: 239 [Moreton Bay]; White *et al.*, 1998: 118 [sting information]; Sutherland & Sutherland, 1999: 92 [Australia-wide]; Edgar, 2000: 146 [circum-Australian and Tas]; Sutherland & Nolch, 2000: 16 [Australia-wide. All Australian records are likely to apply to species other than

the true *P. noctiluca*, which is flatter and larger, and has a softer body].

Pelagia panopyra (Péron & Lesueur, 1807) — Haeckel, 1880: 509; von Lendenfeld, 1884b: 266–267 [tropics, Australia to Peru]; von Lendenfeld, 1887: 18–19 [tropics, Australia to Peru]; Dakin & Colefax, 1933: 198 [NSW]; Dakin & Colefax, 1940: 240 [NSW]; Bloomfield, 1961: 46–47 [Southport, Qld]; Pope, 1963: 193 [wave of stingings late November, NSW]; Thomas, 1963: 208 [NSW].

Pelagia spp. — Holmes, 1996: S26 [N Qld]; Williamson *et al.*, 1996: 228–231, pl. 8.86A [sting information; Australia-wide]; Gershwin & Zeidler, 2008: 15 [eastern Australia].

Pelagia sp.

(Fig. 5D)

Material examined. QLD: QM-G304074, Stradbroke I., 27.30'S, 152.35'E, R. Raven, 7.01.1979; 25.86 mm BD, immature. QM-G5480, Southport, 14.03.1971, in surf, prevailing south east wind, falling tide, overcast day time, 12:00; 1 spec., 2 cm BD. QM-G6312, Tallebudgera, Gold Coast, 21.09.1971, 'in surf, north east wind, colour mauve'; 1 perfect specimen, 3 cm BD. QM-G6703, Caloundra, Sunshine Coast, C.C. Wallace, 11.12.1971, Curramundi Beach, washed up on beach; 1 specimen, c. 4 cm BD. QM-G2612, Proserpine, 26.03.1964; 1 specimen, c. 3 cm BD. QM-G10514, Heron I., lagoon south, C. Limpus, 1.11.1976; 2 specs, c. 1 cm & 2 cm. Photograph by P. Petersen, Underwater World, Sunshine Coast, Qld, 17.09.2000; tisues preserved in EtOH [SAM-XH00439]. Gershwin Teaching Collection, Magnetic I., Townsville, Qld, L. Gershwin, 12.06.2005 [pictured in Fig. 5D]. **NT**: SAM-H1590, Little Bondi, Gove Peninsula, Arnhem Land, Bart Currie, 29.04.1997; 1 spec., 28.58 mm BD. NTM-C010187, Gulf of Carpentaria, P. Alderslade, 5.12.1990. **WA**: NTM-C005752, Houtman Abrolhos, P. Alderslade, 9.07.1987. **TAS**: QM-G309442, Bay with Lighthouse Jetty, Deal I., Kent Group, Bass Strait, 39.2830'S, 147.1850'E, AIMS/NCI, 20.02.1990; 2 specs, 70.29 mm BD and 80.55 mm BD, excellent condition.

Remarks. All of the specimens in the present collection appear to be of the common Australian rigid, pink form, except for those from Tasmania, which are large, flat, and colourless. See discussion above regarding problems of identification of species in this genus. This is the first report of a *Pelagia* species in the Northern Territory.

CYANEIDAE L. Agassiz, 1862

Cyanea Péron & Lesueur, 1810

Cyanea Péron & Lesueur, 1810: 363.

Remarks. The systematic of Australian *Cyanea* forms are in complete disarray at this point in time. No less than 5 species have been described, and subsequently lumped in with the European form *C. capillata*. However, we have studied at least 8 different forms of *Cyanea* in Australian waters, and none matches *C. capillata* in even basic structural features (Table 8). An excellent morphological review of several of these forms was given by Condon (1997), but unfortunately this work has not been formally published. Dawson (2005c) examined forms on both sides of Bass Strait, concluding that at least two species were identifiable, which he referred to *C. annaskala* von Lendenfeld, 1882, and *C. rosea* Quoy & Gaimard, 1824. We are currently preparing a full revision of the Australian *Cyanea*.

The following *Cyanea* species have been previously reported from Queensland:

Cyanea capillata — Pope, 1953b: 111 [NSW & QLD]; Payne, 1960: 10, 47–49 [predator of *Catostylus*; numerous locations throughout southern Qld, including Moreton Bay]; Halstead, 1965: 302, 339, pl. XLIV, figs 1, 2, SA, pl. XLV [GBR]; Kramp, 1965a: 260–261 [SA, VIC, and QLD]; Bennett, 1966: 49, pls. 27, 28 [Australia-wide]; Gillett & Yaldwyn, 1969: 40 [eastern and southern beaches]; Edmonds, 1975: 86–88 [medical effects; widespread throughout Indo-Pacific]; Greenwood, 1980: 91 [Moreton Bay]; Coleman, 1981: 66, and photo centre-right, p. 20 [QLD, NSW, Vic, Tas, SA]; Southcott, 1982: 153–154, fig. 4.45, pls. 14.3, 16.1 [Australia-wide]; Fenner & Fitzpatrick, 1986: 174 [Mackay, Qld]; Gorman, 1988: 13 [Moreton Bay]; Edgar, 1997: 145 [WA to N Qld, including Tas]; Edgar, 2000: 145 [WA to N Qld, including Tas]; Sutherland & Nolch, 2000: 17 [circum-Australian]. [Not *Medusa capillata* Linnaeus, 1758].

Cyanea nozakii — Davie, 1998: 238 [Moreton Bay]; Dawson, 2005c: 361–370 [Cairns]. [Not *Cyanea nozakii* Kishinouye, 1891]

Cyanea spp. — Barnes, 1960: 993–999 [Qld]; Southcott, 1960: 21, fig. 4A [SA]; Southcott, 1963b: 21, fig. 4A [QLD, SA]; Cleland & Southcott,

1965: 152–154 [QLD, Vic, NSW, SA]; Marsh & Slack-Smith, 1986: 40 [WA and QLD]; Williamson *et al.*, 1996: 232–235, pls. 8.57, 8.89–8.94 [stings, Australia-wide]; Condon, 1997: 1–50 (plus plates and tables), various [Australia-wide, including collections from Moreton Bay].

Cyanea cf. *rosea* Quoy & Gaimard, 1824
(Fig. 5E, F)

Cyanea rosea — Dawson, 2005c [? *Cyanea rosea* Quoy & Gaimard, 1824a, b].

Material examined. QM-G5299, 1 immature spec. (48.97 mm BD), Myora, N. Stradbroke I., SE Qld, in coral patch, D. Tranter, 27 July 1951 [identified by P. Pennycuick [*sic*] as *Cyanea* sp.].

Remarks. This specimen from Myora is clearly a juvenile, but it nonetheless possesses a combination of structural characters that separate it from those species summarised by Condon (1997: Table 4.3): a papillose exumbrella, 1:1 tentacle clusters, pleated muscles with intrusions, and raised radial septa. In comparison, *C. lamarckii*, *C. annaskala*, and *C. muellerianthe* also all have a papillose umbrella and 1:1 tentacle clusters, but have simple folds, no muscle intrusions, and flat septa; *C. buitendijki* and *C. mjobergi*, like the Myora form, have pleated muscles with intrusions, and raised septa, but both have a smooth umbrella and narrow tentacle clusters. When Dawson (2005c) applied Quoy & Gaimard's name *C. rosea* to his NSW form, he regrettably gave only brief morphological notes on the species; however, it seems to be a match for the Myora form. It would be informative to collect fresh, mature material of the Myora form, to better understand its relationship with Dawson's *C. rosea*.

Cyanea barkeri sp. nov.
(Fig. 6A, B)

Material examined. HOLOTYPE. QM-G322752, Gold Coast region, precise locality and date unknown, Qld Surf Life Savers; 32 cm BD, gravid female. PARATYPES. QM-G309332, North of Keeper Reef, 18°45'S, 147°16'E, 19-01-1989; 1 spec, c. 15 cm BD, cut in half. QM-G322753, Gold Coast region, precise locality and date unknown, Qld Surf Life Savers; approx. 25 cm BD. SAM-H1585, Mackay Harbour Beach, Mackay, 17.01.08, P. Barker (lifeguard), large swarms previous days; 1 specimen, c. 20 cm BD. OTHER MATERIAL. SAM-XH00429, ethanol-preserved tissues from paratype SAM-H1585. SAM-XH00440, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Apr. 2000; ethanol-preserved tissues, in life dark brown with white spots. SAM-XH00441, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Apr. 2000; ethanol-preserved tissues, in life light brown with dark spots. SAM-XH00442, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Apr. 2000; ethanol-preserved tissues, in life light brown with white margin. SAM-XH00443, Pumicestone Passage, Moreton Bay, Qld, P. Petersen, Apr. 2000; ethanol-preserved tissues, in life dark brown with light dots.

Description of holotype. Bell large, flat, thick, heavy, with large lappets; all specimens with damaged margin, such that marginal morphology cannot be unequivocally interpreted. Exumbrellar surface smooth, lacking gelatinous papillae; covered in finely granulated, sandpaper-like texture.

Subumbrella musculature well developed and conspicuous, in 16 proximal coronal fields and 16 distal radial fields. Coronal muscle fields completely separated by large, heavy, knobby, gelatinous septa, protruding from the subumbrellar surface approximately 1 cm in large specimens; individual muscle bands attached to septa vertically, giving each muscle field a pleated appearance; rhopaliar fields with about 9 large folds; tentacular fields half again as broad as rhopaliar fields, with about 7 large folds. Radial muscle fields protruding slightly into coronal fields, more or less 5-sided, pointed proximally, with flaring sides, and a broadly rounded distal edge; about 6–7 large muscles at base, flaring out to about 20–22 large and small near margin. Canal intrusions from the gastro-vascular sinus lacking in both coronal and radial muscles.

Tentacles arising from the subumbrellar surface near the margin, in 8 adradial horseshoe-shaped groups; groups more than twice as long as broad, each with approximately 300 fine, hollow tentacles, arranged in a crowded row up to 6 tentacles thick. Tentacular nematocysts in a crowded arrangement of fine gelatinous warts.

Oral arms 4, perradial, curtain-like, of flimsy gelatinous consistency, hanging freely under the body, co-mingling with 4 interradial gonads, also hanging freely under the body in a curtain-like manner.

Colour in life: highly variable, including uniform reddish-brown or golden, or whitish

Table 8. Comparison of *Cyanea* species reported in Australian waters. Named species data from original descriptions, plus Bigelow (1913), Kramp (1961b), Russell (1970), and Condon (1997).

Species	Bell surface	Muscles	Intrusions	Septa	Lappets	Tentacle groups
C. capillata (Linnaeus, 1758)	Smooth	Flat, simple; 13–15 circular	Present	Flat	Bifurculate	1:1; 70–150 or more
C. lamarckii Péron & Lesueur, 1810	Papillose	Simple folds; 16–20 circular	Absent	Flat	Bifurculate	1:1; 40 to 60
C. annaskala von Lendenfeld, 1882	Papillose	Simple folds; 16–20 circular	Absent	Flat	Bifurculate	1:1; Up to 150
C. muellerianthe Haacke, 1887	Papillose	Simple; 15–18 circular	Absent	Flat	Bifurculate	1:1; up to 150
C. mjobergi Stiasny, 1921	Smooth	Pleated; 6–7 circular, 4–5 radial, halfway into circulars	Present	Raised	Rounded	1.5:1; hundreds
C. buitendijki Stiasny, 1919	Smooth	Pleated; 7–9 circular	Present	Raised	Rounded	>2:1; up to 200
C. nozakii Kishinouye, 1891	Smooth	Pleated; 5 (or 9–10) circular, 5 radial	(Not indicated)	Broad, round, long, gelatinous ridges, well above muscles	No distinct rhopaliar lappets	1:1; up to about 100
C. rosea Quoy & Gaimard, 1824 (sensu Dawson, 2005c)	Papillose	Pleated; 11–14 circular	Present	(Not indicated)	Bifurculate	1:1; (no. not indicated)
C. cf. *rosea* QM-G5299, Myora	Papillose	Raised, pleated: 9 circular, 3 radial	Present	Raised	? (margin damaged)	1:1; many
C. barkeri sp. nov.	Smooth	Pleated: 7–10 circular, 6 radial	Absent	Broad, T-shaped gelatinous ridges, with muscles to top	? (margin damaged)	>2:1; c. 300

with dark spots, or cream-coloured with dark brown lappets.

Etymology. The specific name, *barkeri*, is in honour of Paul Barker, the Lifeguard Supervisor in the Mackay region, and his brother, Dave, an avid fisherman. Paul and Dave know the marine life of the Mackay region comprehensively, and this intimate knowledge and keen observations have led to their finding many species new to science. It is a great honour to thank them by naming this conspicuous species after them.

Sting notes. Like its congeners, *Cyanea barkeri* can deliver a painful sting, but not typically life threatening. According to Paul Barker, the sting presents as numerous linear whiplike raised wheals, whitish with a red lateral flare. Patients often state that it feels like a lightning rod zap when first hit, very sharp and painful, often covering a large area; the pain is easily relieved with ice, and dulls more quickly than a blue bottle; some patients, particularly with large stings to the body trunk, have trouble breathing. The stings of Cyanea barkeri are not typically prone to scarring, with the sting marks disappearing in 1.5–2 weeks. First aid should include rinsing with seawater (NOT freshwater!) to remove microscopic nematocysts, whether tentacles are present or not, followed by application of ice for pain.

Ecological notes. According to Paul Barker, every 4–5 years large masses of *Cyanea* are observed, typically coming on an easterly swell rather than northerly or southerly. The last was Christmas time, 2007–2008: the swarms arrived in Townsville first, then Mackay, then Cairns, causing beach closures due to stings. During this period, Paul treated about 40–50 stings in a single day. The swarms comprise specimens of a variety of colours and patterns, with all apparently giving the same type of sting. The largest specimens are about 40 cm BD; with most specimens being about 25–30 cm BD.

Remarks. *Cyanea barkeri* is most similar morphologically to *C. nozakii*, in that both have smooth exumbrellar surfaces, pleated subumbrellar muscle bands, and well developed gelatinous ridges separating the circular muscle fields. The most conspicuous difference is in the gelatinous septa separating the circular muscle fields: in *C. nozakii*, these septa are straight, extend well beyond the circular muscle fields into the radial muscle fields, and protrude well above the muscle attachments (see photograph in Bigelow, 1913: pl. 4, fig. 5); in *C. barkeri*, the circular muscle bands nearly cover the septa, which are shorter and T-shaped, with the radial muscle bands extending proximally to the distal edge of the circulars, and the most distal circular bands considerably shorter than the others, due to their attachment along the 'cross-bar of the T' (Fig. 6A). The tentacle groups are also different between the two species, being about as long as wide in *C. nozakii*, with bowed-out or convexly rounded side walls, whereas in *C. barkeri*, the tentacle groups are considerably longer than wide, and the side walls are very straight, giving an almost perfectly squared-off appearance to the clusters; furthermore, *C. nozakii* appears to have about 100 tentacles per group, whereas *C. barkeri* has well over 300. Finally, we have been unable to determine whether the true *C. nozakii* (i.e., from Japan) has gastro-vascular protrusions into the subumbrellar muscle bands; *C. barkeri* does not; thus, if they are present in *C. nozakii*, that would be another prominently distinguishing character. It would be helpful when revising the genus to compare *C. nozakii* type material, if available, or at least material from the type locality, in an effort to establish what other differences exist between the two forms.

Order RHIZOSTOMEAE Cuvier, 1817
Ssuorder KOLPOPHORAE Stiasny, 1921a
CASSIOPEIDAE Tilesius, 1831

Cassiopea Péron & Lesueur, 1810

Cassiopea Péron & Lesueur, 1810: 356.

Remarks. Many of the Queensland records listed below are likely to be attributable to *Cassiopea maremetens* sp. nov. However, without specimens for examination, we are forced to leave them as uncertain records.

Previous Queensland records of *Cassiopea* spp.:

Cassiopea andromeda (Forsskål, 1775) — Stephenson *et al.*, 1931: 50, 71 [Low Isles]; Stiasny, 1931a: 140–141 [Low Isles, GBR, Qld]; Stephenson,

1962: 94 [Myora, Stradbroke I.]; Holland, 2004: 1121 [Port Douglas, Qld].

Cassiopea andromeda var. *baduensis* Mayer, 1915: 183–184, fig. 3 [Badu I., Torres Strait, Qld].

Cassiopea ndrosia Agassiz & Mayer, 1899 — Stiasny, 1934: 913–921 [Hayman I., Whitsundays, Qld]; Kramp, 1965a: 265 [Hope I., Gold Coast, and Thursday I., Torres Strait, Qld]; Kramp, 1970: 18 [Japan to Tahiti, including Australia]; Southcott, 1982: 159, pl. 15.3, 15.4 [Port River, SA].

Cassiopea ornata Haeckel, 1880: 570–571, pl. 37 [northern Australia]; von Lendenfeld, 1884b: 285 [summary]; Kramp, 1970: 18 [Japan to northern Australia].

? *Cassiopea xamachana* R. P. Bigelow, 1892 [Barnes notes, unpublished: J1682, Cockle Bay Reef, Magnetic I., Qld; coll. Dr. Straughn, 19 July 1966].

Cassiopea spp. — Barnes notes, unpublished: J780 [Gon Bung Point, Weipa, Qld; coll. Geoff Webster, 30.07.1961, 'quite common on rock and mud flats at low tide']; Cleland & Southcott, 1965: 160 [Qld reports, stings]; Williamson *et al.*, 1996: 212–213 [northern, eastern and southern Australia].

Cassiopea maremetens sp. nov.

(Fig. 6C–F)

Cassiopea andromeda. – Stephenson, 1962: 94 (Myora, Stradbroke I.). [Not *Medusa andromeda* Forsskål, 1775]

? *Cassiopea ndrosia*. – Kramp, 1965a: 265 (Hope I., Gold Coast).

Material examined. HOLOTYPE. QM-G326486, Lake Magellan, off Lamerough Canal, Pelican Waters, SW of Caloundra, 26° 49′ 42′ South, 153° 6′ 48.6′ East; coll. D. Potter & G. Cranitch; 24.05.2007; about 20 cm BD [pictured in Fig. 6C, D]. PARATYPES. QM-G327932, same data as holotype; 2 specs, c. 8 cm & 15 cm BD, no vesicles among arms. QM-G2519, Myora, in pools near mangroves, N. Stradbroke I., Moreton Bay, W. Stephenson, Zoology Dept, Univ. Qld, 26.07.1961; 10 specs, 2–4 cm BD, 9 with no vesicles among arms, 1 with a single central vesicle. QM-G10491, Woogoompah, southern Moreton Bay, NE edge of Avicennia Is., 15.09.1976; 1 spec, c. 5 cm BD, poor condition, no vesicles among arms. QM-G7662, Proserpine area, A. Hansen, 1972; 1 spec, 9 cm BD, poor condition, no vesicles among arms. QM-G5328, Repulse Bay, A. Hansen, 1964; 2 specs, 6 & 9 cm BD. QM-G6645, Mud I., Moreton Bay, C. Wallace, 8.04.1972; numerous specs, c. 12 cm BD, most lacking vesicles, 1 with numerous microscopic paddle-shaped vesicles and short filaments on central disk. QM-G327970, Moneys Ck., via Bugara, Bundaberg Creek mouth, C. Limpus, no date; 1 spec, 10 cm, poor condition, 1 small vesicle at central disk and at fork in base of arms. QM-G327969, Bentinck I., estuary on NW side of island, P. Davie, 20.11.2002; 2 specs, c. 12–15 cm BD, small vesicles among mouths on central disk. OTHER MATERIAL. Photographs from Pumicestone Passage, P. Petersen, 2000; 2 specs, c. 27 cm BD, tissues preserved in EtOH [SAM-XH00446, SAM-XH00447].

Diagnosis. *Cassiopea* with a broad, shallow, aboral concavity; with about 19 rhopalia; with four square lappets per paramere; with oral arms round in cross section, about 1.5 times as long as bell radius, with 4–6 alternate branches, bifurcated distally; with 1–2 appendages stemming from the central point of the disk, plus one at the base of each pair of oral arms, plus one at distal bifurcation of each oral arm, or lacking; colouration uniform beige to brown to olive green, lacking exumbrellar white blotches or streaks, ocelli not observed.

Description of holotype. Bell flat, with a broad, shallow central concavity. Exumbrellar surface smooth, lacking warts or obvious nematocyst clusters.

Oral disk small, with 2 narrow, flat, leaf-shaped appendages arising from the middle, each about 2 cm long; 4 additional similar appendages arise from the disk, one in the axil of each pair of oral arms, which do not otherwise appear grouped.

Oral arms 8, round in cross section, about half again as long as bell radius; bearing 4–6 alternately arranged, lateral branches, shorter proximally, longer distally, with the central trunk ending in a bifurcation. Each arm bears a narrow, flat, leaf-shaped appendage at the axil of the terminal bifurcation, similar in size and form to those on the oral disk. Thus, each arm bears only a single appendage, plus the one shared near the base. Mouthlets are arranged in a crowded manner along the oral edge of all arms and branches.

Rhopalia 19, within deeply incised notches of square-shaped lappets; each rhopaliar lappet more or less alternates with another similar sized square lappet, flanked by a pair of narrower, rectangular lappets, about half as broad. Thus, there are a total of three velar

lappets between successive rhopalia, and the rhopalium is embedded at the midline of a single broad ocular lappet. Lappets are demarcated near the margin of the exumbrella by permanent furrows. Ocelli not observed.

Subumbrellar surface as a repeating pattern of fine V-shaped muscle bands, the spaces on the rhopaliar radii slightly broader peripherally than the other radii.

Stomach small, occupying about one-fourth the diameter of the disk. Gonads in a poorly-defined four-leaf-clover form within the stomach diameter.

Colour in life: variable in the population, most in the uniform olive green-brown range; this specimen beige with darker brown appendages. Exumbrellar colour not documented; when studied after six months, no trace of radial whitish blotches or streaks was found, thus raising the possibility that they were never present.

Variation. Most of the specimens lack oral arm appendages; size does not appear to be an indicator for the presence or absence of vesicles.

Etymology. The specific name, *maremetens*, literally, the gardener of the sea, is from the Greek *mare* (the sea) and *metera* (to reap, to harvest), in reference to the placid habit of *Cassiopea*, which spends its time gently farming its algal symbionts. Thanks to Emeritus Prof. Robert Milns and Prof. John Pearn, University of Queensland, who suggested this name.

Type locality. Lake Magellan, off Lamerough Canal, Pelican Waters, SW of Caloundra, Gold Coast, Queensland, Australia.

Remarks. *Cassiopea maremetens* is most similar morphologically to *C. ndrosia*, in that both share a shallow aboral concavity to the body shape, about the same number of rhopalia, and cylindrical oral arms with about the same number of branches; however, *C. maremetens* differs from *C. ndrosia* in the lappets being entirely different in shape and number, the conspicuous colouration pattern of *C. ndrosia* is lacking, the oral arms have a distal bifurcation in *C. maremetens*, whereas they do not in *C. ndrosia*, and *C. maremetens* has fewer to no vesicles amongst the mouths (Table 9). Agassiz & Mayer (1899: 175) wrote for *C. ndrosia*, there are '... a large number of leaf-shaped vesicles scattered among the suction mouths. These vesicles are more numerous near the centre than they are at the free ends of the arms'; the pattern of vesicle distribution in *C. maremetens* is consistent among different sized specimens, and one would definitely not call them numerous. We are left wondering about the specimens that lack vesicles; specifically, whether this represents a hitherto unidentified cryptic species, or simply an alternate state of a polymorphic character in this form.

Cassiopea andromeda was previously reported from the Moreton Bay region (W. Stephenson 1962). Stephenson's specimens are no longer in good condition, and could not be unequivocally identified, except to say that the largest has a single central vesicle about 1 cm long; the others, which are smaller, do not appear to have vesicles.

Cassiopea has also been reportedly collected at low tide in the lagoon immediately north of the Marine Station at North Stradbroke I., but was not found during the period of the workshop.

Cassiopea medusae have been widely reported throughout Queensland, as well as many other localities around Australia. We have not studied most of these other collections, so we are unable to comment on the accuracy of their identities. However, two populations that we have studied at length, namely a man-made lake in Darwin, Northern Territory, and a tidal pool in Exmouth, both contain *Cassiopea* species new to science (but beyond the scope of this paper). Overseas workers have also found high rates of differentiation between populations of *Cassiopea*: Hummelinck (1968) found consistent morphological differences among Caribbean populations, and Holland *et al.* (2004) demonstrated molecular evidence of numerous species in the Hawaiian Islands.

An unnamed species of *Cassiopea*, distinct from but closely related to *C. andromeda*, was identified by Holland *et al.* (2004) based on genetic sequencing of a single specimen collected at Port Douglas (GenBank AY319471). We have not had the opportunity to compare the morphology of their form to ours, so we are unable to draw any firm conclusions about the relationship between the two. However, one

Table 9. Comparison of diagnostic characters between *Cassiopea ndrosia* Agassiz & Mayer (1899) and *Cassiopea maremetens* sp. nov., from the region around Moreton Bay.

Species	Bell diam.	No. of rhopalia	Lappets per paramere	Oral arm shape & length	Lateral arm branches	Appendages type & no.	Colour	Type localit y
Cassiopea ndrosia	20 cm, with shallow depression	Variable 18–22	1–2 indistinct	Cylindrical, 30 mm long	4–5, pinnately branched	Many leaf-shaped vesicles, more numerous near center	Ash brown, with spearhead-shaped white spot on rhopaliar radii, plus short white radial streaks and numerous scattered smaller spots	Fiji
Cassiopea maremetens sp. nov.	20 cm, with broad, shallow aboral concavity	c. 19	4, square	Round in cross-section, 1.5 times radius	4–6 alternate, with distal bifurcation	None, or 1–2 central, plus 1 at base of each pair of oral arms, plus 1 at distal bifurcation of each arm	Uniform beige to brown to olive green; lacking white blotches and streaks of *C. ndrosia*	Coastal QLD

would not easily mistake *C. maremetens* for *C. andromeda*. According to Kramp (1961b), in *C. andromeda*, the body is flat and disk-shaped; the lappets are short, blunt, and variable in number; the oral arms are wide and flat; four to six flat, short side branches arise from each arm in a tree-like manner; and numerous small and five or more club-shaped vesicles arise from each arm between the mouths. In contrast, in *C. maremetens*, the aboral surface of the body is concave, giving the impression that it is more bowl-shaped than flat; there are four square lappets in each paramere that are quite distinct; the oral arms and branches are round in cross section; and the number, shape, and location of oral appendages is entirely different (see Table 9). We are thus inclined to think that the species found by Holland *et al.* (2004) was not *C. maremetens*.

CEPHEIDAE L. Agassiz 1862

Cephea Péron & Lesueur, 1810

Cephea Péron & Lesueur, 1810: 360.

Remarks. Three species have been previously reported from Australian waters:

Cephea cephea (Forsskål, 1775) – Stiasny, 1926: 251 [Port Denison, Qld]; Kramp, 1961a: 204 [Green I., GBR]; ? Marsh, 1998: 394 [Shark Bay, WA]; Kramp, 1970: 13, 22 [northern coasts of Australia].

Cephea fusca Péron & Lesueur, 1810: no. 99, p. 361 (= 49) [W de Witt's Land: Kimberley & Pilbara]; Eschscholtz, 1829: 57; Agassiz, 1862: 156 [as *Polyrhiza fusca*]; Haeckel, 1880: 575 [valid]; von Lendenfeld, 1884a: 161 [valid]; von Lendenfeld, 1884b: 286 [valid]; von Lendenfeld, 1884c: 426 [valid]; Mayer, 1910: 654–655 ['probably the same' as *C. cephea*].

Cephea octostyla (Forsskål, 1775) – Stiasny, 1926: 251 [Rockhampton, Qld]; Payne, 1960: 12 [Moreton Bay]; Kramp, 1965a: 265 [Green I., GBR]; Kramp, 1970: 13 [northeastern Australia].

Cephea sp.

(Fig. 7A, B)

Material examined. QM-G327915, 1 spec. (103.40 mm BD), Frenchman's Beach, Point Lookout, North Stradbroke I., Qld, J. Truman, 20.07.2006. QM-G304075,

immature spec. (69.34 mm BD), Hervey Bay, Qld, 25.03'S, 153.05'E, A. Pitt, Jan. 1980.

Remarks. Neither of the two specimens available allows for confident diagnosis. The Hervey Bay specimen looks like it was possibly washed up on the beach, or preserved in alcohol, or both; the exumbrellar papillae cannot be discerned. The Frenchman's Beach specimen is in very good condition; however, the lappets are somewhat tattered, making differentiation between rips and normal separation uncertain, and the oral arms are quite worn, with any appendages that may have previously been attached, now missing.

VERSURIGIDAE Kramp, 1961b

Versuriga Kramp, 1961b

Versuriga anadyomene (Maas, 1903)
(Fig. 7C)

Crossostoma anadyomene Maas, 1903: 56-59, pl. 7, figs. 65-68.

Versuriga anadyomene — Stiasny, 1926: 256 (off Rockhampton, Qld [specimen number is in error, should read G 12046]); Stiasny, 1931b: 36–38 (Wilson Islet, Capricorn Group); Kramp, 1970: 10, fig. 1 (restricted to Indo-West Pacific).

[Synonymy restricted to Australian records]

Material examined. QM unregistered, 1 damaged gravid female specimen (c. 30 cm BD), 18.02.2005, Bare Rock, Moreton Bay, off N. Stradbroke I., coll. MBWS participants. SAM-HX00431, ethanol-preserved tissues taken from previous specimen.

Description of specimen. Bell relatively flat, shaped like a Portobello mushroom, with a reticulated, rugose exumbrellar surface, comprised of adjacent pointy geometric shapes, larger and taller nearer the centre, becoming shorter and more radially orientated toward the margin. Velar lappets rounded, 8 between adjacent rhopalia, the outer two lappets divided midway into 2; ocular lappets reduced in size compared to velar lappets, pointy. Subumbrellar muscle fields 8, roughly triangular, completely divided at the perradii and interradii, with many fine circular bands.

Subumbrellar canal system almost completely reticulated, with broad radial canals anastomosed along their entire length on the interradii and non-anastomosed to about halfway on the perradii.

Oral arms largely amputated in the present specimen; laterally compressed basally, liberally fringed adaxially with frilly mouthlets. Numerous filamentous appendages emit from among the mouthlets and from the oral disk.

Colour in life: Mesoglea translucent whitish, with exumbrellar purple reticulations near the centre, fading to brown near the margin; subumbrellar muscles brown; oral ams whitish with brown mouthlets.

Associations. A crab, *Charybdis feriatus* (ident. P. Davie, Qld Museum, Feb. 2005) and numerous juvenile fish (*Alepes apercna* Grant, 1987 (F. Carangidae); ident. J. Johnson, Qld Museum, Mar. 2008) were collected with the specimen.

Remarks. Apparently uncommon, but has been encountered a few times in the Australian tropics. This is the first record for a member of the Versurigidae from Australian subtropical waters.

Suborder DAKTYLIOPHORAE
Stiasny, 1921

CATOSTYLIDAE Grenacher & Noll, 1876

Catostylus L. Agassiz, 1862

Catostylus mosaicus (Quoy & Gaimard, 1824)
(Fig. 7D)

Cephea mosaica Quoy & Gaimard, 1824a: 569, pl. 85, fig. 3.

Rhizostoma mosaica — Huxley, 1849: 413–434, pl. 38, figs 26, 27, pl. 39, figs 28–34 (east coast of Australia and Bass Strait).

Crambessa mosaica — Haeckel, 1880: 622 (east coast Australia; NSW); von Lendenfeld, 1884b: 299–300 (Port Philip, VIC; Port Jackson, NSW); von Lendenfeld, 1884c: 428 (Port Philip, VIC; Port Jackson, NSW); von Lendenfeld, 1887: 30–31 (historical reports); Agassiz & Mayer, 1898: 16–18, pls. 2, 3 (discussion of regional colour differences; NSW and throughout Qld); Dakin & Colefax, 1940: 210 (estuaries, NSW).

Catostylus mosaicus — Agassiz, 1862: 152 (Port Jackson, NSW; systematics); Mayer, 1910: 666–667 (harbours and estuaries from Brisbane to Melbourne); Mayer, 1915: 190 (discussion of regional colours; Melbourne to Moreton Bay); Badham, 1917: 227 (Broken Bay, NSW; host of *Peachia*); Stiasny, 1922b: 554 (Port Hacking, NSW); Stiasny, 1924: 66–68 (Port Jackson, NSW); Stiasny, 1931a: 154–155 (Port Jackson, NSW); Stiasny, 1931b: 38–39 (plentiful at Port Curtis, Qld); Pope, 1947: 165–166 (NSW harbours and river-mouths); Pope, 1953a: 19 (NSW

harbours and estuaries); Payne, 1960: 16 (Moreton Bay, Gladstone Harbour, and Gulf of Carpentaria); Southcott, 1960: 4–6 (Melbourne to Cairns); Kramp, 1961b: 370 (synopsis of reports); Pope, 1963: 193 (Norah Head, NSW; stings); Southcott, 1963a: 57–58, fig. 5g (medical effects; Qld to Melbourne); Southcott, 1963b: 21, fig. 4b (sting effects; east coast, Melbourne to the tropics); Thomas, 1963: 208 (Hawkesbury estuary, NSW); Cleland & Southcott, 1965: 160–162 (Brisbane, Sydney, Melbourne, Cairns; regional colour differences; stings); Halstead, 1965: 301, pl. 17, fig. 2, pl. 27, pl. 29; Kramp, 1965a: 271–272 (Cairns region); Gillett & Yaldwyn, 1969: 40–42, pl. 18 (southeastern Aus); Kramp, 1970: 15 (east coast Australia, Melbourne to Cairns, and south coast of New Guinea); Southcott, 1971: 2, 4–5, pl. 5, figs 4, 5 (Port Philip Bay, VIC); Edmonds, 1975: 83–85 (medical effects, eastern Australia); Coleman, 1977: 30 (all Australian states except NT [note that photo is of *Pseudorhiza haeckeli*, erroneously attributed to *C. mosaicus*]); Coleman, 1979: 58–59 (every state except NT); Greenwood, 1980: 91 (seasonality at Moreton Bay); Southcott, 1982: 157–157, pl. 15.1, 15.2 (Torres Strait to Port Philip Bay); Fancett, 1986: 379–384 (Port Philip Bay, VIC); Coleman, 1987: 36 (all states but NT); Gorman, 1988: 17, and throughout (Moreton Bay); Wells & Wellington, 1992: 57–61 (sustainability of harvest in eastern Australia); Williamson *et al.*, 1996: 209, 213–214, pl. 8.61 (NSW, QLD, and NT; stings); Edgar, 1997: 147 (Port Philip Bay, VIC, to Torres Strait, QLD); Davie, 1998: 237 (Moreton Bay); Coleman, 1999: 55 (sting effects; Moreton Bay); Edgar, 2000: 147 (Port Philip Bay, VIC, to Torres Strait, Qld); Kingsford *et al.*, 2000: 85–156, various pp. (fisheries management); Pitt, 2000: 269–279 (Botany Bay, NSW; life history); Pitt & Kingsford, 2000a: 143–155 (estuaries and bays, NSW); Pitt & Kingsford, 2000b: 791–799 (estuaries and bays, NSW); Rouse & Pitt 2000: 23–34 (Botany Bay, NSW); Sutherland & Nolch, 2000: 17 (stings; Brisbane to Port Philip Bay); Pitt & Kingsford, 2003a: 303–313 (Lake Illawarra, NSW); Pitt & Kingsford, 2003b: 117–125 (Botany Bay and Lake Illawarra, NSW); Dawson, 2004: 249–260 (Mooloolaba, Sunshine Coast, Qld); Pitt *et al.*, 2004: 115–123 (Lake Illawarra, NSW); Dawson, 2005a: 515–533 (phylogeography, Vic, Tas, NSW, QLD); Pitt *et al.*, 2005: 71–86 (Smiths Lake, NSW).

Catostylus wilkesii Agassiz, 1862: 152 (Lake Illawara, NSW).

Crambessa mosaica symbiotica von Lendenfeld, 1884e: 410 (NSW, brown form); von Lendenfeld, 1885b: 926 (NSW, brown form); von Lendenfeld, 1887: 31 (Port Jackson, NSW); Whitelegge, 1889: 197 (Port Jackson, NSW).

Crambessa mosaica conservativa von Lendenfeld, 1884e: 410 (VIC, blue form); von Lendenfeld, 1885b: 926 (VIC, blue form); von Lendenfeld, 1887: 31 (Port Philip, Port Jackson, Illawarra Lake).

Catostylus mosaicus conservativus — Dawson, 2005b: 723–731 (genetic clade adjacent to Bass Strait).

Catostylus mosaicus mosaicus — Dawson, 2005b: 723–731 (genetic clade NSW to southern Qld).

[Synonymy restricted to Australian records]

Material examined. QM-G850, Moreton Bay (no date); 5 specs, c. 8 cm BD. QM-G3891, Repulse Bay, Qld, 26.03.1966, 'pale creamy network pattern on dorsal surface of umbrella, arms purple, blue mushroom shaped tubercules'; 1 specimen, c. 8 cm BD. QM-G302860, NW of Peel I., Moreton Bay, J.N.A. Hooper & S. Cook, 3.06.1993; 1 specimen, c. 10 cm BD, poor condition.

Remarks. The phenomenon of different colour morphs of *Catostylus mosaicus* occurring consistently in different regions has been noted by many authors, particularly with reference to the Sydney form being typically brown due to symbiotic algae in the tissues, and the Port Philip Bay form being typically deep blue due to lack of these algae. These two forms were given sub-species status based on these colour differences, and hailed as newly evolving species (von Lendenfeld 1884e, 1885b). In tropical Queensland waters, *Catostylus* is typically white with a narrow blue band around the margin of the bell (Gershwin, unpub.). In Moreton Bay, Agassiz & Mayer (1898) and Mayer (1915) remarked that almost every individual of *Catostylus* was deep cobalt blue, and this is still the case (P. Davie, pers. obs.). For the hundred or so years following von Lendenfeld's separation of the two forms, other authors recognised the colour differences but did not adopt the nomenclatural separation.

Pitt & Kingsford (2000a) studied the population ecology of *Catostylus mosaicus* from six different bays in the Sydney region, concluding that variations in abundance and timing of recruitment differed among bays, suggesting that the populations are isolated breeding units.

Dawson (2005a) compared two genes from each of nine populations of *Catostylus mosaicus* sampled from north of Moreton Bay to Melbourne, and northern Tasmania. He found a deep genetic divergence between eastern and southern clades that geographically separate around Cape Howe, on the border between NSW and Victoria. He then went on to revalidate the nomenclatural separation of von Lendenfeld's original two forms (Dawson 2005b).

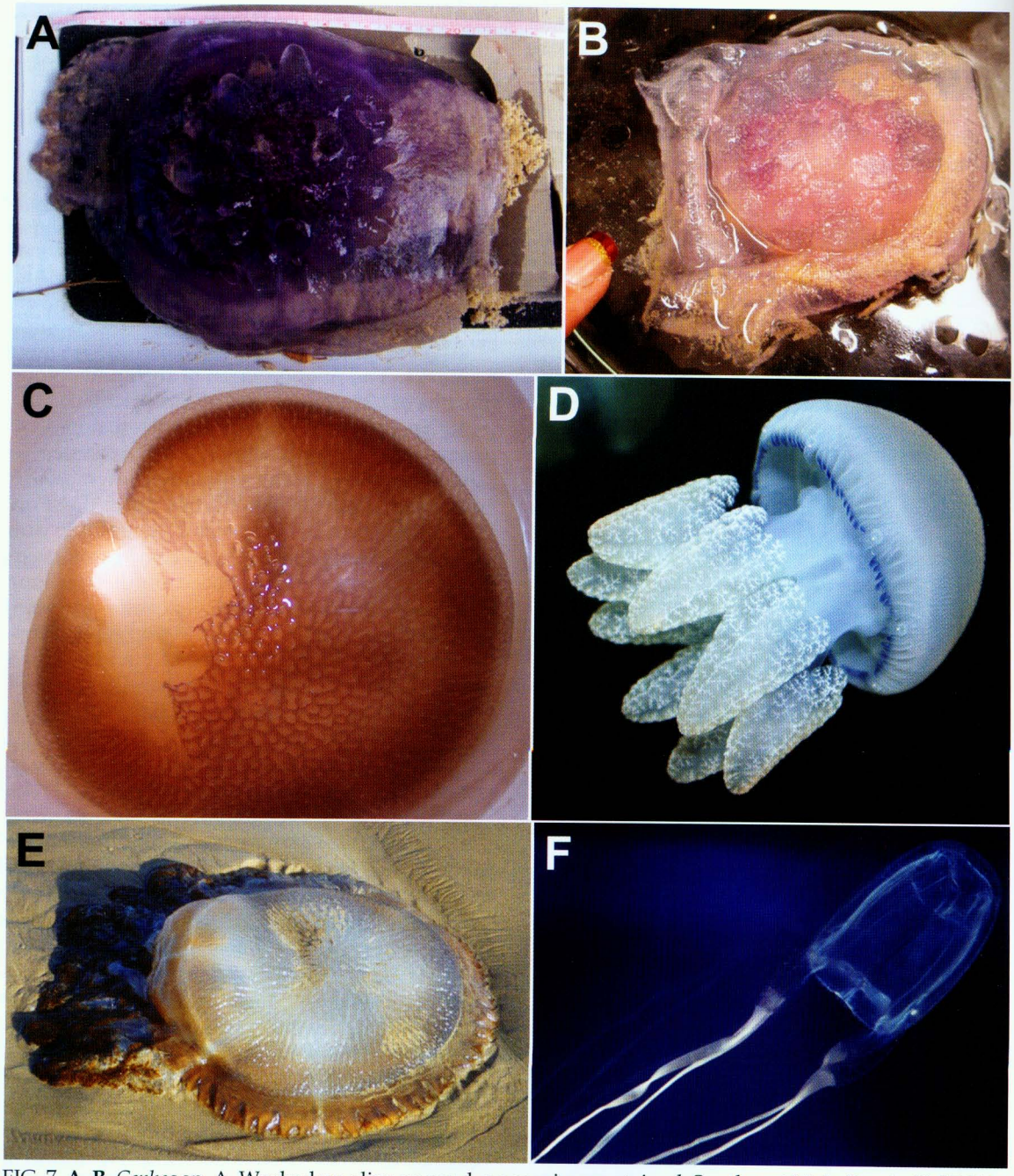


FIG. 7. **A, B**, *Cephea* sp. A. Washed up alive on sand, no specimen retained; Southport Main Beach, 13.05.2006 (photo by Col Neil, Qld Surf Lifesaving Assoc., used with permission). B. QM-G327915, Stradbroke I., Moreton Bay, preserved; fingernail = 1 cm wide. **C**, *Versuriga anadyomene*, live, (QM unregistered). **D**, *Catostylus* c.f. *mosaicus*, live, Cairns region colour morph. **E**. *Crambione cookii* Mayer, live, unregistered, washed up on beach near Mooloolaba, Sunshine Coast (photo by Puk Petersen, used with permission). **F**. 'Morbakka', live (QM-G322299), from Moreton Bay (photo copyright Queensland Museum, used with permission).

The morphology and genetics of the N Qld and Moreton Bay populations have not yet been studied in the light of this new information about the southern morphs. However based on colour alone, it seems possible that Moreton Bay and N Qld populations may also need separate species or subspecies status. Testing this hypothesis should be a priority for future research. However, before using separate names, it is important for nomenclatural stability that type specimen status be established, and neotypes, preferably with genetic voucher material, be established as required.

Crambione Maas, 1903

Crambione cookii Mayer, 1910
(Fig. 7E)

Crambione cookii Mayer, 1910: 677, pl. 74, fig. 1 (Cooktown, Qld); Kramp, 1970: 14 (only recorded from Great Barrier Reef).

[Synonymy restricted to Australian records]

Material examined. Photograph by Puk Petersen (Underwater World, Sunshine Coast), washed up on beach near Mooloolaba, Sunshine Coast, summer 1999–2000; approximately 45 cm BD, no specimen retained.

Remarks. Analysis of the photograph and witness statements suggest that this was *Crambione cookii*, which is native to tropical Queensland, but has not been reported since its original discovery. This record, therefore, comprises significant southerly range extension.

Class CUBOZOA Werner, 1973
Order CARYBDEIDA Gegenbaur, 1856 (sensu Werner, 1984)

TAMOYIDAE Haeckel, 1880
(sensu Gershwin, 2005a)

Morbakka Gershwin, 2008

Morbakka Gershwin, 2008: 24–25.

Diagnosis. Tamoyidae with tall, robust, conspicuously warty body; with flat, broad, ribbon-like tentacles; with well developed 'spike' in bend of pedalial canal; with conspicuous perradial lappets on the velarium; with long, straight 'rabbit-ear-form' rhopalial horns; exumbrellar warts typically coloured bright pink.

Morbakka fenneri Gershwin, 2008
(Fig. 7F)

Morbakka fenneri Gershwin, 2008: 26–31, figs 1–5.

Distribution. *Morbakka fenneri* was first found in the Moreton Bay region; it is said to be commonest at Redcliffe, but has also been found at Stradbroke I.. The larger form is commonest at Mackay, where one or two specimens a year are collected (P. & D. Barker, pers. com.); a few specimens have been collected at Port Douglas or Cairns (B. Cropp, pers. com.; R. Hore, pers. com.); a single specimen was collected at Balgal Beach, north of Townsville, and a couple at Ayr, south of Townsville. It has also been collected offshore from Cairns (Little *et al.* 2006). Smaller forms have been found occasionally from Coffs Harbour (NSW) to Sydney.

Remarks. The Cubozoa of Australia were recently revised by Gershwin (2005a, 2005b, 2005c, 2006a, 2006b, 2007, 2008) and Gershwin & Alderslade (2005, 2006). The species commonly referred to as 'Morbakka' (Fenner *et al.* 1985; Southcott 1985) actually comprises several regional morphs, most of which are yet to be sufficiently understood for proper diagnosis (Gershwin, 2008). The 'Moreton Bay carybdeid' (from whence the common name 'Morbakka' was derived) was formally described in volume 1 of the Moreton Bay Workshop proceedings; however, resolving the question of whether 'Morbakka' as we know it is a species or a species cluster must await collection and study of additional material.

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