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# *Morbakka fenneri*, a new genus and species of Irukandji jellyfish (Cnidaria: Cubozoa)

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## ABSTRACT

A cubozoan jellyfish, *Morbakka fenneri* gen. nov., sp. nov. is described. *Morbakka* differs from other genera and species in the Carybdeida by having a large, warty body; flat, ribbon-shaped tentacles; a prominent upward-pointing ‘thorn’ at the bend of the pedalial canal, and conspicuous broadening of the canal where it meets the tentacle; frown-shaped or dumbbell-shaped rhopalial niche ostium; long, straight, rabbit-ear shaped rhopalial horns; lack of non-lensed eye spots on the rhopalia; and three types of tentacular nematocysts and two types of bell nematocysts. Its morphology, genetics and sting symptoms clearly put it in the Irukandji group (i.e., *Carukia*, *Malo*, *Gerongia*), most closely related to *Gerongia rifkinae*. A larger northern Queensland form, and a smaller New South Wales form of *Morbakka* may also prove to be specifically distinct. *Morbakka* has been associated with severe Irukandji syndrome. □ *Cnidaria*, *Cubozoa*, *Tamoyidae*, *Irukandji syndrome*, *fire jelly*, *jellyfish*, *marine stingers*, *Queensland*, *Australia*.

A large and conspicuous eastern Australian cubozoan commonly called ‘morbakka’, ‘fire jelly’ or ‘tamoya’, has been well known to marine scientists, and to Queensland Surf Life Savers, for more than 20 years. Curiously it has never been properly classified or formally described, and this is finally undertaken in the present paper.

*Morbakka* was first described in the non-taxonomic sense by Southcott (1985), and has been extensively discussed by Fenner (1985, 1986b), Williamson *et al.* (1996), and others (see literature compilation under genus Remarks). However, more than 20 years later, our knowledge of this conspicuous and important animal has progressed little. Fenner (1986b, 1991, 1997) demonstrated that it can give systemic symptoms similar to Irukandji syndrome, and Little *et al.* (2006) recently implicated it (as ‘fire jelly’) in a serious sting resulting in heart failure. However, its reproductive biology, predator-prey ecology, and seasonal patterns have never been investigated, and nor have its toxins been studied.

Hopefully, the first formal description of the genus that is presented here, and the summary of current knowledge included, will help to stimulate further taxonomic investigation, as well as essential research into ecology, toxicology, and basic biology.

## MATERIALS AND METHODS

All taxonomic observations and measurements were made on preserved material unless otherwise noted. Measurements were made with Max-Cal digital calipers to the nearest 0.01 mm. Bell height (BH) was measured from the apex of the bell to the velarial turnover. Diagonal bell width (DBW) was measured across diagonal pedalia on a flattened specimen, at the height where the pedalius joins the exumbrella of the bell. Interrhopalial width (IRW) was measured between adjacent rhopalia, with the specimen flattened. Tentacle base width (TBW) was measured at the uppermost part of the tentacle, immediately below the pedalius; if the tentacle was flattened, width was measured across the widest points. In opaque specimens, a search

for phacellae was made by making a small incision in the upper corners of the bell, and then pulling back a small amount of mesoglea to expose the floor of the stomach, or by opening up the full length of the body wall to expose the stomach, and then opening the stomach in the same manner. In transparent specimens, absence of phacellae was obvious. Nematocysts were examined and measured with a Leica DMLB compound microscope and Leica IM-50 Image Manager v. 1.20 for Windows; all observations and photographs were made through a 40x objective (i.e., 400 x magnification). Nematocysts were identified following the keys of Calder (1974), Mariscal (1971), Williamson *et al.* (1996), and Gershwin (2006a).

*Abbreviations used.* Australian Museum, Sydney (AM); Museum of Tropical Queensland, Townsville (MTQ); Queensland Museum, Brisbane (QM); and South Australian Museum, Adelaide (SAM). Specimens from the Peter J. Fenner international cubozoan collection are indicated with his initials (PJF), and are housed in the Queensland Museum; specimens from the Ronald V. Southcott collection are indicated with his initials (RVS) and correspond to extensive notes archived in the South Australian Museum. Everywhere in the text that 'morbakka' is not italicised, it is being used as a common name.

#### SYSTEMATIC ACCOUNT

Phylum CNIDARIA Verrill, 1865

Subphylum MEDUSOZOA Petersen, 1979

Class CUBOZOA Werner, 1973

Order CARYBDEIDA Gegenbaur, 1856  
(sensu Werner, 1984)

Family TAMOYIDAE Haeckel, 1880  
(sensu Gershwin, 2005a)

#### *Morbakka* gen. nov.

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

**Type species.** *Morbakka fenneri* sp. nov., here designated.

**Etymology.** The genus name, *Morbakka*, is taken from the common name 'Morbakka', which

was derived by Southcott (1985) from 'Moreton Bay carybdeid'. Using the same term for both the scientific and common name should prevent any confusion in future reference to these animals. Gender is masculine.

**Remarks.** Gershwin (2005a, and earlier papers) considered Morbakka to be so closely allied to the 'Darwin carybdeid', *Gerongia rifkinae* Gershwin & Alderslade, 2005, that she considered them to belong to the same genus. However, the cnidomes are so distinct, as are fine structures such as the rhopalial horns and velarial canals, that I now believe generic distinction is necessary. Nevertheless *Gerongia* and *Morbakka* form a clade distinct from the 'true Irukandjis' (*Carukia* species), as well as from the 'pseudo-Irukandjis' (*Malo* species). Sting data indicate that *Malo* spp. are the most dangerous because they can cause life-threatening hypertension. Species of *Carukia* cause distressing, but not life-threatening illness, while the *Gerongia* + *Morbakka* clade cause the least severe envenomations and may be termed 'mild Irukandjis'. It should be noted that symptoms resembling Irukandji-syndrome can also result from stings from the multi-tentacled form of *Physalia* (Hydrozoa: Siphonophora), *Gonionemus* (Hydrozoa: Limnomedusae), *Nemopilema nomurai* (Scyphozoa: Rhizostomeae), as well as at least two cubozoans in the family Alatinidae (Fenner *et al.* 1993; Williamson *et al.* 1996; Yoshimoto & Yanagihara 2002; Gershwin 2005a, 2005c).

Locally, *Morbakka* has often, and erroneously, been identified as *Tamoya*, however *Morbakka* lacks any trace of the gastric phacellae that are diagnostically present and vertical in *Tamoya*.

#### Previous literature relating to *Morbakka*.

*Specific to Moreton Bay form.* As Morbakka – Southcott 1985: 324 (derivation of name); Fenner *et al.* 1985: 550–555 (severe sting case at Moreton Bay, sting experiments with specimens from Mackay); Fenner 1987: 97, fig. 3 (sting at Maroochydore, Sunshine Coast); Fenner 1997: 36–39, 51, 102–104, and throughout (stings and specimens, Sydney to Mackay). As *Tamoya virulenta* – Davie 1998: 238 (field guide). As *Tamoya gargantua* – Payne 1960: 5 (Moreton Bay and Gold Coast).

*Specific to larger northern form(s).* As Morbakka – Fenner *et al.* 1985: 550–555 (severe sting case

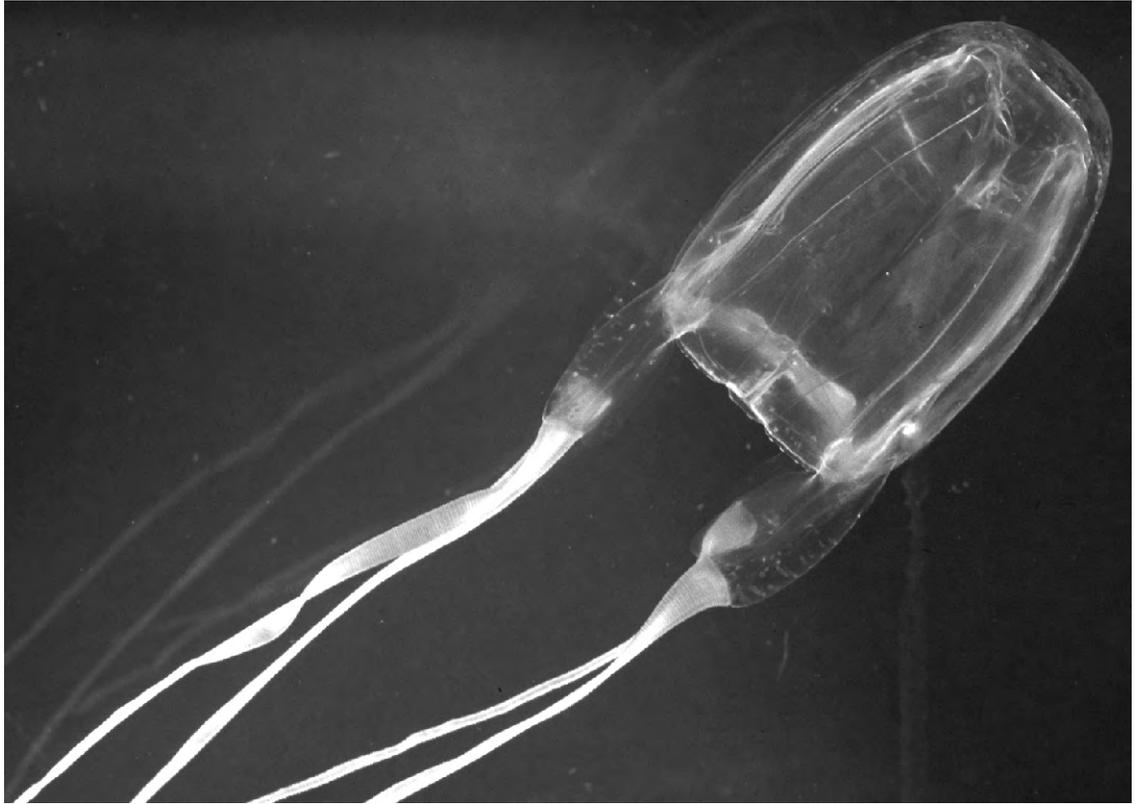


FIG. 1. *Morbakka fenneri* sp. nov., holotype specimen (QM-G322299), from Moreton Bay, photographed live (photo copyright Queensland Museum, used with permission).

at Moreton Bay, sting experiments with specimens from Mackay); Fenner 1986b: 118–119 (fire jelly, identification, stings; Mackay); Fenner 1997: 36–39, 51, 102–104, and throughout (stings and specimens, Sydney to Mackay); Gershwin 2006a: 11, 41, pl. 23 (cnidome). As Fire jelly – Little *et al.* 2006: 426, table (life-threatening envenomation, Briggs Reef, off Cairns Qld).

*Non-specific mention.* As *Morbakka* – Fenner 1986a: 99 (fire jelly, stings); Burnett & Calton 1987: 581–602 (toxicology); Williamson *et al.* 1987: 222–223 (identification, stings, treatment); Fenner 1991: 638–639 (fire jelly, morbakka comprises two species at least); Gurry 1992: 31 (medical); Franc 1995: 914 (stings); Pearn 1995: 107 (stinging); Williamson & Burnett 1995: 105 (fire jelly, medical); Holmes 1996: S26 (stings); Williamson *et al.* 1996: 148–149, 241–245, and various, pl. 9.7 (medical and biological); Morandini & Marques 1997: 188–189 (comparison with Brazilian syndrome); Fenner 1998: 22–27 (fire

jelly, Irukandji-like syndrome); White *et al.* 1998: 113–114 (medical); Sutherland & Nolch 2000: 17–18 (fire jelly, medical); Burke 2002: 19 (stings); Taylor *et al.* 2002: 175–180 (comparison to Irukandji sting of unknown origin); Gershwin 2005a: 118, pl. 4.6B, D, and throughout (taxonomy and phylogeny); Gershwin 2005b: 23 (comparison with *Malo maxima* and other Irukandjis); Gershwin 2005c: table 1 (comparison with other carybdeid forms); Gershwin & Alderslade 2005: 27–36 (comparison to *Gerongia rifkinae*); Gershwin 2006b: 801–802 (reply to Little *et al.* 2006 paper, comments on priority of claims in authorship of knowledge); Fenner 2006: 802–803 (reply to Little *et al.* 2006 paper); Gershwin 2007: 64–66 (comparison with other Irukandji species. As Tamoya – ? Pope 1951: 270–272 (New Caledonia, harvested for food); Exton *et al.* 1989: 625–626 (fire jelly, use of cold packs); Sutherland 2001: 607–609 (medical); Fenner 2002: 1169 (‘Irukandji-like’ syndrome).

***Morbakka fenneri* sp. nov.**

(Figs 1–5)

*Tamoya virulenta* — Davie, 1998: 238, colour photograph [reproduced here as Fig. 1] (not *T. virulenta* Kishinouye, 1910).

*Tamoya gargantua* — Payne, 1960: 5; Moreton Bay and Gold Coast. (not *T. gargantua* Haeckel, 1880).

**Material examined.** HOLOTYPE. QM-G322299, North Stradbroke I., 13.01.1998, coll. Dept. of Environment; 110.41 mm BH, 98.84 mm DBW, 50.90 mm IRW, 16.49 mm TBW (Figs. 1, 2A).

PARATYPES. **Queensland:** QM-G313646, Scarborough Boat Harbour, coll. Scarborough Seafoods, 30.01.1998. QM-G317014 [PJF coll.], no locality, coll. Australian Institute of Marine Science. QM-G317016 [PJF coll.], Cape Hillsborough, N. of Mackay, D. Barker, 9.05.1987. QM-G317017 [PJF coll.], Bowen Harbour, Bowen, 20.05.1989. QM-G317018 [PJF coll.], Slade Point, N. of Mackay, D. Barker, 29.04.1989. QM-G317019 [PJF coll.], Slade Point, N. of Mackay, D. Barker, 29.04.1989. QM-G317020 [PJF coll.], Eimeo Beach, N. Mackay, 30.10.1985. QM-G317022 [PJF coll.], no locality, coll. Australian Institute of Marine Science. QM-G317026 [PJF coll.], Mackay Harbour, no date. QM-G317028 [PJF coll.], Mackay Harbour Beach, P. Fenner, no date. QM-G317029 [PJF coll.], Ayr, M. Mulcahy, 1991. QM-G317030 [PJF coll.], Mackay Harbour, 19.01.1986. QM-G317031 [PJF coll.], no locality, coll. Australian Institute of Marine Science. QM-G317048 [PJF coll.], Cape Hillsborough, N. of Mackay, 9.05.1987. QM-G317049 [PJF coll.], Ayr, M. Mulcahy, no date. QM-G317063 [PJF coll.], Mackay, no date. QM-G317071, female specimen, off Townsville, coll. R. Hartwick (Stn CF3), Tucker trawl, 10.04.1981. MTQ-G61430, 1 large specimen with two large fish protruding from gut, locality unknown (from JCU teaching collection). SAM-H1598 [RVS A265], 1 dissected specimen, with shrimp high up under bell, off Sandgate, Moreton Bay, inshore water, near surface, coll. Zool. Dept. Univ. Qld, 10.01.1957. SAM-H1599, commercial fishing grounds off Sarina, S. of Mackay, R. and R. Marriage, 30.04.2005; tissues preserved in EtOH housed at SAM. SAM-H1600, Marina Mirage, Dickson Inlet, Port Douglas, coll. Brett Kilpatrick, 17.04.2003, forwarded by R. Hore. SAM-H1601, Balgal Beach, north of Townsville, coll. Balgal Beach police officers, 12.10.2004. SAM-H1612 [RVS A2831], Mackay Harbour, P. Fenner, 18.04.1985, at surface. SAM-H1613, Mackay, no date. SAM-H1614, 3 specimens [rehydrated after being dried], Mackay, 1980–90s. **New South Wales:** AM-G15791, Port Jackson, coll. Sydney University Zoology Dept.; 1 spec., c. 65 mm BH, 55 mm DBW. AM-G14529, Ramsgate Beach, Botany Bay, M. Logan, 15.05.1974; 37.17 mm BH, 34.2 mm DBW, produced severe sting.

**Description of holotype.** Bell 110 mm tall, half as wide, with evenly thick mesoglea of rigid

consistency; with straight sides and flat to shallowly-rounded top. Exumbrellar surface with numerous gelatinous warts, especially concentrated apically; coronal furrow absent. Interradial furrows deep and well marked, extending to just above point of subumbrellar lamellae. Adradial furrows deep in lower half, with well defined interradial pillars and perradial ‘smile lines’; shallower in upper half.

Pedalia 4, one on each corner of bell, simple and unbranched, long scalpel-shaped, lacking any overhang of inner keel (Fig. 2B). Pedalial canals quadratic in cross section throughout length, broadly flaring to meet tentacle; with strongly defined upward-pointing ‘spike’ at bend, adaxially along lamella, with rounded abaxium and point (Figs. 2B, C). Pedalia armed with haphazardly arranged, raised, horizontal bars of nematocysts confined to outer keel. Measurements of one pedaliu: 53.70 mm in length, 23.82 mm in width at midpoint; at midpoint, pedalial canal 8.22 mm wide, inner keel 8.45 mm wide, and outer keel 7.56 mm wide; thus, ratio of the keels to the canal about 1:1:1. Tentacles 4, one per pedaliu, unbranched; flat, ribbon-like, broad, with base considerably flared to meet pedaliu.

Rhopalial niche region prominently raised upon ‘perradial pillar’ defined by adradial furrows on both sides. Rhopalial niche ostium with two covering scales (1 upper, 1 lower), both broadly convex in outline, forming frown-shaped or dumbbell-shaped ostium (Figs. 2D, E). Rhopalial horns could not be observed in this specimen due to partial opacity of preserved mesoglea, but observed in other specimens to be long, straight, with a ‘rabbit ear’ appearance (Figs. 2D, 3A). Subumbrellar rhopalial windows flat, indented only at point of rhopalial stalk (Fig. 3A); frenulum extending over window to point of rhopalial connection. Eye spots faded in this specimen by the time of study, but observed in other live specimens to lack lateral eye spots, similar to those described for *Malo maxima* and *Malo kingi* (Gershwin 2005b, 2007). Rhopalial warts not studied in this specimen, but observed on adaxial side of stalk in other specimens (Fig. 3B). Statolith shape unknown.

Velarium broad and heavy, connected to subumbrella with 4 perradial bracket-like frenulae.

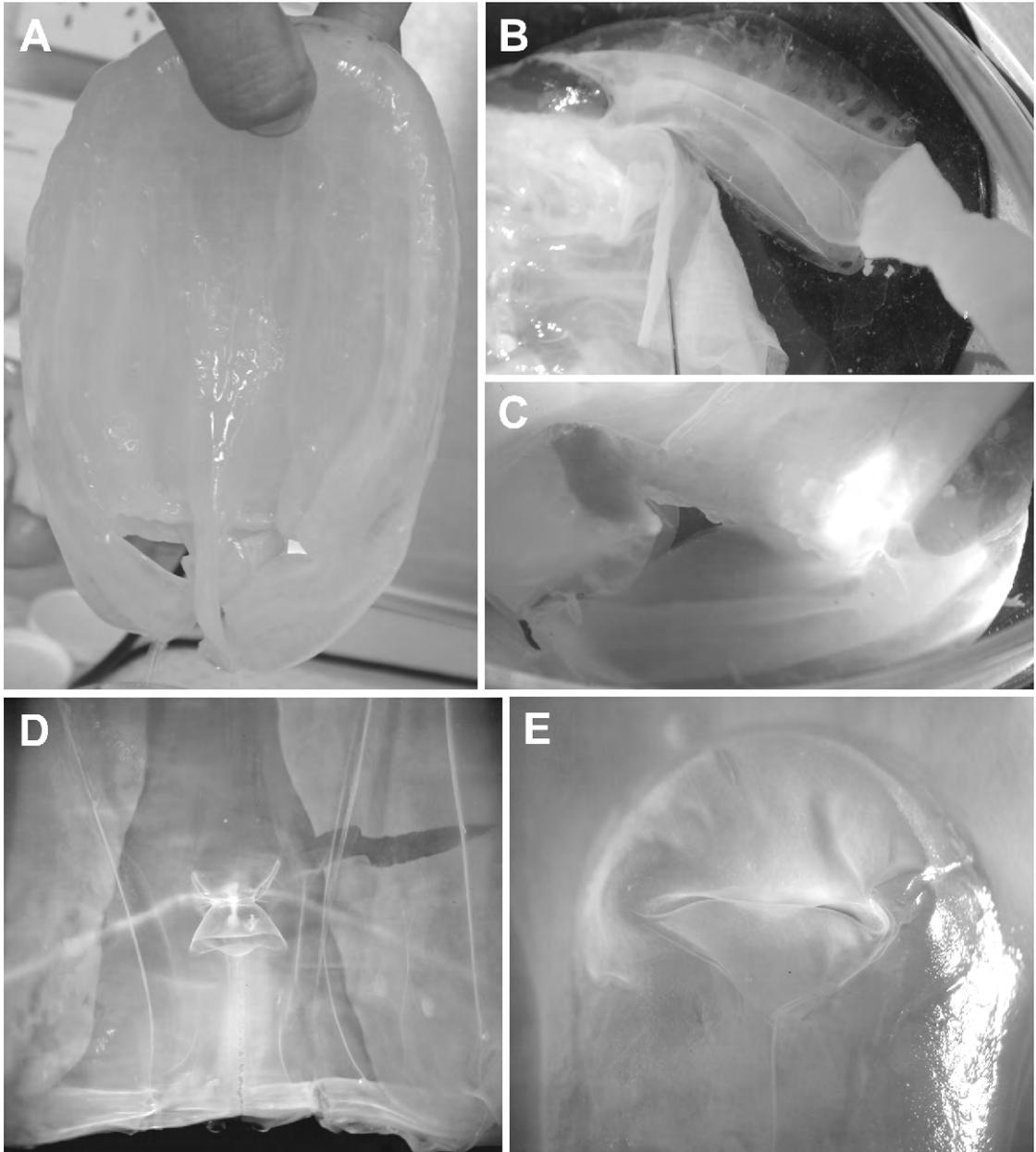


FIG. 2. *Morbakka fenneri*, sp. nov. **A**, holotype, preserved. **B**, paratype SAM-H1600 (Port Douglas), showing general pedial shape, and form of pedial canal. **C**, holotype, showing rounded tip of pedial canal spike. **D**, paratype SAM-H1598 [RVS A265], showing general shape of rhopial niche, upper and lower covering scales, and rhopial horns. **E**, holotype, showing elevated rhopial region.

Frenulae well developed, hollow along free edge, upon a solid gelatinous base; extending out onto velarium about halfway to margin, and in the other direction to top of rhopial windows

as described above. Velarial canals so overgrown in this specimen so as to appear as one solid mass, with only the tips defined along the velarial margin; in most *Morbakka* specimens,

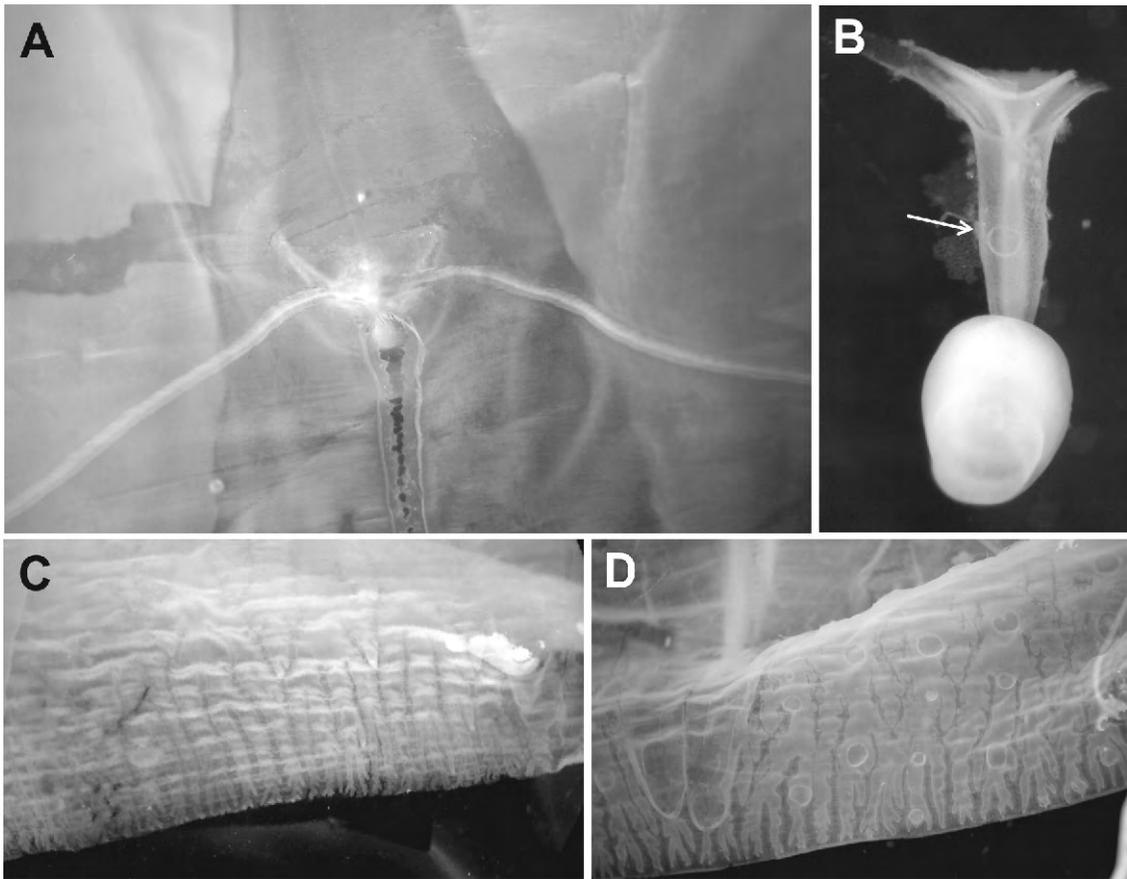


FIG. 3. *Morbakka fenneri* sp. nov. **A**, paratype SAM-H1598 [RVS A265], subumbrellar view of rhopaliar window and rhopaliar horns; note also upper portion of frenulum extending from rhopaliar to bottom of photo. **B**, paratype SAM-H1598 [RVS A265], rhopaliar dissected out of specimen, showing rhopaliar wart on stem (arrow). **C**, velarium; note lack of warts and massive perradial lappet just visible on left of photo. **D**, velarium, paratype specimen SAM-H1600 from Port Douglas; note narrow perradial lappets to left of photo, and gelatinous warts scattered over canals. Note also, different branching patterns between two specimens, parallel in C, dendritic in D.

velarial canals appear as separated, parallel, well-defined straight canals with numerous lateral diverticula, resembling 'feathers' or 'trees' (Fig. 3C), or as dendritic canals (Fig. 3D). Perradial lappets very narrowly triangular in shape in holotype (cf. Fig. 3D); in some specimens perradial lappets massive (Fig. 3C). Velarium armed with nematocyst warts scattered on lappets, lacking on canals; some other specimens lack warts (Fig. 3C) or warts lacking on lappets but present over canals (Fig. 3D).

Manubrium moderately long, extending to about one-half height of bell cavity. Mouth with four well-developed triangular lips, with slightly

thickened margins and straight, uncrenulated edges (Fig. 4A). Stomach large and bag-like, connected to subumbrellar surface with well-developed mesenteries. Mesenteries flap-like in upper half of bell, with a fine cord extending down to rhopaliar. Floor of stomach densely patterned with parallel corrugations (Fig. 4B; termed 'area corrugata' by Southcott, 1967); gastric phacellae lacking.

Gonads leaf-like, pleated, attached along each of 4 interradial septa as pairs of hemi-gonads; full-length of subumbrellar cavity, reaching both stomach and pedial regions, with attachment along total length of gonadal sheets; gonads

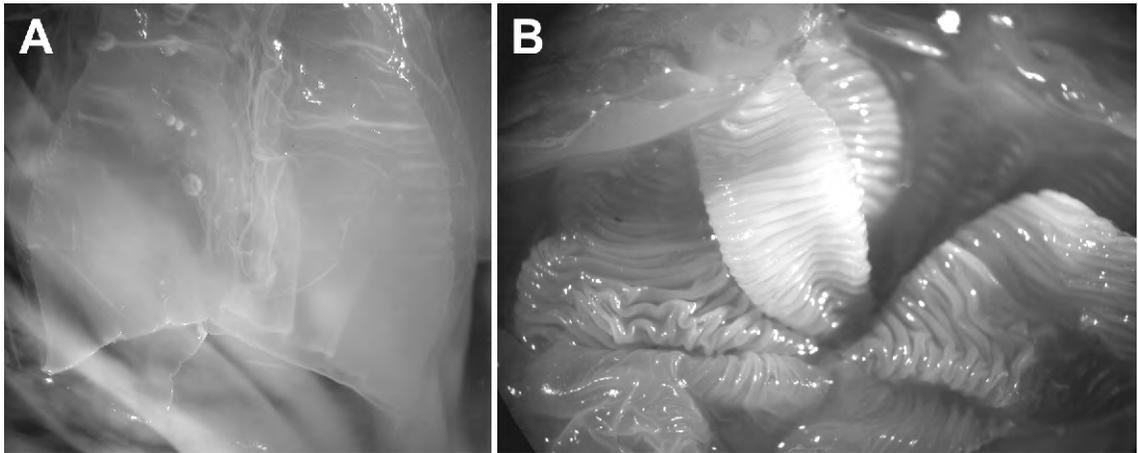


FIG. 4. *Morbakka fenneri* sp. nov. A, paratype SAM-H1600 from Port Douglas, manubrium and lips; note smooth, straight edges. B, paratype QM-G317071, area corrugata in stomach; note lack of gastric phacellae.

narrow in this specimen, about as broad as pillars, possibly immature or recently spawned. Inter-radial suture not interpreted due to thickness of mesoglea obscuring view.

**Colouration:** Preserved specimen with translucent mesoglea; colourless warts; tentacles pink. In life (based on observations of other specimens), bell is transparent to translucent, nematocyst warts bright pink, and tentacles pale pink.

**Nematocysts** (Fig. 5). According to Cleland & Southcott (1965: pl. 2), the tentacles contain holotrichous isorhizas and unidentified haplonemes. According to Hartwick (unpublished nematocyst identification poster), the tentacles contain microbasic *p*-mastigophores, 45–75  $\mu\text{m}$  long, and 2 types of football shaped isorhizas, 45  $\mu\text{m}$  long, and the bell warts contain subspherical isorhizas of two types, similar to those on the tentacles. According to Gershwin (2006a), who studied the cnidome of a specimen from Port Douglas, the tentacles contain three types of nematocysts – club-shaped microbasic *p*-mastigophores (Type 4), spines scattered, 60–70  $\mu\text{m}$  long  $\times$  13–18  $\mu\text{m}$  wide; and two types of large oval isorhizas, one with loose tubule, one with tight tubule, 49–56  $\mu\text{m}$  long  $\times$  28–34  $\mu\text{m}$  wide. She further found that the bell warts contain two types of nematocysts: 1) spherical isorhizas, 27–30  $\mu\text{m}$  long; and 2) oval, poorly defined, with papillated outer surface and loosely wound tubule, as wide as type 1, but 1.5 times as long.

Currently no information is available about the nematocysts of the manubrium.

**Etymology.** This species is named to honour Professor Peter Fenner AM, M.D., who has devoted much time and personal interest to resolving the differences between this species and other large cubozoans. I have unwavering admiration and respect for his knowledge and dedication to marine stinger research and stinger safety, and he has been a personal inspiration and mentor in my study of cubozoans.

**Ecology.** *Morbakka fenneri* is relatively rare, being only occasionally found, and then as solitary collections. No information presently exists as to its general behaviour, life cycle, or predator-prey relationships.

**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 Island. The larger form is most common at Mackay, where one or two specimens a year are collected (P. and D. Barker, pers. comm.); a few specimens have been collected at Port Douglas or Cairns (B. Cropp, pers. comm.; R. Hore, pers. comm.); 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). A smaller form is occasionally found in New South Wales from Coffs Harbour to Sydney.

**Sting Potential and Management.** *Morbakka fenneri* is capable of inflicting a severe sting which may

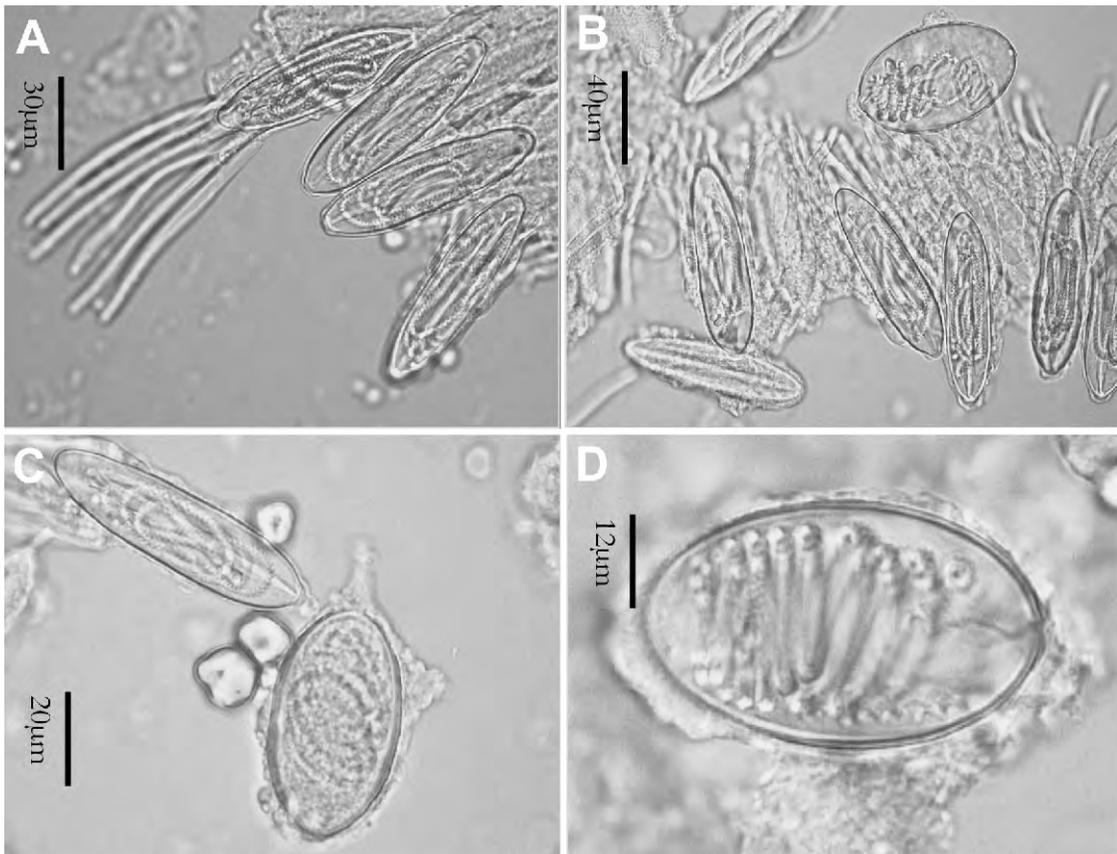


FIG. 5. *Morbakka fenneri* sp. nov., tentacular nematocysts, from paratype specimen SAM-H1600 (Port Douglas). **A**, club-shaped microbasic p-mastigophores (with fibrils still connected to the nematocyst in the lower right). **B**, mastigophores and large oval isorhiza. **C**, mastigophore and large oval isorhiza. **D**, large oval isorhiza. [Previously published in Gershwin 2006a].

include symptoms similar to Irukandji Syndrome as first noted and described by Fenner *et al.* (1985) and Fenner (1991, 1997, 2006). Little *et al.* (2006) even reported a life threatening case, in which heart damage occurred, though this is exceptional.

*Morbakka* stings are best avoided by the use of protective clothing. Management of stings should include dousing the stung area with plenty of vinegar to neutralise undischarged nematocysts; ice packs may help to reduce pain and swelling, but should not be used prior to vinegar. If systemic symptoms onset (e.g., body pain, nausea or vomiting, difficulty breathing, sweating), or if in doubt, ring '000' for an ambulance; the patient should be transported to hospital as soon as possible.

**Remarks.** *Morbakka* is often erroneously called 'tamoya' among Queensland Surf Life Saving groups, but *Morbakka fenneri* and *Tamoya haplonema* (also sometimes locally called *Tamoya virulenta*) appear to be only convergently similar. No member of the Irukandji group in Australia, including *Morbakka*, possesses gastric phacellae, whereas the western Atlantic *Tamoya haplonema* does. Other differences between *Morbakka* and *Tamoya* include: *Morbakka* has well developed perradial lappets, whereas they are lacking in *Tamoya*; *Tamoya* has lateral eye spots, whereas *Morbakka* does not; and *Morbakka*, like the other species in the Irukandji group (i.e., *Carukia*, *Malo*, *Gerongia*), has pronounced rhopaliar horns, whereas they are absent in *Tamoya*. Furthermore, the nematocysts are entirely different:

*Morbakka* tentacles have three types of nematocysts, club-shaped microbasic *p*-mastigophores with dense spines the entire shaft length, and loose- and tight-tubule large oval isorhizas, whereas *Tamoya* tentacles have only one type of nematocysts, club-shaped rhopaloids with a very long shaft and spines concentrated on a swelling at the distal end, with a tuft of spines midway. *Morbakka* is also often colloquially called 'fire jelly', in reference to the pain of the sting; however, the common name 'fire jelly' is also often applied to any sting of unknown origin in tropical Queensland, so one must be cautious in interpreting sting data relating to these terms.

From its closest known genetic and morphological relative, *Gerongia rifkinae*, *Morbakka* is easily distinguished by its size and shape, bell wartiness, colouration of the warts, and nematocysts. Whereas *G. rifkinae* reaches about 60 mm BH and 20 mm BD, *Morbakka* come in at least two sizes: the classic Moreton Bay form reaches about 90 mm BH and 30 mm wide, and the northern form reaches about 180 mm BH and 60 mm wide; another much smaller form, about 25 mm BH and 10 mm wide, is known only from New South Wales. The bell of *G. rifkinae* is sparsely freckled with low purple nematocyst warts, whereas the bell of *Morbakka* is densely warted with magenta raised gelatinous knobs. Finally, the tentacular nematocysts of *G. rifkinae* are entirely Type 4 microbasic *p*-mastigophores, whereas three types of nematocysts are present on the tentacles of *Morbakka*, as described above. A comparative table of diagnostic characters of genera in the Tamoyidae was given by Gershwin & Alderslade (2005).

Fenner (1986b, 1991, 1997) was the first to note consistent differences between typical Moreton Bay and north Queensland forms, suggesting that 'morbakka' comprises at least two different species. North Queensland morbakkas are typically large, however large specimens do also occur in Moreton Bay that closely resemble the northern form. Thus, the taxonomic and geographical boundaries remain problematic. Furthermore, there is a small New South Wales form that appears to be genuinely rare, and is currently only known from a small number of photographs and poorly preserved

specimens. So, while there is some evidence for three (or more) potential *Morbakka* species, only *M. fenneri* is currently here recognised. Resolution of this issue will require a more detailed study of morphology, and internal structures, of a good series of specimens from each of the three groups — perhaps reinforced by additional molecular analyses.

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