**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 rhopaliial niche ostium; long, straight, rabbit-ear shaped rhopaliial 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, toxinology, 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 pedaliium joins the exumbrella of the bell. Interrhopaliial 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 pedaliium; 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 pedalial 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 larger northern form(s). As Morbakka — Fenner et al. 1985: 550–555 (severe sting case
A new Irukandji jellyfish

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


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).


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). Pedialical 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 pedalium: 53.70 mm in length, 23.82 mm in width at midpoint; at midpoint, pedialical 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 pedalium, unbranched; flat, ribbon-like, broad, with base considerably flared to meet pedalium.

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.

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). Pedialical 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 pedalium: 53.70 mm in length, 23.82 mm in width at midpoint; at midpoint, pedialical 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 pedalium, unbranched; flat, ribbon-like, broad, with base considerably flared to meet pedalium.

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.
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 rhopalial 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,
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 rhopalium. 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. 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 rhopalium to bottom of photo. B, paratype SAM-H1598 [RVS A265], rhopalium 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.
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 µm long, and 2 types of football shaped isorhizas, 45 µm 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 µm long x 13–18 µm wide; and two types of large oval isorhizas, one with loose tubule, one with tight tubule, 49–56 µm long x 28–34 µm wide. She further found that the bell warts contain two types of nematocysts: 1) spherical isorhizas, 27–30 µm 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
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.

ACKNOWLEDGEMENTS

With deepest gratitude I thank Peter Fenner for introducing me to the fabulous world of cubozoans, for laying the observational and intellectual foundation of knowledge on Morbakka, for bringing me back to Australia to work and study, and for unwavering support through academic adversity; you are my hero, Peter. I am grateful to the following people and institutions for specimens and information (in alphabetical order): Balgal Beach police officers, Paul and Dave Barker, Steve Cook, Ben Cropp, Peter Davie, Barb Done, Merrick Ekins, Peter Fenner, John Hooper, Russell Hore, Brett Kilpatrick, Thierry Laperousaz, Rhonda and Russell Marriage, Museum of Tropical Queensland, Port Douglas boat hire, Queensland Museum, Jacque Rifkin, South Australian Museum, and Wolfgang Zeidler. Field work and travel costs were generously funded by the South-east Queensland Branch of the Australian Marine Sciences Association, the Australian-American Fulbright Foundation, the Australian Biological Resources Study (grant no. 20045 to LG and W. Zeidler; grant no. 207-63 to LG), CRC Reef Research, James Cook University, the Robert W. King Memorial Scholarship Foundation, Lions Foundation, and the University of California.

LITERATURE CITED


Cleland, J.B. & Southcott, R.V. 1965. Injuries to Man from Marine Invertebrates in the Australian Region.


A new Irukandji jellyfish


