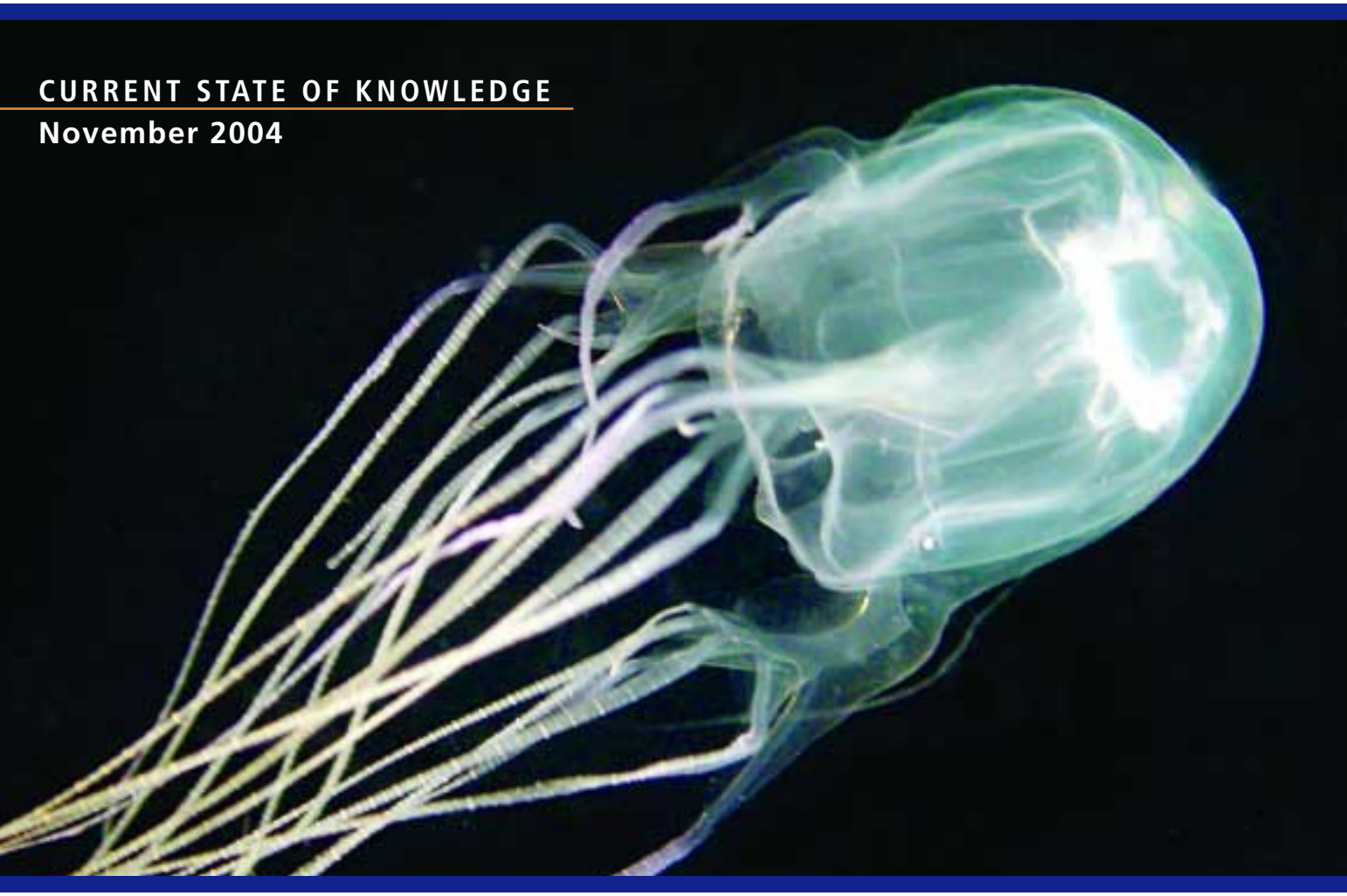
Stinging Jellyfish
in tropical Australia

CURRENT STATE OF KNOWLEDGE
November 2004



With few exceptions, jellyfish that cause debilitating or fatal stings in humans are cubozoan or box jellyfish which were named because of their box-shaped bodies. Box jellyfish can be found in most tropical waters around the world. In Australia, they are found in tropical waters predominantly in the wet season (November to May), but can be present throughout the year. The large multi-tentacled jellyfish *Chironex fleckeri* can be found close to the coast. In addition, several species of smaller jellyfish that can cause Irukandji syndrome are found near the coast as well as near reefs and islands.

Despite their notoriety, little is known about many box jellyfish. However, Commonwealth, state and local governments as well as universities, private individuals, community groups and philanthropic organisations are funding research to discover the types, distribution, seasonality and life cycles of these jellyfish. These funds are also supporting research to reduce the risk of being stung, improve the treatment of victims, and educate locals and visitors about box jellyfish.

Classifying box jellyfish

Jellyfish with box-shaped bodies or bells are called cubozoan jellyfish. They belong to the Phylum Cnidaria which also includes sea anemones, corals, true jellyfish and bluebottles.

There are two main groups of cubozoan jellyfish – chirodropids and carybdeids. Chirodropid jellyfish include the large box jellyfish *Chironex fleckeri* and species of *Chiropsalmus*. Carybdeids include the jimble *Carybdea rastonii and* Irukandji jellyfish such as *Carukia barnesi*.

Chirodropid jellyfish can be larger than carybdeid jellyfish. For example, *Chironex fleckeri* can grow 300-380mm across the bell and one species of *Chiropsalmus* can grow to 90mm across the bell. The carybdeid jellyfish *Carukia barnesi* usually only grows to about 10mm across the bell. Other carybdeids can grow to 80mm across the bell.

Chirodropid jellyfish have multiple tentacles hanging from each of the four corners of their bells while carybdeids usually have a single tentacle hanging from each corner. For example, *Chironex fleckeri* can have up to 60 tentacles, 15 on each corner. Species of *Chiropsalmus* can have up to nine tentacles on each corner of the bell.

In contrast, the carybdeid jellyfish *Carukia barnesi* has a single retractile tentacle, up to 750mm long, hanging from each corner of its body. The jimble *Carybdea rastonii* also has a single tentacle from each corner of its bell which can be up to 300mm long. However, some species of carybdeids may have several tentacles from each corner. For example, *Tripedalia binata* has two tentacles from each corner of its bell.

Photo by Lisa-ann Gershwin

The stinging cells of some cubozoan jellyfish are concentrated in bands on the tentacles

Chirodropid jellyfish usually only have stinging cells on their tentacles. Most carybdeid jellyfish such as *Carukia barnesi* have stinging cells on both the body and tentacles.

Distribution & abundance

Box jellyfish can be found in most tropical seas around the world. In Australia, they are found in tropical waters predominantly in the wet season (November to May), but may be present throughout the year.

Carukia barnesi, the first jellyfish shown to cause Irukandji syndrome, has been found from Port Douglas in north Queensland, to as far south as the Whitsundays. The jellyfish are found offshore as well as along coastal beaches when northerly or north-easterly winds and currents are thought to carry them onshore. The number of jellyfish in inshore waters can vary between years, probably due to changing weather conditions. In 1999-2000, two scientists sampling north of Cairns every day for four months over summer caught 270 *Carukia barnesi* (most of them were caught in three days). The following year, only two jellyfish were caught in the same time.

Life cycle

There are almost 30 species of cubozoan or box jellyfish but the life cycles of only a few are known. The life cycle of the box jellyfish *Chironex fleckeri* was revealed in the early 1980s.

Adult male and female jellyfish are thought to release sperm and eggs into the water. The fertilised eggs develop into 'planula' larvae which may swim for a few days before settling to the bottom of the creek. The planulae develop into polyps and crawl about for several days before attaching to rocks on the creek bed. The tiny polyps start feeding on plankton and then the polyps bud off extra polyps. Each polyp metamorphoses into a single miniature box jellyfish (called a medusa) about 1.5mm in size which grows and develops into larger jellyfish. These small jellyfish make their way to the creek mouth and along sandy beaches.

The life cycle of most carybdeid jellyfish including *Carukia barnesi* is unknown. The polyps of a carybdeid jellyfish from Puerto Rico have been found in creeks on dead bivalve shells.

Chirodropid Jellyfish

Chirodropid jellyfish have multiple tentacles hanging from each corner of their box-shaped bodies. They usually have stinging cells only on their tentacles.

Photo by Chloe Lucas, CRC Reef

Chironex fleckeri

- Large, almost transparent jellyfish up to 380mm across
- Up to 15 tentacles from each corner of its box-shaped body
- Found in tropical waters from Exmouth, WA to near Gladstone, Queensland
- Found near the coast and some coastal islands such as Magnetic Island near Townsville and some inshore Whitsunday Islands
- Severe and potentially life-threatening sting that causes burning skin pain. Severe stings may cause the victim's breathing to cease or the heart to stop

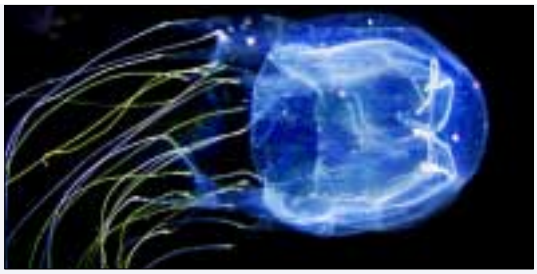


Photo by Lisa-ann Gershwin

Chiropsalmus

These jellyfish are smaller than Chironex and have up to nine tentacles from each corner of the bell. Only one species of Chiropsalmus was thought to occur in Australia (mistakenly called Chiropsalmus quadrigatus). Now thought to be several different species that are yet to be named. The sting is painful but does not cause Irukandji syndrome.

Vision & movement

Unlike many jellyfish, the multiple-tentacled box jellyfish *Chironex fleckeri* is a fast and agile swimmer and is rarely ever found washed up on beaches. It can swim at up to three knots and manoeuvre around pylons and piers. Although *Carukia barnesi* is also a box jellyfish, it is not as proficient at swimming as *Chironex fleckeri*.

All cubozoans have eyes so that they can hunt prey and avoid objects in the water. Each jellyfish has 24 eyes clustered into four groups of six on each side of its box-shaped body. There are two types of eye in each cluster – two complex eyes similar to human eyes (with retinas, lenses and corneas) and two simple pit eyes and two slit eyes. Although cubozoan jellyfish do not a have a brain (they have neurons concentrated in four nerve centres), recent studies indicate that they can form images.

Jellyfish also have organs called statocysts located below the eye clusters that help them maintain balance in the water. Inside each statocyst is a hard nodule called a statolith that is composed of calcium sulfate. In many species of box jellyfish, statoliths have daily growth rings and can be used for ageing them. It may also be possible to use statoliths to identify jellyfish species when their soft body parts are destroyed.

Feeding & venom

Box jellyfish feed on fish, crustaceans and other marine invertebrates. They use potent venom to quickly kill their prey so that it does not escape. The venom is contained in stinging cells called nematocysts. Most box jellyfish have several different types of nematocysts; the type and proportion of nematocysts can be used to identify some species.

The stinging cells have a miniature harpoon coiled inside them which is everted (turned 'inside –out') when the jellyfish contacts its prey. The bulb of the nematocyst injects toxin through the shaft and into the prey. The tentacle is contracted, and the pedalia (oar-like structures at the base of the tentacles near the bell) push the food into the manubrium or mouth which is located inside the bell. Once the nematocysts are fired, the jellyfish has to produce new nematocysts to replace them.

Photo by Teresa Carrette, JCU

Stinging cells have miniature harpoons coiled inside them

Chironex fleckeri has tentacles that can be extended to more than three metres long. There are billions of nematocysts along each tentacle. When *Chironex fleckeri* is young and eating mostly prawns, only five percent of the nematocysts contain venom which is potent to vertebrates. However, as the jellyfish grows and its diet switches to fish, the proportion of vertebrate-potent venom increases and can be found in 30-40 percent of the nematocysts.

It takes only a few centimetres of *Chironex* tentacle to kill a small fish. Only a few metres of tentacle (which may contain billions of stinging cells) is needed to contact a swimmer's exposed flesh to deliver a dose of venom that could be fatal within minutes.

Species of box jellyfish that cause 'Irukandji syndrome' appear to feed mainly on larval or adult fish.

The sting

The box jellyfish *Chironex fleckeri* are the most venomous marine creatures on the planet and, in Australia, have killed almost 70 people in the last 120 years. In the Northern Territory, fatal box jellyfish stings have been reported in every month of the year except August. Most stings occur in shallow water when the wind is light and the water calm (although stings have occurred in rough weather, in very dirty, deeper water). Victims usually blunder into tentacles trailing behind the jellyfish which are almost invisible in the water. Most stings occur on the lower legs and body.

Pain is instant and severe. The tentacles are like sticky threads and leave raised red marks. The venom of the box jellyfish is neurotoxic (attacks nerves), cardiotoxic (attacks the heart) and dermatonecrotic (destroys skin). Therefore, victims can rapidly stop breathing, sometimes within a few minutes of the sting. Death occurs rapidly unless prompt first aid and medical aid is available. If the victim survives, they are often scarred. Treating the sting sites as if they were

Carybdeid Jellyfish

Carybdeid jellyfish usually only have a single tentacle hanging from each corner of their box-shaped bodies. They have stinging cells on both body and tentacles.

Photo by Karen Gowlett-Holmes

***Carybdea rastonii*, jimble**

- About 15-40mm tall
- Found in southern waters from Coffs Harbour, NSW, to Albany, Western Australia

Photo by Lisa-ann Gershwin

Carybdea xaymacana

- Similar to *Carybdea rastonii* but smaller, rarely more than 15-25mm tall
- Common off Perth, from Busselton to Geraldton. Also found in Cairns region

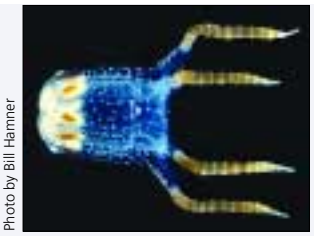


Photo by Bill Hamner

Carybdea sivickisi

- Up to 8mm tall, with adhesive pads on top of body, and orange and brown striped tentacles
- Common in algal beds of Magnetic Island near Townsville, the Whitsundays, Tasmania and South Australia

Photo by Lisa-ann Gershwin

Tripedalia binata

- Bell usually less than 10mm, with two tentacles on each corner
- Found near Darwin, Weipa and Cairns, typically among mangroves

burns greatly reduces the scarring, suggesting that it may be secondary infections that cause the scarring.

Irukandji syndrome

In 2002, stings from Irukandji jellyfish killed two people – one man in the Whitsundays and another on a reef near Port Douglas. It is possible that these jellyfish have been responsible for deaths in the past that were attributed to other causes such as decompression sickness, heart failure with fluid on the lungs (pulmonary oedema) and drowning.

The initial sting of the Irukandji jellyfish is usually not very painful although this is not always the case. Irukandji stings have been confirmed in shallow water as little as 30mm deep.

About 5-45 (usually 30) minutes after being stung, the person starts to develop 'Irukandji syndrome' – a set of symptoms that often include severe lower back pain, muscle cramps, vomiting, restlessness and anxiety. In rare cases, the victim can suffer pulmonary oedema (fluid on the lungs), hypertension or heart failure that could be fatal if not treated.

Carukia barnesi was the first jellyfish shown to cause Irukandji syndrome. It is named after Dr Jack Barnes who proved the link between its sting and the Irukandji syndrome. The syndrome is named after the Irukandji Aboriginal tribe who live in the Cairns area in north Queensland where *Carukia barnesi* is found.

Photo by Surf Life Saving Queensland

A stinger-resistant net in north Queensland

While Irukandji was originally used to refer to a single species of jellyfish, *Carukia barnesi*, it is now used to refer to any box jellyfish with a sting that produces Irukandji syndrome. So far, only a few species of carybdeid jellyfish have been shown to cause Irukandji syndrome, however, it is believed that a sting from several other species of jellyfish can produce the syndrome.

In Australia, most cases are restricted to waters north of the Tropic of Capricorn although some occur as far south as Bundaberg on the east coast. They occur mostly between November and May but cases have been recorded in all months of the year. In rare cases, Irukandji-like syndrome has been reported from Moreton Bay, Newcastle, in and around Sydney Harbour and near Perth.

The number of people who are stung and present to hospital each year varies - from only a few, to more than 200 people. In the summer of 2001-02, approximately 160 people were stung by mid February (approximately 100 people in Cairns, 10-15 in Townsville, 20 in the Whitsundays, 10-12 in Great Keppel, 15 in Agnes Waters). In the 2002-03 summer, about 40 people were stung in the same time. In the 2003-04 summer, 33 people were stung in Cairns.

First aid

1. **Call for assistance.** See a lifesaver or lifeguard or ring 000 and ask for ambulance.
2. **Emergency care.** The sting victim should be removed from danger when it is safe to do so, and restrained from rubbing the sting. Administer Cardio-Pulmonary Resuscitation if the victim's breathing or heart stops.
3. **Treat the sting.** The sting should be flushed with plenty of undiluted household vinegar. This disables the undischarged stinging cells (nematocysts) so that they cannot discharge and sting the victim. However, it is not an antidote and will not stop the scarring from *Chironex fleckeri* stings, nor the pain. Keep the victim calm.
4. **Seek medical aid.** Transport to hospital via ambulance. There is an anti-venom for *Chironex fleckeri* stings and medical assistance should be sought as soon as possible so that it can be administered. There is no anti-venom for Irukandji syndrome. In rare cases, envenoming by Irukandji jellyfish can cause dangerously high blood pressure (severe hypertension). The patient should be taken to hospital as soon as possible if they develop Irukandji syndrome to be treated for the pain and other severe systemic symptoms.

Photo by Ben Cropp

Fire jelly, Morbakka or Moreton Bay stinger

- Often erroneously called Tamoya (which do not occur in Australia)
- At least 3 undescribed species
- 60-80mm wide
- One flattened tentacle up to 1m long in each corner of bell
- Found from Port Douglas, Queensland to Sydney, NSW

Irukandji jellyfish

Stings from several species of almost transparent jellyfish may produce Irukandji syndrome in the victim. The sting from some species can cause very high blood pressure which could be life-threatening. Found near tropical islands, beaches and the outer reef.

Photo by Lisa-ann Gershwin

Carukia barnesi

- Almost invisible in water
- About 10mm across bell with one tentacle from each corner
- Found close to the coast between Port Douglas and the Whitsundays, Queensland
- Sting causes Irukandji syndrome

Photo by Mark Alexander

Undescribed carybdeids

Stings from several species of as yet undescribed carybdeids can produce Irukandji syndrome

Preventing the sting

Swim in supervised areas such as a beach where Surf Life Saving Queensland (SLSQ) Lifesavers and Lifeguards monitor the presence of dangerous jellyfish.

The mesh used in stinger-resistant nets in north Queensland is fine enough to keep out the box jellyfish *Chironex fleckeri* but may allow Irukandji jellyfish to pass through. A lycra body suit can help protect against stings.

Photo by Townsville Bulletin

Surf Life Saving Queensland monitors the presence of jellyfish at supervised beaches

Future research

There is still much research to be done to better understand box jellyfish. Some key areas of research include:

- Unravel the life cycle of *Carukia barnesi* and other Irukandji jellyfish.
- Identify factors that cause appearance of jellyfish so that their arrival (and departure) from beaches can be predicted.
- Discover how many species of jellyfish cause Irukandji syndrome so that doctors are better able to treat stings. This work is underway with both traditional and molecular methods being used to identify jellyfish species, especially those on offshore islands and the Great Barrier Reef that cause the life-threatening symptoms of severely high blood pressure and heart failure.
- Study the action of all venoms involved in Irukandji syndrome to improve treatment of all aspects of these stings.
- Find an effective pre-hospital treatment for the pain as well as the hypertension after an Irukandji sting.
- Develop swimming enclosures that prevent the entry of the smaller jellyfish such as *Carukia barnesi*. An ultra-fine mesh net is being trialled inside the standard stinger net.
- Find alternate methods to control and prevent stings from Irukandji jellyfish. A lotion for prevention of jellyfish stings is being developed.
- Discover whether severe symptoms such as hypertension and heart failure can be predicted and prevented in victims.

Other stinging jellyfish

All jellyfish have stinging cells and several other jellyfish in Australian waters can cause very painful stings. These jellyfish are 'scyphozoan' jellyfish and not cubozoan or box jellyfish. The bells of scyphozoan jellyfish are domed and not box-shaped and have many tentacles hanging underneath.

Photo by Clay Brice, Western Australian Museum

Cyanea

Commonly called the hair jelly or lion's mane jellyfish. It can be up to 400mm across the bell and has many hair-like tentacles which can be up to 500mm long. The hair jelly is found in coastal waters throughout Australia. The sting is unpleasant.

Photo by Lisa-ann Gershwin

Pelagia

This jellyfish is found around the world in tropical and temperate waters. It can be up to 30mm across the bell in Australia. Stings are painful.

More information

- CRC Reef website on Irukandji **www.reef.crc.org.au/aboutreef/coastal/irukandji.html**
- Queensland Government Irukandji Jellyfish Response Group at **www.marinestingers.com.au**
- Dr Peter Fenner's website about jellyfish at **www.marine-medic.com.au**
- Dr Jamie Seymour's website about box jellyfish at **www.jcu.edu.au/interest/stingers/**
- Lisa-ann Gershwin's website about jellyfish at **www.medusozoa.com**

Bluebottles & Pacific man-o-war

Physalia species cause stings that are similar to those from jellyfish although these animals are siphonophores (hydrozoans) and not jellyfish (scyphozoans and cubozoans). About 10-30,000 stings each year are reported along the east coast of Australia from *Physalia* with about 500 reported from Western Australia and South Australia. No fatalities have been confirmed from these animals in the Southern Hemisphere but there have been several fatalities from related species in the Northern Hemisphere.

Instead of the usual jellyfish bell, *Physalia* have a gas-filled sac that floats on the surface of the water and tentacles that hang underneath. *Physalia* can change the orientation of its float and use it to 'sail' with the wind. There are stinging cells (or nematocysts) in rows along the tentacles. The life cycle of these stingers is not known.

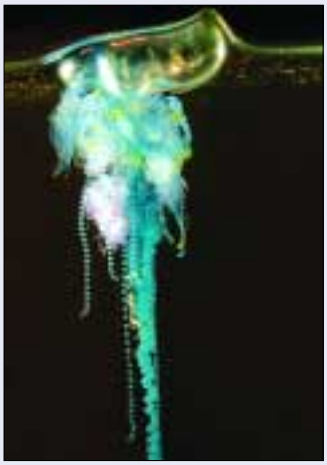


Photo by Lisa-ann Gershwin

The bluebottle

The bluebottle *Physalia utriculus* is Australia's most common species. It has a blue float usually 20-80mm long (but can be up to 150mm long) which is wrinkled on the top. The bluebottle has a single main retractile tentacle hanging from the float that can be contracted to a few centimetres or extended to several metres long. Many shorter smaller tentacles may also hang from the float. The bluebottle is found in vast numbers on the eastern Australian coast every year. They also occur in South and Western Australia. The sting causes immediate pain which can last more than an hour. The pain is usually in the lymph glands that drain the legs and arms.

It is possible that there are two other species of *Physalia* that are much larger than the bluebottle and have both been called **Pacific man-o-war**. The Pacific man-o-war is related to the Portuguese man-o-war from the Atlantic Ocean. The float of the Pacific man-o-war is 100-150mm long compared with the Portuguese man-o-war which has a float which can be 250-300mm long. The float of the Pacific man-o-war has 7-8 long retractile tentacles and many shorter, fine tentacles hanging from it. The long retractile tentacles can be extended to 10 metres long. The Pacific man-o-war causes a sting which is more painful than those from the bluebottle. The pain can be relieved by cold packs. In some cases, the victim may suffer a moderate Irukandji-like syndrome with back pain, and muscle cramps in the limbs, abdomen and chest.

This brochure was written by Louise Goggin (CRC Reef), Lisa-ann Gershwin (James Cook University and Australian Institute of Marine Science), Peter Fenner (MD), Jamie Seymour (James Cook University) and Teresa Carrette (James Cook University).

Thanks to Peter Dawes (Surf Life Saving Queensland) and Russell Hore (Reef Biosearch).

CRC Reef Research Centre

Ensuring the future of the world's coral reefs

CRC Reef Research Centre Ltd is a knowledge-based partnership of coral reef ecosystem researchers, managers and industry. Its mission is to provide research solutions to protect, conserve and restore the world's coral reefs.

CRC Reef Research Centre Ltd is a joint venture between the Association of Marine Park Tourism Operators, Australian Institute of Marine Science, Great Barrier Reef Marine Park Authority, Great Barrier Reef Research Foundation, James Cook University, Queensland Department of Primary Industries and Fisheries, Queensland Seafood Industry Association and Sunfish Queensland Inc. The University of Queensland is an associate member.

Established and supported under the Australian Government's Cooperative Research Centres Program

CRC Reef Research Centre
PO Box 772 Townsville
Queensland 4810 Australia
Telephone: 07 4729 8400
Email: info@crcreef.com
Website: www.reef.crc.org.au

Published by CRC Reef Research Centre Ltd 2004
Printed on recycled paper

Design by www.boabinteractive.com.au

Chironex fleckeri. Photo by Chloe Lucas, CRC Reef