

# **Current Status of Knowledge and Action on Irukandji**

Collated by **CRC Reef** on behalf of the  
**Queensland Government Irukandji Jellyfish  
Response Taskforce**

Information supplied by:  
**James Cook University**  
**Surf Life Saving Queensland**  
**Queensland Health**  
**Australian Institute of Marine Science**

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## **Irukandji: Current Status of Knowledge and Action**

### **Introduction and Background**

In response to this year's severe stinger season, and in particular, the fatalities of two international visitors from 'Irukandji Jellyfish Syndrome', Tourism Queensland coordinated the first meeting of a whole of State Government response to this issue on Wednesday 8<sup>th</sup> May 2002. This meeting discussed current marine stinger actions being undertaken by government agencies, community organisations (particularly Surf Life Saving Queensland) and operators, in the areas of community education, research and physical barriers.

Due to the large number of stakeholders involved, it was agreed that there was a need to adopt a collaborative and coordinated approach to this issue amongst all stakeholders. These include all relevant Queensland Government agencies and all levels of Government (i.e. local, State and Commonwealth), research institutions, community organisations, regional tourism authorities and tourism operators in North Queensland. A Queensland Government Irukandji Jellyfish Response Taskforce was established to achieve this coordinated approach, along with two working groups – a Research Working Group and a Prevention and Response Working Group. Refer to Attachment A for a list of member organisations of the Taskforce and Working Groups.

The first initiative of the Taskforce was to collate all available information on agreed current knowledge and preventative and response actions with regards to Irukandji Jellyfish Syndrome. CRC Reef agreed to coordinate this task, and this paper represents that collative exercise. This paper includes input from all experts in this area, and provides the basis upon which the future actions of the working groups will be developed. It is intended to be a working document, which will be updated as new knowledge becomes available and new issues arise.

### **A Global Perspective**

Two deaths from jellyfish causing the Irukandji syndrome in North Queensland during the 2001-02 summer have drawn disproportionate international attention. Potentially deadly jellyfish are not unique to North Queensland or northern Australia. Deaths from jellyfish occur regularly in other tropical countries but the deaths draw less media attention and the species responsible is often not identified.

### **The Cairns Experience 2001-2002**

The 2001-2002 season produced the highest number of Irukandji syndromes on record. In total, 116 patients presented to the Cairns Base Hospital with Irukandji syndrome (this does not include those that presented to other hospitals or local doctors). Of these, 20% occurred on the reef, the rest occurred on beaches north and south of Cairns. 22% were overseas tourists, 70 % were local residents and the remainder were either visiting Queenslanders or interstate visitors. 24% of stings occurred on the hands, face, neck or feet, the remainder occurred on areas that potentially could have been protected by the currently available stinger suits. Only 55% of patients had any effective first aid applied prior to arrival at the Emergency Department. Helicopter retrieval was necessary in 12% of patients, while the rest either attended by ambulance or presented by themselves. 20% had evidence of heart problems from the sting and of these, 6 (5%) had demonstrable heart

dysfunction (2 were severe). One patient died as a result of complications (intracerebral haemorrhage). 37% were discharged within 6 hours of presentation the remainder requiring admission. 41% were discharged after 24 hours and the remainder either required heart monitoring or intensive care treatment (2).

### **Responsible Jellyfish**

Irukandji syndrome is the name given to a group of systemic symptoms that occur after the sting of a jellyfish. Only one species, *Carukia barnesi* (*C. barnesi*), has been demonstrated to cause the syndrome but unpublished studies implicate at least six different species, most of them as yet undescribed by scientists.

### **Distribution and Abundance**

The distribution of Irukandji syndrome in Australia seems to be largely restricted to northern Australia between the Tropics of Cancer and Capricorn. On the east coast, it occasionally occurs as far south as Bundaberg. On the west coast, it is a significant problem for pearl divers based in Broome.

Irukandji syndrome occurs most frequently in the Cairns – Port Douglas and Whitsunday regions. In the Cairns – Port Douglas region, about 50% of stings are recorded from inside the stinger resistant swimming enclosures (“stinger” nets) at Palm Cove and the other 50% are recorded from offshore and reef areas.

Collected specimens identifiable as *C. barnesi* have only been recorded from the immediate Cairns region and there is one report of it from Townsville offshore waters. In the 2001-02 summer they were collected primarily from Palm Cove, Trinity Beach and Fitzroy Island.

Most cases of Irukandji syndrome occur between November and May (“the season”) but cases have been recorded in every month of the year.

Jellyfish causing Irukandji syndrome on the mainland (northern beaches of Cairns) usually occur for short periods of time (3-4 days) and usually only several times each season. They may, however, be present around reefs and offshore islands throughout the season.

The occurrence of *C. barnesi* is highly variable from year to year. During 2000/01, 90 days of continuous sampling at Palm Cove caught 3 animals. Similar sampling in 2001/02 caught over 300 animals in 2 days.

The origin of *C. barnesi* that appear on the mainland beaches is unknown. *C. barnesi* is most abundant after N/E winds in the Cairns area. Information on Irukandji appearance has not been determined in other areas to date.

### **General Biology**

The cubozoans (Class Cubozoa) or box jellyfish are the most dangerous group of jellyfish and have caused hundreds, possibly thousands of human deaths in tropical and sub-tropical waters worldwide. There are two families of cubozoans - the chirodropids (including *Chironex fleckeri* or box jellyfish) and the carybdeids (including the Irukandji jellyfish). The carybdeids generally have only one tentacle arising from each corner of the bell, the chirodropids have many tentacles in each corner.

Carybdeids are usually smaller than chirodropids, although very large ones do occur worldwide. *C.barnesi* only grows to about 25mm across the bell while *Chironex fleckeri* can grow to 350mm across the bell.

Most research to date has been carried out on chirodropids, in particular *Chironex* and *Chiropsalmus* spp., rather than carybdeids.

### **Life History and Behaviour**

The life history of *C.barnesi* and other Australian Irukandji stingers is unknown. The lifecycle for carybdeid box jellyfish is only known for *Carybdea alata* from Hawaii and Puerto Rico and *Tripedalia cystophora* from the northern hemisphere. For these animals, juveniles or polyps are thought to live on coral reefs.

In offshore waters around coral reefs, box jellyfish that cause Irukandji syndrome are usually well dispersed and the incidence of stings is very small. However, when they move inshore, probably carried by currents, they become concentrated at the waters edge. At certain times of the year (usually 8-10 days after a full moon), spawning aggregations may also occur on offshore reefs.

Some box jellyfish that cause Irukandji syndrome are attracted to lights and night divers on the reef are occasionally stung.

### **Irukandji Syndrome**

Classic Irukandji Syndrome is one of a collection of systemic symptoms and signs occurring after:

1. Marine sting while swimming, and
2. A latent period of 'wellness' between the sting and onset of *systemic* symptoms (usually 30 minutes but between 5 and 40 minutes).

The "Classic" syndrome is:

"Severe systemic symptoms developing after a sting from *Carukia barnesi*, a small box jellyfish (carybdeid). The initial skin sting is mild but followed approximately 30 minutes later by a classical sequence of symptoms, including severe low back pain, excruciating muscle cramps in all 4 limbs, the abdomen and chest, and sweating, anxiety, restlessness, nausea, vomiting, headache and palpitations".

Signs of Irukandji syndrome are:

Local signs include minor erythema, piloerection and local sweating, which may be mild or profuse, or generalised severe sweating. After the latent period the characteristic severe lower back pain commences, together with severe leg, abdominal, chest and arm pain. In some this pain is constant while in others it appears in waves and may radiate into the feet. Anxiety and agitation accompanied by restlessness, nausea, vomiting and headache follow. Although there is a sensation of breathlessness the blood's oxygen content is normal. Palpitations and hypertension are common, as is a poor peripheral circulation.

The period of distressing features of Irukandji syndrome is variable, from a few hours to several days.

Since 1983 there have been 11 published reports of reversible cardiac failure occurring in patients who have experienced classic Irukandji syndrome. The cause of the cardiac failure is open to debate with opinions varying from the effects of a direct

cardiac toxin to catecholamine induced cardiac failure. There have been two recent deaths (2002) following the development of classic Irukandji syndrome. The first occurred near Hamilton Island in the Whitsunday Islands and the second at Opal Reef off Port Douglas.

### **Location of stings on the body**

Unlike *Chironex* stings, which occur mainly on a victim's legs in shallow water, most *Carukia* stings occur in deeper water (>1m) and on the victim's body just below the surface. Thus *Carukia* stings are usually on the trunk or upper arms of swimmers, or on the back (or back of neck if a wetsuit is worn) in surfacing divers.

### **Treatment**

#### *First Aid*

Ensure safety of first aid provider then remove victim from danger. Check for conscious level and assess airway, breathing, circulation as per Australian Resuscitation Council's recommendations; resuscitate if required.

Restrain victim or others from rubbing the sting. The sting site should be doused liberally with vinegar. This will ensure that any undischarged nematocysts are made inactive and unable to fire. Vinegar does not alter the venom in any way and must not be considered an antidote.

The use of pressure immobilisation bandages (PIB) remains controversial and, on the recommendation of the Australian Resuscitation Council, vinegar and transport for medical attention must take priority pending research on PIB's safety and efficacy.

#### *Medical management*

To date the mainstay of medical treatment of Irukandji syndrome is the control of symptoms being experienced and observing and investigating for possible complications. A cornerstone of the management is that of adequate pain relief through the aggressive use of intravenous pain-killers. Historically pethidine has been advocated as the analgesic of choice although anecdotal experience is moving towards morphine or fentanyl. There is no trial that demonstrates superiority of one over the other although theoretical reasons may influence the choice. The large amounts of analgesic requirements may encroach on the safe dosage of pethidine (given its known neurotoxicity in large doses). Similarly the prolonged sedative and dysphoric effects of morphine may sway the choice towards fentanyl. Overall there is no proven superiority of one over the other. No other medication has yet been tested for pain relief, although this area needs research.

The use of anti-histamines as an adjunct to analgesia is unclear. Their utilisation has reduced the amount of analgesic required in one trial. However, the addition of a medication with a significant risk of side effects needs to be balanced against the risk of opiate toxicity.

The utilisation of catecholamine antagonists such as  $\alpha$ -blockers has proven effective in the Mackay region. The use of  $\beta$ -blockers is controversial with severe renal shutdown occurring in one published case. Although there is growing consensus that  $\beta$ -Blockers should be avoided there is no absolute consensus as to whether  $\alpha$ -Blockers may be of benefit.

There are no antivenoms to the Irukandji toxins and antidotes are of questionable benefit.

## **Prevention**

### *Beach Closure*

Surf Life Saving Queensland has developed an advanced draft Best Practice Guidelines for Marine Stinger (Risk Management).

Drag netting trials show a close relationship between stings occurring and jellyfish being caught. As a result Surf Lifesaving Queensland (SLSQ) has recently developed and implemented a new policy for Irukandji stings. The beach is now closed anytime a researcher nets an Irukandji, regardless of a sting or not. Additionally, the beach is closed immediately after the first sting is confirmed. The beach (enclosure) remains closed until a change of tide and weather pattern occurs and/or net drags are carried out and no jellyfish are collected. Further, a warning sign may be used alongside the yellow warning flag suggesting days when the presence of Irukandji may be higher than normal. This will be after 2 days of northerly / north-easterly winds together with an afternoon high tide. This new policy will hopefully help reduce the number of Irukandji sting cases in Queensland where Surf Life Saving Queensland lifesavers or lifeguards patrol the beach: the previous SLSQ policy was 2 confirmed Irukandji stings before the lifeguard closed the beach. Yellow flags are currently flown at all times on Queensland patrolled beaches. Signs are used to advise of possible further risk factors (e.g. presence of Irukandji jellyfish).

### *Barrier Nets*

There are currently 20 “stinger nets” in north Queensland, designed and sold by Uninet. They have a mesh size of 25mm and are designed to exclude large box jellyfish and large segments of box jellyfish tentacles and in the right locations are very effective at doing this. They do not exclude small segments of box jellyfish or *Carukia barnesi*. The nets work well on beaches with moderate tidal ranges but are not appropriate in areas of large tidal range such as in the Mackay Region, or those with fast currents, as in the Whitsunday Islands.

Tests of a finer, 8mm mesh net were carried out in 1990 but were unsuccessful. Issues with the finer mesh nets include fouling and increased resistance to waves and currents that can cause the nets to lift and let animals, including box jellyfish, inside the net.

Further trials are underway in Cairns using a shade cloth mesh together with the normal mesh.

### *Stinger Suits*

Lycra “Stinger” suits provide protection against irukandji stings provided that undue pressure is not applied. For example sitting on a jellyfish while wearing a suit could lead to a sting. Bathers wearing stinger suits are still vulnerable to unprotected areas such as feet, hands, neck and face.

### *Topical Creams*

Compounds have been isolated that may, one day, be able to be used for some form of protection from stinging jellyfish, including being added to ultra-violet protection creams.

### *Community/visitor education*

On behalf of the Prevention and Response Working Group, Surf Life Saving Queensland is coordinating the development of a range of visitor, community and tourism industry education materials and initiatives. Together with Surf Life Saving Queensland, Tourism Queensland and the Regional Tourist Organisations will be responsible for disseminating this information to visitors and tourism operators, and Queensland Health and Local Governments will be responsible for disseminating the information to the local communities.

## **Toxicology**

### *Mode of Delivery*

Venom is delivered by nematocysts that in *C. barnesi* occur on both the bell (body) and the tentacles. A single jellyfish can have a number of different kinds of nematocysts used for different purposes. Tentacles can be different lengths and shapes and nematocysts on tentacles can be uniformly distributed along the tentacle or aggregated (eg pearl-like strings of nematocysts on *C.barnesi*).

### *Toxins Involved*

The toxins involved in causing Irukandji syndrome are unknown. At least 20 different types of proteins are present in *C.barnesi* venom.

### *Effects of Toxins*

Preliminary, published, laboratory studies using crude venom extract (from squashed whole animals) suggest that *C.barnesi* venom acts as a presynaptic neuronal sodium agonist. Similar tests also suggest that *C.barnesi* venom powerfully stimulates noradrenaline release.

## **Response of Tourism Industry**

Tourism operators in North Queensland have contributed to the prevention of marine stings, in the past, by distributing educational information to visitors in the form of brochures and fact sheets. However, following the severe stinger season of 2001/02 many operators ceased distributing this information for fear that it was potentially inaccurate and out of date. Also, the brochure previously produced by the Queensland Tropical Health Unit was reported to be 'out of print', therefore tourism operators report and that they have had no updated information to distribute for some time.

As a response to the recent severe season, some dive operators are now strongly encouraging their guests to wear lycra stinger suits, along with providing them with a standard marine stinger warning notice. Quicksilver Connections is presently trialling the use of a full body stinger suit that will also offer protection for the face, hands and feet (although stings still may occur on any exposed part of the body).

Tourism operators in North Queensland have recently attended marine stinger information sessions organised by Tourism Whitsundays (in Airlie Beach on 20 April) and jointly by Townsville Enterprise and Tourism Tropical North Queensland (in Cairns on 27 June 2002). These sessions have provided scientific and medical information on Irukandji Jellyfish Syndrome, as well as addressing operators' queries on the issue and appropriate risk management responses.

Townsville Enterprise has coordinated a local marine stinger group for some years, which initiated the development of a Marine Stinger Visitor Awareness Campaign in early April 2002. The work of this group has been dovetailed into the Queensland Government Irukandji Jellyfish Prevention and Response Working Group to ensure a collaborative and coordinated approach to marine stinger (including Irukandji) visitor education.

**Irukandji Websites:**

<http://www.reef.crc.org.au/aboutreef/coastal/irukandji.html>

<http://www.marine-medic.com/pages/biology.html>

<http://cnsfse01.jcu.edu.au/schools/tropbio/cubozoan.html>

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## Further information

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**ATTACHMENT A: Queensland Government Irukandji Jellyfish Taskforce and Working Groups membership**

**Queensland Government Irukandji Jellyfish Taskforce**

- Tourism Queensland (lead agency)
- Queensland Health
- Department of Emergency Services
- Great Barrier Reef Marine Park Authority
- Environmental Protection Agency
- Department of the Premier and Cabinet
- Department of Innovation and Information Economy
- Department of Local Government and Planning
- CRC Reef
- Surf Life Saving Queensland

**Queensland Government Irukandji Jellyfish Prevention and Response Working Group**

- Queensland Health (lead agency)
- CRC Reef
- Tourism Queensland
- Townsville Enterprise
- Surf Life Saving Queensland
- Local Government Association of Queensland
- Queensland Ambulance Service
- Queensland Parks and Wildlife Service (EPA)
- Association of Marine Park Tourism Operators
- James Cook University
- Department of Emergency Services

**Queensland Government Irukandji Jellyfish Research Working Group**

- CRC Reef (lead agency)
- James Cook University
- Australian Institute of Marine Scientists
- National Research Centre of Environment Toxicology
- Queensland Health
- Department of Innovation and Information Economy
- Surf Life Saving Queensland
- Great Barrier Reef Marine Park Authority
- Australian Venom Research Unit
- Tropical Australian Stinger Research Unit (James Cook University).