Acanthaster planci **System:** Marine

Kingdom	Phylum	Class	Order	Family
Animalia	Echinodermata	Asteroidea	Spinulosida	Acanthasteridae

Common name coral-feeding starfish (English), coral-eating starfish (English), crown-of-thorns-starfish (English), giant thorny starfish (English)

Synonym

Similar species

Summary

Coral gardens from Micronesia and Polynesia provide valuable marine resources for local communities and environments for native marine species such as marine fish. In coral ecosystems already affected by coral bleaching, excess tourism and natural events such as storms and El Nino, the effects of the invasive coral-feeding starfish (*Acanthaster planci*) on native coral communities contributes to an already dire state of affairs. *Acanthaster planci* significantly threatens the viability of these fragile coral ecosystems, and damage to coral gardens by the starfish has been quite extensive in some reef systems.

[view this species on IUCN Red List]

Species Description

These impressively adorned 20 to 30cm sized starfish (PERSGA/GEF 2003) exist in two colour morphs: grey-green to red-brown in the Pacific Ocean, and blue to pale red in the Indian Ocean (Benzie, 1999). Colour combinations can vary from purplish-blue with red tipped spines to green with yellow-tipped spines (Moran, 1997). Those on the Great Barrier Reef are normally brown or reddish grey with red-tipped spines, while those in Thailand are a brilliant purple (Moran, 1997). Specimens of up to 60cm (and even 80cm) in total diameter have been collected (Chesher, 1969; Moran, 1997). The juvenile starfish begins with 5 arms and develops into an adult with an astounding 16 to 20 arms, all heavily armed with poisonous spines 4 to 5cm in length, which can inflict painful wounds (Moran, 1997; Birk, 1979). Arm values vary between localities with a range of 14 to 18 given for the Great Barrier Reef (Moran 1997). Starfish are usually concealed during daylight hours, hiding in crevices (Brikeland and Lucas, 1990; Chesher, 1969). Groups of starfish often move as huge masses of 20 to 200 individuals, presenting a terrifying \"front\" which destroys the reef as it moves through (Chesher, 1969). Signs of starfish presence are obvious; the coral skeleton is left behind as the result of starfish feeding and stands out sharply as patches of pure white, which eventually become overgrown with algae (Chesher, 1969). In some cases, herbivorous sea urchins move in to feed on algae, creating a pattern against the white coral that resembles the holes of swiss cheese (Tsuda *et al*. 1970).

Notes
(1) An interesting example of mutualism has been described between the sessil branching pocilloporid corals, which obviously have a limited behavioural capacity to fend off enemies, and crustacean species. The crab *Trapezia ferruginea* and the shrimp *Alpheus lottini* live on the coral as symbionts and are protected by coral mucus from predators. In return, they protect corals from enemy attacks, including predation by the coral-feeding starfish, *Acanthaster planci* (Glynn, 1976, in Hay *et al*. 2004). Species the starfish would readily feed on if it weren't for the presence of these mutualistic crustaceans include: *Acropora gemmifera*, *A. nasuta*, *A. loripes*, *Seriatopora hystrix*, *Pocillopora damicornis* and *Stylophora pistillata* (Pratchett, 2001).
(2) The question of whether *Acanthaster planci* outbreaks are a naturally recurring phenomena or a novel, more recent development remains unanswered. Some scientists have found evidence which indicates that *Acanthaster planci* outbreaks have been an integral part of the ecosystem for at least 7000 years on some reefs (Walbran *et al*. 1989, in Keesing *et al*. 1992). This would imply coral reefs were able to naturally recover from such events. However, other authors refute the evidence of this hypothesis (Keesing *et al*. 1992).

Lifecycle Stages
For a detailed diagrammatic representation of the complex life cycle of *Acanthaster planci* please see: *Australian Institute of Marine Science. 1997. Crown-of-thorns Starfish Life Cycle*. After the gametes (eggs and sperms) and hormones (which stimulate other individuals to release gametes) of *A. planci* are shed into the seawater they have a short amount of time to become fertilised before they become unviable (Madl, 1998). After fertilisation, the zygote develops into a larvae. After drifting around for two to three weeks, the 0.5mm small larvae starts to morph and eventually settles and attaches itself to the sea floor where it completes its metamorphosis (Madl, 1998). Larval life may last longer than three weeks if conditions are unfavourable (Birkeland and Lucus, 1990, in Benzie, 1999). Various substrates, particularly crustose coralline algae with bacterial surface films, induce *Acanthaster*'s planktonic larvae to settle and metamorphose (Johnson and Cartwright, 1996). One group of scientists found that thyroxine accelerates development in *Acanthaster* through larval stages (Johnson and Cartwright, 1996). After settlement, the larva metamorphoses into a juvenile starfish, a process which takes about two days (Moran, 1997). Initially the juvenile starfish has only five rudimentary arms, but additional arms develop rapidly as the starfish begins to feed on encrusting algae (Moran, 1997). At the end of six months, the starfish is about 1cm in size and begins to feed on corals (Moran, 1997). Individuals are able to reproduce after two years (Lucas, 1973, in Babcock and Mundy, 1992). Being a rapid grazer of coral polyps, it takes only three to four years for the coral-feeding starfish to reach a reasonable size of 30-35cm (Madl, 1998). After three to four years, it is thought to go into a senile phase where growth declines dramatically and reproduction is low (Moran, 1997). It is not known how long starfish live, although they have been kept in aquaria for as long as eight years (Moran, 1997).

Uses
During *Acanthaster planci* outbreaks in Japan, the carcasses of starfish were used as fertiliser (M. Yamaguchi, pers. comm., in Birkeland and Lucus 1990).
Acanthaster planci is a significant coral predator and is known as a keystone species. It has the potential to alter coral ecosystems in significant and important ways. This makes it a useful indicator species and one which should be monitored when assessing the health of coral reef ecosystems (see Hill and Wilkinson 2004).

Habitat Description
The coral-feeding starfish (*Acanthaster planci*) is limited by the location of its food source - coral - from just below spring tide level to a depth limit of 65 metres (Chesher, 1969). Soft substrate is avoided by the coral-feeding starfish as it lacks a gripping surface for the tube feet to hold on to (Chesher, 1969). In areas of strong wave action, sand can provide a barrier to movement of the starfish between reef patches (Chesher, 1969). The starfish prefers to live in more sheltered areas, such as lagoons, and in deeper water along reef fronts (Moran, 1997). They generally avoid shallow water on the tops of reefs, where the water conditions are likely to be more turbulent (Moran, 1997). When the weather is calm the potential range of the starfish increases and the starfish may cross sand patches and may feed in shallow water areas (Chesher, 1969; Moran, 1997).

Reproduction
Sexes are separate and females release huge amounts of gametes directly into the sea (Benzie, 1999). An individual female *Acanthaster planci* can produce up to 60 million eggs per year (Conand, 1985, in Babcock and Mundy, 1992). If conditions are favourable and there is an abundant larval survival, the high reproductive potential of even a few adult *A. planci* may allow the production of a massive settlement of juveniles (Birkeland, 1982). According to data derived from one location in the Great Barrier Reef, Australia, major spawning occurred in December 1991, with smaller spawning events following in January (Babcock and Mundy, 1992). Over two-thirds of the population aggregate to participate in this spawning event, which usually occurs in the morning or afternoon and may be driven by pheromones released into currents (Babcock and Mundy, 1992). *A. planci* often spawns in a characteristic arched posture, usually on top of elevated rocks or corals at elevations of 30m to reefs flats (Babcock and Mundy, 1992). Migration to shallow water is commonly associated with *A. planci* spawning (Babcock *et al*. 1994). Babcock and Mundy (1992) record 47% fertilisation rates between animals separated by 32m and 23% for animals separated by over 60m. Fertilisation rates achieved are two orders of magnitude greater than those recorded for other marine organisms, due to the large amounts of gametes produced (Babcock and Mundy, 1992).

Nutrition
Acanthaster planci larvae feed on phytoplankton (Birkeland, 1982) and dissolved organic matter (Hoegh-Guldberg, 1994). Once they have developed into juvenile starfish they feed on encrusting algae (Moran, 1997). Adult *Acanthaster planci* feed primarily on coral, hence one of its names (coral-feeding starfish). The starfish feeds on polyps of corals by everting its stomach and secreting enzymes (Birk, 1979). Other animals feed on coral but none so efficiently as *Acanthaster planci* (Chesher, 1969), which is aptly referred to as a \"corallivore\" and spends on average about 45% of its time feeding (De'ath and Moran, 1998). A single starfish of *Acanthaster planci* can graze ten square metres a year of coral (Vicente, 1999). Measurement of feeding rates of *Acanthaster planci* have shown that feeding rates in summer are about twice that in winter, but are significantly depressed following the summer spawning season (Keesing and Lucas, 1992). In the laboratory, specimens have eaten molluscs and echinoderms, however scleractinian corals are their primary prey (Chesher, 1969). Scleractinia is an order of coral known as stony or hard corals which is made up of 18 families. Preferred species in the Western Pacific include *Montipora* spp., *Acropora* spp. and other members in the *Acroporidae* and *Pocilloporidae* families (Colgan, 1987; Quinn and Kojis, 2003). *Acropora gemmifera*, *A. nasuta*, *A. loripes*, *Seriatopora hystrix*, *Pocillopora damicornis* and *Stylophora pistillata* are preferred species too, however, they are protected by mutualistic crustaceans (see notes) (Colgan 1987; Glynn, 1976, 1980, 1983, in Colgan, 1987; Pratchett, 2001). In French Polynesia, *Acanthaster planci* show a feeding preference for all growth-forms of *Acropora* as well as the genus *Montipora* and *Pocillopora* (Faure, 1989).

General Impacts
Predation of corals by *Acanthaster planci*, storm damage, coral diseases and temperature-related stresses were the most commonly recorded natural impacts to coral reefs. The impact of coral-feeding starfish on natural coral assemblages can be severe and long-lasting. In some reefs 90% of live coral cover is lost. Please follow this link for details on the *general impacts of A. planci* compiled by the ISSG.

Management Info
There is substantial research and information on both ecological and management-based aspects of the coral-feeding starfish (*Acanthaster planci*) and its control. Please follow this link for details on *management options for the control of A. planci* compiled by ISSG.

Principal source:

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Review: Ian Miller, Coordinator of Broadscale Surveys AIMS Long Term Monitoring Program Australian Institute of Marine Science. Australia

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ALIEN RANGE

[1] AMERICAN SAMOA
[30] AUSTRALIA
[1] COOK ISLANDS
[1] COSTA RICA
[2] EGYPT
[1] FIJI
[1] FRENCH POLYNESIA
[5] GUAM
[1] INDIA
[1] INDIAN - OCEAN EASTERN
[1] INDIAN - OCEAN WESTERN
[5] INDONESIA
[4] JAPAN
[1] MADAGASCAR
[2] MALAYSIA
[3] MALDIVES
[1] MARSHALL ISLANDS
[2] MAURITIUS
[2] NEW ZEALAND
[8] NORTHERN MARIANA ISLANDS
[1] OMAN
[1] PACIFIC - WESTERN CENTRAL
[12] PALAU
[1] PANAMA
[1] PAPUA NEW GUINEA
[1] PHILIPPINES
[1] SAMOA
[1] SAUDI ARABIA
[1] SOUTH AFRICA
[1] SUDAN
[3] THAILAND
[1] UNITED STATES
[3] VANUATU

Red List assessed species 2: LC = 2;

Helcogramma striata **LC**
Luzonichthys williamsi **LC**

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