

# Dugongs in the Great Barrier Reef

CURRENT STATE OF KNOWLEDGE  
April 2002

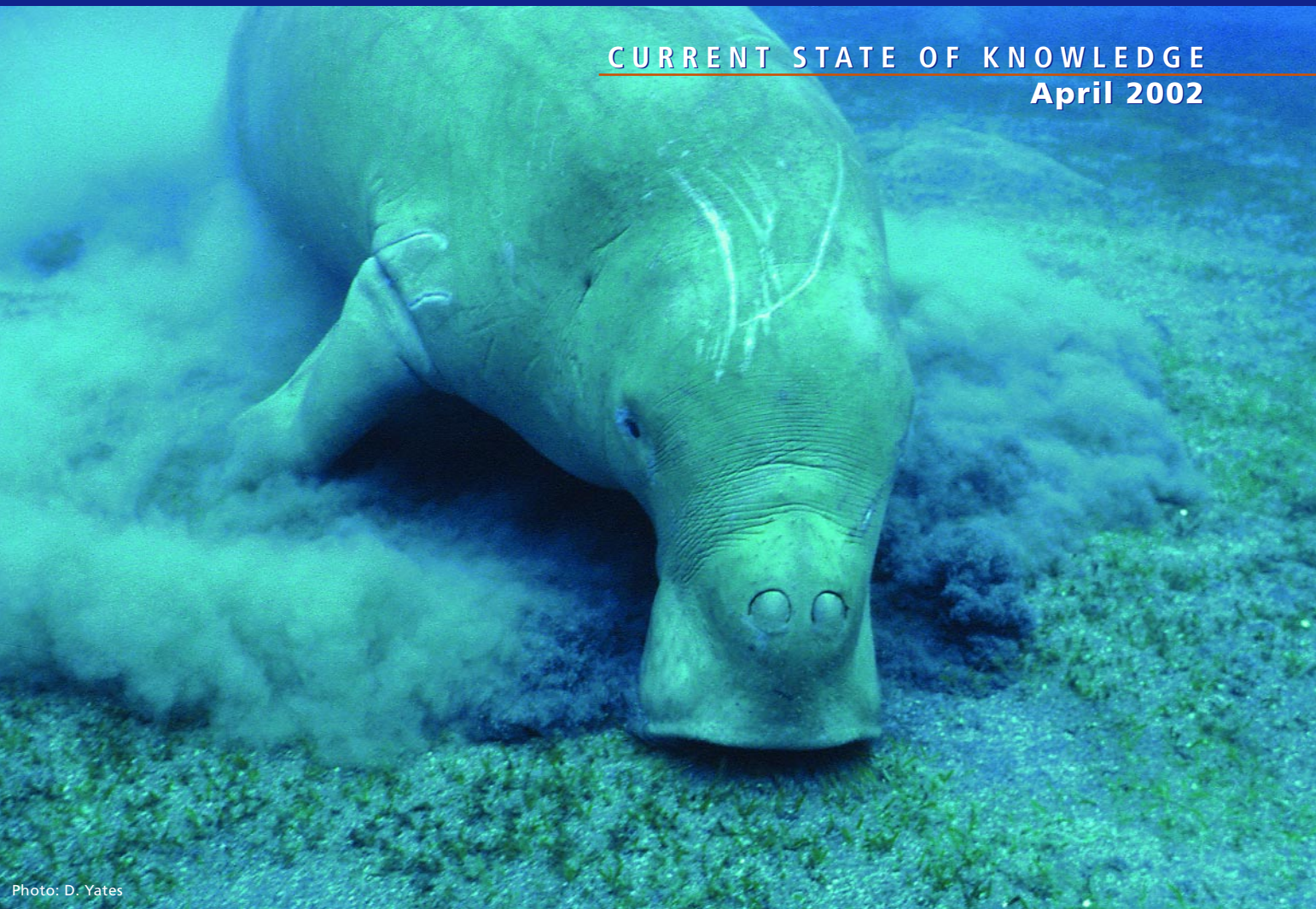


Photo: D. Yates

Dugongs live in the shallow waters of at least 37 countries and territories around the world. Throughout their range which runs from east Africa to Vanuatu between about 26° north and south of the Equator, dugongs are threatened by rising pollution from the land, coastal development, boat traffic, entanglement in fishing nets, and hunting and poaching for their meat and trophies.

Dugongs are not in imminent danger of disappearing but it is likely that they will vanish from parts of their range. The World Conservation Union (IUCN) has listed dugongs as vulnerable to extinction on a global scale because the numbers of dugongs worldwide appear to have declined by at least 20% over the last 90 years (about three dugong generations).

(continued)

Dugongs have already disappeared from some places including the waters off Mauritius, Taiwan, western Sri Lanka, the Maldives, Japan's Sakishima Shoto Islands, Hong Kong's Pearl River estuary, several islands in the Philippines and parts of Cambodia and Vietnam.

Although dugongs are found in the waters of many countries, nearly all of them except Australia are developing nations with limited capacity to contain impacts on dugongs within sustainable limits. Therefore, dugong conservation world-wide is largely dependent on Australian initiatives.

Australia is home to most of the world's dugongs which live in northern waters between Shark Bay in Western Australia and Moreton Bay in Queensland. One of the reasons for nominating the Great Barrier Reef as a World Heritage Area in 1981 was its importance as a feeding ground for large populations of dugongs.

Dugongs are not considered under threat in most parts of Australia, however, the number of dugongs has declined along the urban coast of Queensland. To protect dugongs, especially in the Great Barrier Reef region, Dugong Protection Areas and Marine National Parks have been established along the east coast of Queensland. Australia has a critical role in protecting these unique marine mammals.

## Dugong biology

Dugongs (*Dugong dugon*) are marine mammals in the Order Sirenia which are commonly called sea cows. There are only four living species of sea cow - three manatee species (Trichechidae) found in the Atlantic region and one dugong (Dugongidae) in Australian tropical and subtropical waters. Sea cows are more closely related to elephants than they are to other marine mammals such as whales or dolphins.

In Australia, scientists have learned a lot about the biology of dugongs by studying their carcasses. Researchers from James Cook University in Townsville collected specimens from dugongs that had been killed accidentally in fishing nets and in shark nets (set for the protection of swimmers). Other dugong parts

were donated by Aboriginal or Torres Strait Islander hunters from remote communities in northern Australia, as well as from Papua New Guinea. From these autopsies, researchers learned about dugong anatomy, lifespan, breeding and diet.

Dugongs grow to three metres long, can weigh up to 400 kg and live for 70 years or longer. The age of a dugong is estimated by counting growth layers in its tusks, like measuring rings in a tree. The tusks erupt after puberty in males and in a small proportion of older females.

Their ears (which have no flaps or lobes) and eyes are on the side of the head. Dugongs do not see very well but are believed to have acute hearing within narrow sound thresholds. They have sensitive bristles covering their upper lip which they use to find and grasp seagrass.

Dugongs generally surface to breathe after only a few minutes. Their paired nostrils are on the top of the head and have valves to stop water entering when they dive.

Dugongs have flippers and tails that resemble those of dolphins, but they lack a dorsal fin. Unlike dolphins which can often be individually recognised from their physical characteristics, most dugongs are difficult to distinguish even though they are marked by scars which are often made by the tusks of other dugongs.

## Breeding

Groups of male dugongs follow a female when she is in oestrous ('in heat') and many mate with her, inflicting scars on the female's back, and on each other.

Females have their first calf when they are between six and 17 years old and then produce calves only once every 2.5–5 years. The female will bear one calf after a pregnancy which lasts about 14 months.

Newborns are about 1.2 metres long and weigh about 30 kg. The calves suckle for 18 months or longer. They never venture far from their mothers and often ride above their backs. So far, only one orphaned calf has been successfully rehabilitated in Australia. Dugongs are expensive to keep in oceanaria because they suckle for so long and their seagrass diet cannot be grown in captivity.

Dugongs have few natural predators but sharks, crocodiles and killer whales will feed on young dugongs.

## Diet

Dugongs feed mainly on seagrass, but can supplement their vegetarian diet with invertebrate animals such as polychaete worms, sea squirts and shellfish.



*Researchers from CRC Reef have undertaken extensive seagrass mapping surveys within the Great Barrier Reef.*

In the Great Barrier Reef region, dugongs feed mostly on small, delicate seagrasses, especially *Halophila* and *Halodule*, which are low in fibre, high in nitrogen and easily digestible. Dugongs can dig up whole seagrass plants including the roots. They do not favour lush seagrass meadows.

Often very little of their preferred food can be seen on the seabed. In the Great Barrier Reef region, there are eight genera and 14 species of seagrass. The distribution of the seagrass depends on the availability of light and the type of sediment. In areas of high turbidity where the water is murky, seagrasses are limited to the area



Photo: GBRMPA, B. Cropp

*The bond between the dugong cow and calf is strong. The calf suckles from a nipple under each flipper.*

Dugong feeding trails on the sea floor.

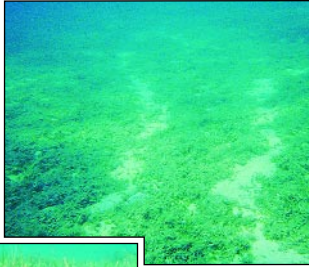


Photo: DPI Cairns

Dugongs seem to prefer small delicate seagrasses to dense older and coarser ones.



Photo: DPI Cairns

between the high and low watermark, but seagrasses have been found more than 30 metres deep in the clear waters off the northern coast of Cape York. Dugongs can dive to at least 39 metres but spend most of their time in shallow water, less than 10 metres deep.

## Dugong populations around Australia

There appear to be two genetically distinct groups of dugongs in Australian waters. One group ranges from Moreton Bay in southern Queensland to Western Australia. The other lineage has a more restricted distribution ranging from Moreton Bay to the Northern Territory. These two groups may represent separate invasions of dugongs on to the Australian continental shelf.

## Dugong movements

Dugongs can move large distances, travelling alone or with their calves in search of food. They appear to have a good memory of place because satellite tracking shows that they return hundreds of kilometres to specific locations.

Of the 29 dugongs tracked on the east coast of Australia, more than half moved more than 80 km from the point of capture (and up to 600 km). Aerial surveys also show large fluctuations in dugong numbers over long stretches of coastline that can only be explained by movements of large numbers of dugongs. One of the suggested causes of these movements is changes in seagrass distribution and abundance.

Dugongs also use estuarine creeks and streams. Of nine dugongs tracked by satellite in the Hinchinbrook area, six used mangrove-lined creeks at some stage. The dugongs were found mostly within 600 metres of the creek mouth, but some travelled 2.7 km up creeks. Dugongs travelled up to 10 km through one creek that rejoined the main channel. One dugong caught north of Cooktown travelled 15 km up a creek in this region.

One dugong tracked in Shoalwater Bay spent nearly three months in a tiny area where there was a strip of seagrass only a few metres wide. Therefore, the total area of seagrass may not be a good indication of its value to dugongs. Other factors that influence seagrass quality, such as protein concentration or the ability to regenerate quickly, determine the value of a seagrass bed to dugongs.

## Population changes

Historical accounts of dugong numbers off the Queensland coast are almost unbelievable today. In his book 'Queen of the Colonies' published in 1876, Ebenezer Thorne wrote:

*"One of the fishermen of Wide Bay told the writer...he had seen a mob which appeared to fill the water with their bodies. He computed this school...to be half a mile wide and from three to four miles long...The writer's boat once anchored in Hervey's Bay, in one of those channels through which the tide passes when running off the flats. For between three and four hours there was a continuous stream of dugong passing while the tide went out, which those in the boat could only liken to the rush of cattle out of a stockyard after a general muster...some thousands must have gone out with the tide"*

The best scientific indication of changes in dugong numbers comes from data collected by the Queensland Shark Control Program – the program designed to make popular bathing beaches in Queensland safe from shark attack. Nets have been deployed at popular beaches in eight locations along the Queensland coast between Cairns (17°S) and the Gold Coast (28°S) since 1962 to reduce the numbers of resident

sharks. Every two days, contractors check equipment at a number of popular beaches in their region and record the catch, including any dugong by-catch. Analysis of the annual catch per beach for the nets indicates that the numbers of dugongs caught declined from the inception of the program. The estimated rate of decline averaged about 8.7% per year. This is a decline of 97% of the initial catch rates over the 38-year sampling period (1962–99). This decline provides an index of the change in dugong numbers from all causes in the regions where nets were deployed. The large declines reported are confirmed by anecdotal information. Aboriginal elders consider that dugong numbers in the southern Great Barrier Reef World Heritage Area have been declining for decades.

Since the mid 1980s, standardised aerial surveys to determine the patterns of dugong distribution and abundance have been conducted in many regions of Australia. Surveys in the Great Barrier Reef region have been conducted in two series: one along the remote coasts north of Cape Bedford near Cooktown and; in the more populated coast south of Cooktown.



Photo: GBRMPA, G. Ryan

A dugong, clearly visible in shallow water

The remote coast was surveyed in 1984, 1985, 1990, 1995 and 2000 using the same technique. The number of dugongs did not change significantly during these surveys; this area supports an estimated 10,000 dugongs and 4,400 km<sup>2</sup> of seagrass. This suggests that the dugong population is stable in the northern Great Barrier Reef. However, the surveys showed

that the dugong distribution changed between surveys. The surveys in 1985, 1990 and 1995 indicated that Princess Charlotte Bay supported between 37–56% of dugongs in the northern Great Barrier Reef region. The corresponding proportion for 2000 was about 24%. The survey suggested that these dugongs had moved from Princess Charlotte Bay to south of Cape Melville.

In the southern Great Barrier Reef, the surveys also showed large-scale dugong movements and some decline. Estimates of the dugong population between Dunk Island and Bundaberg fluctuated from a minimum of 3,500 dugongs in 1986 to 1,700 animals in 1994 to about 4,000 dugongs in 1999. The numbers of dugongs counted between Cooktown and Dunk Island were insufficient to estimate the population size with accuracy in 1986, 1992

or 1999, despite historical records of the region supporting substantial Indigenous hunting in the 1960s. Shark meshing data also indicate a huge decline in dugong numbers in the Cairns region since the 1960s.

Aerial surveys indicate that the numbers of dugong in the Hervey Bay to Great Sandy Strait region have fluctuated from about 2,200 in 1988, to 800 in 1994, 1,650 in 1999 and 1,710 in 2001.

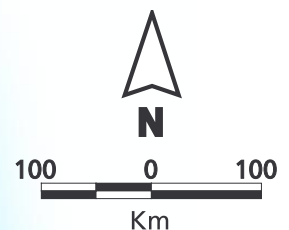
In 1992, more than 1,000 km<sup>2</sup> of seagrass were lost from Hervey Bay when there were two floods and a cyclone within three weeks. The dugongs in the region stopped breeding and many died of starvation (99 carcasses were recovered). Some dugongs travelled up to 900 km and four carcasses were washed up south of Sydney. However, by 1993, there were more dugongs counted in Moreton Bay than had been seen in any of the 28 previous surveys. This suggests that some dugongs moved and survived. Studies from the Gulf of Carpentaria demonstrate that seagrasses may take a decade to fully recover in areas subjected to changes caused by extreme forces of nature, such as cyclones. Most of the seagrass in Hervey Bay has now recovered and dugongs have moved back into the area.

## Why have dugongs declined in the southern Great Barrier Reef?

People who lived in coastal north Queensland in the early part of the century have been interviewed by researchers from James Cook University. They said that they noticed that there were fewer dugongs along the coast even in the 1960s.

To maintain populations, at least 95% of adult dugongs alive at the beginning of a year must still be alive 12 months later. The maximum sustainable mortality from all human impacts is estimated to be about 1–2% of adult females per year. If dugongs calve later and less often because they are not getting enough to eat, they will produce fewer young which means that their sustainable mortality as a result of human impact would be even less.

While fishing has been blamed for dugong loss, it is not the only, or necessarily the major activity to impact dugong populations. Natural dugong births and deaths, and extreme weather events can impact population movement and numbers. Hunting, modern farming practices, increasing boat traffic, and land clearing causing a change in the composition of river run-off, all have an influence.



## Aboriginal and Torres Strait Islander issues

Some Aboriginal people regard dugongs as a vital part of their Aboriginality. It is widely recognised that dugong meat and oil are among the most valuable traditional foods of coastal Aborigines and Torres Strait Islanders in northern Australia. Hunting can be carried out under permit in the Great Barrier Reef Marine Park except in Preservation Zones.

A large inshore Preservation Zone was established by management agencies primarily to protect dugongs in the Far Northern Section of the Park, south of Cape Melville. Following the decline of the dugong in the southern Great Barrier Reef, some traditional owners decided to suspend dugong harvesting. There is also no hunting permitted south of Cooktown. The Darumbal-Noolar Murree Aboriginal Corporation for Land and Culture of Rockhampton have signed a formal agreement with the Great Barrier Reef Marine Park Authority (GBRMPA). Other traditional owner groups have recently made historic declarations that it would be inappropriate for hunting to continue within their regions and hunting has been suspended until populations recover. Nonetheless, the interest of Aboriginal and Torres Strait Islanders in dugongs transcends hunting and they seek involvement in all areas and aspects of their management.

## Protecting dugongs in Australia

In Australia, dugongs are not considered to be under serious threat throughout much of their range. Dugongs in Australia are not listed as at risk of extinction under the Commonwealth Environment Protection and Biodiversity Conservation Act. However, the numbers of dugongs on the urban coast of Queensland have declined as explained above and so, dugongs are listed as vulnerable under the Nature Conservation Act in Queensland.

Photo: H. Schliepmann



*Dugong Protection Areas provide quality seagrass habitat for dugongs.*

Most of the dugongs and their habitat on the urban coasts of Queensland are in marine parks; the Great Barrier Reef Marine Park and the associated Queensland Marine Parks in the Great Barrier Reef region, the Hervey Bay Marine Park and the Moreton Bay Marine Park. The distribution and abundance of dugongs has also influenced the placement of highly protected areas along the remote areas of the Great Barrier Reef Marine Park near Cape York.

In 1997, the Australian and Queensland governments agreed to several measures aimed at arresting the decline of dugongs along the urban coast of Queensland. The most significant initiative was to establish a series of Dugong Protection Areas along the coastline, in which gill and mesh net fishing is restricted and, in the Hinchinbrook Region, boat speeds are restricted.

Sixteen Dugong Protection Areas have now been established along the Queensland coast using Queensland Nature Conservation legislation and Queensland Fisheries legislation. In 1999, a conservation plan for dugongs in Queensland was implemented by the Environmental Protection Agency. This plan further reinforced the functions of Dugong Protection Areas.

## Shark nets

Since 1962, shark nets (which have been used since the 1960s to protect bathers) have caught at least 654 dugongs in Queensland, an average of 18 per year. Very few of these dugongs were released alive. Following a review in 1992, many shark nets have been replaced with lines of baited hooks.

Ten nets remain in the Great Barrier Reef region; five at locations near Cairns and five near Mackay. With the decline in numbers of dugongs in the southern Great Barrier Reef and since the reorganisation of the netting program in 1992, fewer dugongs are being caught in Great Barrier Reef nets.

In 1997, the Great Barrier Reef Ministerial Council decided that all nets should be replaced with drumlines unless the nets are preferable for reasons of human safety. A decision to replace all nets with baited lines may be controversial. Some scientists and resource managers believe that nets as well as lines are needed to keep the numbers of inshore sharks low enough so that their risk of attacking people is acceptably low.

Others consider that there is evidence that lines are at least as effective as nets, and in places with some species such as tiger sharks, are more effective in minimising the risk of shark attacks on bathers. They therefore consider that any by-catch of marine mammals in shark nets is unacceptable in a World Heritage Area, given the extremely low risk of a swimmer being attacked by a shark.

## Future directions

- Dugong Protection Areas (DPAs) are an important first step in the recovery of dugongs along the urban coast of Queensland. The success of DPAs requires that there is no illegal fishing within them. The DPAs must also continue to provide quality seagrass habitat for dugongs and be the preferred location for most of them on the urban coast.
- Initiatives should be expanded to address all possible causes of dugong decline, especially loss of habitat and habitat quality.
- Management regimes should be implemented for the urban coast of Queensland to minimise human impacts on dugongs in local regions.
- Indigenous people and commercial fishers should be encouraged to participate in the management of dugongs throughout the coastal waters of Queensland.
- Vessels should maintain a 25-knot speed limit and less than 10 knots in important dugong feeding areas (such as Hinchinbrook Dugong Protection Area).

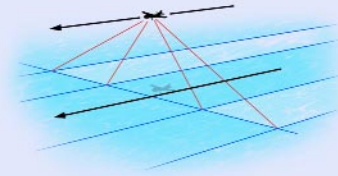
## Counting dugongs

One of the most efficient and reliable ways to study the distribution and abundance of dugongs in a population is to count them using aerial surveys. These surveys were first used in the 1970s and an improved method established in the 1980s.

Dugongs are counted at the same time by two researchers seated on either side of a light aircraft. Each observer watches a 200 metre-wide strip of sea on either side of the aircraft. The plane flies at a constant height (137 metres above sea level) and speed (185 km/h) along pre-determined transects which are perpendicular to the coast.

The dugong counts are then used to estimate population sizes. The counts are corrected for perception bias (the proportion of dugongs seen in the transect but missed by observers) and availability bias (the proportion of dugongs below the surface that are invisible due to water turbidity).

Researchers are working on improving the estimate of dugong numbers from aerial surveys. Fibreglass models of dugongs have been used to measure the depths at which dugongs can be seen from the air in waters of different turbidity and sea state. Miniature computers have been attached to the tails of 15 dugongs to measure the depths and times of 40,000 dives. This allows scientists to estimate how much time dugongs are likely to be available to observers during aerial surveys in waters of different turbidities, depths and sea states. Improved information on the size of dugong populations should be available in 2002.



*Dugong aerial surveys are conducted along pre-defined transects. The aircraft flies at a constant height and speed while two observers on either side search for dugongs in a defined strip of sea.*

## Satellite tracking

Recent advances in technology, coupled with inventive science, have made it possible to track dugongs using satellite tags. The device is connected to a satellite transmitter which sends signals to polar orbiting weather satellites. With the incorporation of GPS technology, dugongs can now be located 24 hours per day to within a few metres of their actual position. This technology will provide new insights into how dugongs use seagrass beds and what constitutes good habitat for them.

To tag a dugong, researchers in a small boat use the noise of the engine to move the dugong to shallow water. They place a net over the dugong's head and flippers, fit a belt-like device containing a remote release to the dugong's tail and then release the animal. When the researchers want to release the belt from the dugong they have to get within 500 m of it and then press a button on the release transmitter. The entire tagging apparatus then floats free.

*This brochure was written by Dr Ivan Lawler (CRC Reef, James Cook University), Professor Helene Marsh (CRC Reef, JCU), Ms Brenda McDonald (JCU) and Mr Tony Stokes (GBRMPA).*



Ensuring the future of the world's coral reefs

CRC Reef is a knowledge-based partnership of coral reef managers, researchers and industry. Its mission is to plan, fund and manage world-leading science for the sustainable use of the Great Barrier Reef World Heritage Area.

CRC Reef is a joint venture between:

- 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
- Queensland Seafood Industry Association
- Sunfish Queensland Inc.

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