

## *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*, *Seriatorpora 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 Lucas, 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 Lucas 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*, *Seriatorpora 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:

**Compiler:** IUCN/SSC Invasive Species Specialist Group (ISSG) with support from La Fondation d'entreprise Total

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

**Publication date:** 2007-01-09

## 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

## BIBLIOGRAPHY

65 references found for *Acanthaster planci*

### Management information

Al-Jufaili, S., Al-Jabri, M., Al-Baluchi, A., Baldwin, R.M., Wilson, S.C., West, F. and Matthews, A.D. 1999. Human impacts on coral reefs in the Sultanate of Oman, *Estuarine Coastal & Shelf Science*. 49(SUPPL. A): 65-74.

**Summary:** An interesting report of the state of coral communities in Oman and the human and natural impacts contributing to their degradation.

Bell, P.R.F. 1992. Eutrophication and coral reefs some examples in the Great Barrier Reef lagoon, *Water Research* 26 (5): 553-568.

**Summary:** Algal growth and high nutrient levels are investigated in relation to the Great Barrier Reef (Australia).

Birkeland, C. 1982. Terrestrial Runoff As a Cause of Outbreaks of *Acanthaster planci* (Echinodermata: Asteroidea), *Marine Biology* 69: 175-185

**Summary:** This paper analyses the distinct possibility that historical outbreaks of *A. planci* can be linked to fluctuations in phytoplanktons, in particular because of heavy rain seasons in Micronesia and Polynesia.

Birkeland, C. and Lucas, J.S. 1990. *Acanthaster planci: major management problems of coral reefs*. Florida: CRC Press.

**Summary:** An online book available in limited form. Overview of global management strategies for the crown of thorns starfish.

Black, K.P. and Moran, P.J. 1991. Influence of hydrodynamics on the passive dispersal and initial recruitment of larvae of *Acanthaster Planci* Echinodermata Asteroidea on the Great Barrier Reef, *Marine Ecology Progress Series* 69 (1-2): 55-65.

**Summary:** Study which has implications for *A. planci* control, in particular for the development of early warning systems.

Brodie, J., Fabricius, K., De ath, G. and Okaji, K. 2005. Are increased nutrient inputs responsible for more outbreaks of crown-of-thorns starfish?, *Marine Pollution Bulletin* 51 (1-4): 266-278.

**Summary:** A study looking at evidence linking *A. planci* outbreaks with nutrient run-offs.

[Centre for Environment, Fisheries & Aquaculture Science \(CEFAS\), 2008. Decision support tools-Identifying potentially invasive non-native marine and freshwater species: fish, invertebrates, amphibians.](#)

**Summary:** The electronic tool kits made available on the Cefas page for free download are Crown Copyright (2007-2008). As such, these are freeware and may be freely distributed provided this notice is retained. No warranty, expressed or implied, is made and users should satisfy themselves as to the applicability of the results in any given circumstance. Toolkits available include 1) FISK- Freshwater Fish Invasiveness Scoring Kit (English and Spanish language version); 2) MFISK- Marine Fish Invasiveness Scoring Kit; 3) MI-ISK- Marine invertebrate Invasiveness Scoring Kit; 4) FI-ISK- Freshwater Invertebrate Invasiveness Scoring Kit and AmphISK- Amphibian Invasiveness Scoring Kit. These tool kits were developed by Cefas, with new VisualBasic and computational programming by Lorenzo Vilizzi, David Cooper, Andy South and Gordon H. Copp, based on VisualBasic code in the original Weed Risk Assessment (WRA) tool kit of P.C. Pheloung, P.A. Williams & S.R. Halloy (1999).

The decision support tools are available from:

<http://cefas.defra.gov.uk/our-science/ecosystems-and-biodiversity/non-native-species/decision-support-tools.aspx> [Accessed 13 October 2011]

[The guidance document](http://www.cefas.co.uk/media/118009/fisk_guide_v2.pdf) is available from [http://www.cefas.co.uk/media/118009/fisk\\_guide\\_v2.pdf](http://www.cefas.co.uk/media/118009/fisk_guide_v2.pdf) [Accessed 13 January 2009].

Chess, J.R., Hobson, E.S. and Howard, D.F. 1997. Interactions between *Acanthaster planci* (Echinodermata, Asteroidea) and Scleractinian Corals at Kona, Hawaii I, *Pacific Science* 51 (2): 121-133.

**Summary:** A study of feeding preferences of *A. planci* in an Hawaiian reef.

De ath, G. and Moran, P.J. 1998. Factors affecting the behaviour of crown-of-thorns starfish (*Acanthaster planci* L.) on the Great Barrier Reef: 1: Patterns of activity, *Journal of Experimental Marine Biology & Ecology* 220 (1): 83-106.

**Summary:** Feeding behaviour and activity times of *A. planci*.

Done, T.J. 1988. Simulation of recovery of pre-disturbance size in populations of *Porites* spp. damaged by the of thorns starfish *Acanthaster planci*, *Marine Biology* 100: 51-61.

**Summary:** Estimation for recovery times for five reefs in the Great Barrier Reef are calculated using models.

Fraser, N., Crawford, B.R. and Kusen, J. 2000. Best practices guide for crown-of-thorns clean-ups. Proyek Pesisir Special Publication. Coastal Resources Center Coastal Management Report #2225. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island. 38 pages.

**Summary:** The authors present a best practices guide for the control of *A. planci*.

Harriott, V., Goggin, L. and Sweatman, H. 2003. Crown-of-thorns starfish on the Great Barrier Reef. Current state of knowledge. November 2003 (revised edition). CRC Reef Research Centre Ltd.

**Summary:** This paper provides a detailed overview on the current thinking of the causative factors behind *A. planci* outbreaks, as well as recommended control options.

Hill, J. and Wilkinson, C. 2004. Methods for Ecological Monitoring of Coral Reefs - A Resource for Managers. Townsville: Australian Institute of Marine Science.

**Summary:** A look at monitoring methods for managers of coral reefs.

Johnson, D.B., Moran, P.J. and Driml, S. 1990. Evaluation of a crown-of-thorns starfish *Acanthaster planci* control Program at Grub Reef Central Great Barrier Reef Australia, *Coral Reefs* 9 (3): 167-171.

**Summary:** Review of a control project carried out at Grub Reef (Great Barrier Reef, Australia).

Keesing, J.K., Wiedermeyer, W.L., Okaji, K., Halford, A.R., Hall, K.C. and Cartwright, C.M. 1996. Mortality rates of juvenile starfish *Acanthaster planci* and *Nardoa* spp. measured on the Great Barrier Reef, Australia and in Okinawa, Japan, *Oceanologica Acta* 19 (3-4): 441-448.

**Summary:** Study providing evidence of the importance of predation as a determinant of survival rates of small starfish.

Lassig, B. Controlling crown-of-thorns starfish. 1995. Great Barrier Reef Marine Park Authority.

**Summary:** This paper provides comprehensive information on the management options for *A. planci*.

Ravindran, J., Raghukumar, C. and Raghukumar, S. 1999. Disease and stress-induced mortality of corals in Indian reefs and observations on bleaching of corals in the Andamans, *Current Science (Bangalore)* 76 (2): 233-237.

**Summary:** Report on the status of coral reefs in some locations in the Andamans (India).

Sano, M. 2000. Stability of reef fish assemblages: Responses to coral recovery after catastrophic predation by *Acanthaster planci*, *Marine Ecology Progress Series* 198: 121-130.

**Summary:** An interesting look at the recovery of reefs at Iriomote Island (Ryukyu Islands, Japan) - one of the places most affected by *A. planci* predation.

Seymour, R.M. and Bradbury, R.H. 1999. Lengthening reef recovery times from crown-of-thorns outbreaks signal systemic degradation of the Great Barrier Reef, *Marine Ecology Progress Series*. 176 (0): 1-10.

**Summary:** Worrying study on the recovery time for reefs of the Great Barrier Reef (Australia), which uses mathematical models to predict recovery rates.

Sluka, R.D. and Miller, M.W. 1999. Status of crown-of-thorns starfish in Laamu Atoll, Republic of Maldives, *Bulletin of Marine Science* 65 (1): 253-258.

**Summary:** Results of a survey for the presence of *A. planci* in the Maldives.

Teruya, T., Suenaga, K., Koyama, T., Nakano, Y. and Uemura, D. 2001. Arachidonic acid and alpha-linolenic acid, feeding attractants for the crown-of-thorns sea star *Acanthaster planci*, from the sea urchin *Toxopneustes pileolus*, *Journal of Experimental Marine Biology & Ecology* 266 (2): 123-134.

**Summary:** Details the discovery of chemical compounds derived from a sea urchin which could be potentially used as feeding attractants in the control of *A. planci*.

## General information

Adler, M., Kaul, A. and Jawad, A.S.M. 2002. Foreign body synovitis induced by a crown-of-thorns starfish, *Rheumatology* 41: 230-231.

**Summary:** Description of a patient wounded by *A. planci* and his subsequent treatment.

- Babcock, R.C. and Mundy, C.N. 1992. Reproductive Biology, Spawning and Fiel's Fertilization Rates of *Acanthaster planci*, *Aust. J. Mar. Freshwater Res.* 43: 525-534.  
**Summary:** A study of *A. planci* spawning patterns and behaviour at Davies Reef in the Great Barrier Reef.
- Babcock, R.C., Mundy, C.N. and Whitehead, D. 1994. Sperm diffusion models and in situ confirmation of long-distance fertilization in the free-spawning asteroid *Acanthaster planci*, *Biological Bulletin (Woods Hole)* 186 (1): 17-28.  
**Summary:** Study on the diffusion of sperm during spawning of *A. planci*.
- Baker, V.J. and Coleman, G.J. 2000. A guide to the reef monitoring database: Long-term monitoring of the Great Barrier Reef. Townsville: Australian Institute of Marine Science  
**Summary:** An overview of how to use the reef monitoring database.
- Benzie, J.A.H. 1999. Major genetic differences between crown-of-thorns starfish (*Acanthaster planci*) populations in the Indian and Pacific Oceans, *Evolution* 53 (6): 1782-1795.  
**Summary:** This paper explores the genetic diversity between populations of *A. planci* from two different oceanic regions (the Pacific and the Indian Oceans) and contributes to growing evidence that widespread marine species can be highly structured and may speciate (form new species) rapidly.
- Birk, S. 1979. *Crown of thorns Management Plan May 1979*.
- Brook, F.J. 1999. The coastal scleractinian coral fauna of the Kermadec Islands, southwestern Pacific Ocean, *Journal of the Royal Society of New Zealand* 29 (4): 435-460.  
**Summary:** Overview of the coral life of the Kermadec Islands.  
Available from: <http://www.rsnz.org/publish/jrsnz/1999/27.pdf> [Accessed 11 February 2008]
- Cameron, A.M., Edean, R. and De Vantier, L.M. 1991. Predation on massive corals: Are devastating population outbreaks of *Acanthaster-planci* novel events?, *Marine Ecology Progress Series* 75 (2-3): 251-258.  
**Summary:** Interesting study on the changes in coral composition caused by *A. planci* on the Great Barrier Reef (Australia).
- Chesher, R.H. 1969. Destruction of Pacific corals by the sea star *Acanthaster planci*, *Science* 165: 280-283.  
**Summary:** Review of the damage caused in the 1960s by the crown of thorns starfish outbreaks.
- Colgan, M.W. 1987. Coral Reef Recovery on Guam (Micronesia) After Catastrophic Predation by *Acanthaster planci*, *Ecology* 68 (6): 1592-1605.  
**Summary:** A study reporting the quick recovery of coral reefs in Guam following predation by *A. planci*.
- Crown of thorns starfish clean-up report: Light House Reef 7-03-2002. 2002.  
**Summary:** Report on clean up operations on Light House Reef, Palau.
- De Vantier, L.M. and Deacon, G. 1990. Distribution of *Acanthaster planci* at Lord Howe Island Solomon Islands South Pacific Ocean the southernmost Indo-Pacific reef, *Coral Reefs* 9 (3): 145-148.
- Done, T.J., Dayton, P.K., Dayton, A.E., and Steger, R. 1991. Regional and local variability in recovery of shallow coral communities Moorea French Polynesia South Pacific Ocean and Central Great Barrier Reef Australia, *Coral Reefs* 9 (4): 183-192.  
**Summary:** Study comparing the state of some coral reefs in Moorea (French Polynesia) and the Great Barrier Reef (Australia).
- Fabricius, K.E. 1996. Ecosystem recovery after episodic disturbance: Resilience of some coral reefs after *Acanthaster* outbreaks, *Senckenbergiana Maritima* 27 (3-6): 227-235.  
**Summary:** A study on the growth of macro-benthos, such as soft corals or macro-algae, following invasion damage by *A. planci*.
- Fagoonee, I. 1990. Coastal marine ecosystems of Mauritius, *Hydrobiologia* 208: 55-62.  
**Summary:** Review of the state of coastal ecosystems in Mauritius.
- Faure, G. 1989. Degradation of coral reefs at Moorea Island French Polynesia by *Acanthaster planci*, *Journal of Coastal Research* 5 (2): 295-305.  
**Summary:** Feeding preference of *A. planci* on the coral reefs of Moorea (French Polynesia).
- Glynn, P.W. 1984. An amphinomid worm predator of the crown-of-thorns sea-star and general predation on asteroids in Eastern and Western Pacific coral reefs, *Bulletin of Marine Science* 35 (1): 54-71.  
**Summary:** Details of a worm predator and its effect on *A. planci* levels in Panamanian coral reefs.
- Glynn, P.W. 1993. Monsoonal upwelling and episodic *Acanthaster* predation as probable controls of coral reef distribution and community structure in Oman, Indian Ocean, *Atoll Research Bulletin* 0 (379): 1-66.  
**Summary:** *A. planci* presence on coral reefs of Oman is reviewed.
- Guzman, H.M. and Cortes, J. 1989. Coral reef community structure at Cano Island Pacific Costa Rica, *Marine Ecology* 10 (1): 23-42.  
**Summary:** An overview of coral structure on reefs of Cano Island (Costa Rica) and predators present, including *A. planci*.
- Guzman, H.M. and Cortes, J. 1992. Cocos Island (Pacific of Costa Rica) coral reefs after the 1982-1983 El Niño disturbance, *Revista de Biología Tropical* 40 (3): 309-324.  
**Summary:** Overview of the factors contributing to the degradation of the corals reefs of Cocos (Keeling) Islands.
- Hart, A.M. and Klumpp, D.W. 1996. Response of herbivorous fishes to crown-of-thorns starfish *Acanthaster planci* outbreaks: I. Substratum analysis and feeding ecology of *Acanthurus nigrofuscus* and *Scarus frenatus*, *Marine Ecology Progress Series* 132 (1-3): 11-19.  
**Summary:** A study conducted in the Great Barrier Reef to investigate whether the increased turf algal resource linked to *A. planci* is prompting responses in the feeding ecology of herbivorous fishes.
- Hay, M.E., Parker, J.D., Burkepile, D.E., Caudill, C.C., Wilson, A.E., Hallinan, Z.P. and Chequer, A.D. 2004. Mutualisms and Aquatic Community Structure: The Enemy of My Enemy Is My Friend, *Annu. Rev. Ecol. Syst.* 35: 175-197.  
**Summary:** A look at the fascinating world of underwater mutualism, the dynamic relationship that plays an important role in constructing an ecosystem and community.
- Hoegh-Guldberg, O. 1994. Uptake of dissolved organic matter by larval stage of the crown-of-thorns starfish *Acanthaster planci*, *Marine Biology (Berlin)* 120 (1): 55-63.  
**Summary:** Study on feeding ecology of *A. planci* larvae.

[ITIS \(Integrated Taxonomic Information System\), 2007. Online Database \*Acanthaster planci\*](#)

**Summary:** An online database that provides taxonomic information, common names, synonyms and geographical jurisdiction of a species. In addition links are provided to retrieve biological records and collection information from the Global Biodiversity Information Facility (GBIF) Data Portal and bioscience articles from BioOne journals.

Available from: [http://www.itis.gov/servlet/SingleRpt/SingleRpt?search\\_topic=TSN&search\\_value=157194](http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=157194) [Accessed 6 February 2007]

Johnson, L.G. and Cartwright, C.M. 1996. Thyroxine-accelerated larval development in the crown-of-thorns starfish, *Acanthaster planci*, *Biological Bulletin (Woods Hole)* 190 (3): 299-301.

**Summary:** Report on larval development of *A. planci*.

Keesing J.K. and Lucas J.S. 1992. Field measurement of feeding and movement rates of the crown-of-thorns starfish *Acanthaster Planci*, *Journal of Experimental Marine Biology & Ecology* 156 (1): 89-104.

**Summary:** Study of feeding rates of *A. planci* on the Great Barrier Reef (Australia).

Keesing J.K., Bradbury, R.H., Devantier, L.M., Riddle, M.J. and; De ath, G. 1992. Geological evidence for recurring outbreaks of the crown-of-thorns starfish a reassessment from an ecological perspective, *Coral Reefs* 11 (2): 79-85.

**Summary:** This authors refute the hypothesis that *A. planci* outbreaks are a reoccurring phenomenon on some reefs on the Great Barrier Reef.

Lane, D.J.W. 1996. A crown-of-thorns outbreak in the eastern Indonesian Archipelago, February 1996. *Coral Reefs*. 15: 209-210.

**Summary:** This paper reports an outbreak of *A. planci* in Sulawesi, Indonesia.

Lourey, M.J., Ryan, D.A.J. and Miller, I.R. 2000. Rates of decline and recovery of coral cover on reefs impacted by, recovering from and unaffected by crown-of-thorns starfish *Acanthaster planci*: A regional perspective of the Great Barrier Reef, *Marine Ecology Progress Series* 196: 179-186.

**Summary:** A study of coral recovery rates in the Great Barrier Reef.

[Madl, P. 1998. Marine Biology I : Colloquial Meeting of Marine Biology I: \*Acantaster planci\*.](#)

**Summary:** An overview of *A. planci* as observed on the Great Barrier Reef (Australia), including development, primary food sources, predators, control methods and toxicity.

Available from: <http://www.sbg.ac.at/ipk/avstudio/pierofun/planci/planci.htm> [Accessed 20 November 2006]

McKenna, S.A. and G.R. Allen (eds.). 2005. A Rapid Marine Biodiversity Assessment of the Coral Reefs of Northwest Madagascar, *Bulletin of the Rapid Assessment Program* 31, Conservation International, Washington, DC.

**Summary:** A summary of the result of a coral reef survey in northwest Madagascar.

[Moran, P. 1997. Crown-of-thorns starfish questions and answers. Australian Institute of Marine Science \(AIMS\).](#)

**Summary:** Overview of life cycle of *A. planci*.

Available from: <http://www.aims.gov.au/pages/reflib/cot-starfish/pages/cot-000.html> [Accessed 20 November 2006]

Nakamura, R. 1986. A morphometric study on *Acanthaster planci* populations in the Ryukyu Islands Japan, *Galaxea* 5 (2): 223-238.

Palau Conservation Society. 1999. *Crown of thorns starfish control strategy draft*.

PERSGA/GEF. 2003. Coral Reefs in the Red Sea and Gulf of Aden. Surveys 1990 to 2000 Summary and Recommendations. PERSGA Technical Series No. 7. PERSGA, Jeddah.

**Summary:** An overview of coral reefs in this Middle Eastern area.

Pinca, S., Beger, M., Jacobson, D and Keju, T. Undated. The State of Coral Reef Ecosystems of the Marshall Islands

**Summary:** Overview of the health status of coral reefs of the atolls and islets of the Marshall Islands.

Pratchett, M.S. 2001. Influence of coral symbionts on feeding preferences of crown-of-thorns starfish *Acanthaster planci* in the western Pacific, *Source Marine Ecology Progress Series* 214: 111-119.

**Summary:** The effect of mutualistic crustacean on the feeding preference of *A. planci*.

Quinn, N.J. and Kojis, B.L. 2003. The dynamics of coral reef community structure and recruitment patterns around Rota, Saipan, and Tinian, western Pacific, *Bulletin of Marine Science* 72 (3): 979-996.

**Summary:** Comments on the types of coral communities now present in reefs around Rota, Saipan and Tinian.

Salvat, B., Hutchings, P., Aubanel, A., Tatarata, M. and Dauphin, C. Undated. The status of the coral reefs and marine resources of French Polynesia

**Summary:** An overview of the coral and marine resources in French Polynesia with a brief summary of the outbreaks of *A. planci*.

Seymour, R. M. 1989. Is *Acanthaster planci* a near-optimal predator?, *Ecological Modelling* 46 (3-4): 239-260.

**Summary:** Discusses the link between population outbreaks of *A. planci* with large-scale environmental disturbances such as cyclones  
Tsuda, R.T. 1971. *Status of Acanthaster planci and coral reefs in the Mariana and Caroline Islands June 1970 to May 1971*. University of Guam.

**Summary:** Summary of surveys of *Acanthaster* in the Mariana and Caroline Islands.

Tsuda, R.T., Jones, R.S., Randall, R.H. and Struck, M.R. 1970. *Acanthaster planci crown of thorns starfish: Resurvey of Saipan and Tinian: Survey of Aguijan*. University of Guam.

**Summary:** Results of surveys for *Acanthaster* and the state of coral communities of Saipan, Tinian and Aguijan Islands.

Vicente, N. 1999. Natural treasures under heavy pressure *Oceanorama* 30: 7-12.

**Summary:** A look at the pressures affecting natural coral ecosystems in the Red Sea.

WWF. 2003. Fiji Islands marine ecoregion: An overview of outstanding biodiversity, threats, opportunities and key stakeholders for conservation.

**Summary:** A look at the natural and diverse marine environments, species and processes of Fiji, with a focus on their economic and social importance to the Fijian people.