

Reef

**Oral History of Human Use
and Experience of Crown of Thorns
Starfish
on the Great Barrier Reef**

**A Report Submitted to the
Great Barrier Reef Marine Park Authority**

**by
Regina Ganter**

**Institute of Applied Environmental Research
Griffith University
Brisbane, July 1987**



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Introduction

This oral history study was commissioned by the Great Barrier Reef Marine Park Authority "to determine what evidence there is for the occurrence of previous aggregations of crown of thorns starfish". This initiative followed a Crown Of Thorns Starfish Advisory Committee recommendation in January 1985 to conduct "a study of oral history of human use and of experience of the Great Barrier Reef", after a pilot study in oral history was executed at James Cook University of North Queensland for the Great Barrier Reef Marine Park Authority (Burns, 1982). The Authority recommended to focus this study on extractive industries on the Great Barrier Reef prior to 1960 by recording operators, divers and others involved in these industries (trochus, beche-de-mer, pearling, trawling).

The study is seen as a contribution to the Great Barrier Reef Marine Park Authority's general interest in the relationship between man and the reef, and is located within the framework of a doctoral dissertation on the development and social relations of the pearl-shell, trochus and beche-de-mer industries on the Great Barrier Reef. Rights in the use of the material produced during this study for teaching and research purposes are vested in the consultant. These materials represent the fieldwork notes towards a dissertation, and persons not on the permanent staff of the Great Barrier Reef Marine Park Authority require the permission of the research officer to use them. Inquiries should be directed to Regina Ganter, School of Humanities, Griffith University, Nathan, Queensland, 4111. The proper ownership of information on the tapes is considered as resting with the informants.

Acknowledgements

This study was funded by the Great Barrier Reef Marine Park Authority and carried out with the administrative support of the Schools of Humanities and Australian Environmental Studies at Griffith University. I would like to thank my interviewees for their enthusiastic response, and also the wives of my interviewees who were present at tape-recording and whose contribution tends to go unnoticed in the description of the tapes. Thanks are due to the Department of Community Services for transport on the Melbidir from Thursday Island to Saibai Island, and to the chairmen of the Aboriginal and Torres Strait Island communities visited for arranging accommodation and introductions. The professional contacts supplied by the Great Barrier Reef Marine Park Authority and the advice obtained from these are greatly appreciated. For linguistic advice I am indebted to Dr. Athol Chase, Dr. Anna Shnukal and Professor Bruce Rigsby. Pedro and Gloria Guivarra, Joyce Isua, Gloria Kabai, Elma Yoelu and Mrs. Tamwoy looked after me in Torres Strait.

Methodology

Location of Informants

Consultation with a number of professional persons, and perusal of the contact index of the previous oral history project, yielded a preliminary list of some 130 potential interviewees, from which those most relevant for this study were selected as a fruitful starting point in coastal centres. The major tool in the location of informants was the tracing of networks of knowledge bearers supplied by respondents themselves. At least 15 of the relevant potential interviewees died during the course of this study before contact was established which underlines the urgency of this project.

Selection Criteria

It was considered desirable that the sample should strike a balance between indigenous and non-indigenous respondents, tap a range of various reef experiences, and focus particularly on the trochus, pearl-shell and beche-de-mer industries. Informants were considered desirable for inclusion in the sample if they had a significant involvement with the Great Barrier Reef prior to 1960, or had some pioneering role in reef uses, or were connected in another form with the above industries.

Fieldwork

The fieldwork phase of the project lasted 15 weeks, consisting of three separate journeys of four to six weeks' duration each. Transportation for the first two journeys was by car (Brisbane-Townsville) and Four-Wheel-Drive (Brisbane-Hopevale) hired at low rates from Griffith University, the third journey was by plane to Cairns, Bamaga, and Thursday Island. The major centres of Aboriginal recruitment onto luggers on the East Coast were visited, except Portland Roads. No respondents were found at Palm Island which served only as a "last resort" recruiting centre.

Between 8 June 1986 and 17 January 1987, 40 interviews with 44 indigenous informants, and 47 interviews with 48 non-indigenous informants were conducted in the following locations:

Brisbane area.....	5
Hervey Bay	2
Bundaberg.....	2
Gladstone.....	10
Yeppoon.....	6
Mackay.....	12
Townsville area.....	7
Ingham-Tully-Innisfail area.....	5
Cairns area.....	14
Hopevale, Wujal-Wujal, Cooktown.....	7
Lockhart River, Bamaga.....	9
Thursday Island, Saibai.....	8

That is a total of 87 interviews with 92 informants. (Informants are those separately listed in the Index of Tapes. Wives and others who were present in a supporting role are not classed as informants.)

Interviewing

Respondents were contacted by telephone, letter or visit to introduce the research officer and her interest, to gauge the respondent's type of involvement with the Great Barrier Reef and to arrange an appointment, usually at the respondent's home, unless otherwise requested. No preliminary interviews were conducted because it had been felt within the Great Barrier Reef Marine Park Authority that during the previous oral history project much valuable information may have been lost in such preliminary interviews. No mention of crown of thorns starfish was made in the introduction in order not to distort the responses solicited. The interview atmosphere was relaxed and taping equipment consisted of a small portable cassette recorder and unobtrusive lapel microphones.

Respondents were usually asked to summarize their life history, which was followed up with questions concerning relevant experiences. The issue of crown of thorns starfish sightings was introduced by asking about the dangers of diving in the case of divers, or by enquiring about changes in the reef environment. If a respondent who had direct experience of the reef prior to 1960, did not introduce the topic, the interviewer did. During many of the interviews a collection of old photographs from private photo-albums and Oxley Library was introduced to stimulate discussion. (Some oblique remarks on some of the tapes refer to the photo-albums being passed around.) All interviewees were shown Photographs A to H in Appendix I, in order to identify the crown of thorns starfish and to help an estimate of the densities encountered.

Summary of Findings

- * Australian reef users evidenced a high awareness of crown of thorns starfish prior to 1960: 48 of 92 informants said they had seen crown of thorns starfish before 1960 (Ch.1.1).
- * This awareness is especially high among trochus divers (Chs. 2.1, 2.4).
- * Of the Australian indigenous groups, Eastern Torres Strait Islanders (from Murray, Darnley, and Stephen Islands) are most familiar with crown of thorns starfish. There are indications of reef husbandry on Murray Island involving the destruction of crown of thorns starfish prior to 1960, and a specific term for crown of thorns starfish, *urmemeg*, exists in the Meriam language (Chs. 2.2, 2.4).
- * No folklore surrounding crown of thorns starfish, and no specific cure for crown of thorns starfish-inflicted injuries were encountered (Ch. 2.3).
- * The familiarity with crown of thorns starfish among Australian indigenous people correlates highly with trochus gathering activities, so that an inference from their familiarity with crown of thorns starfish to a long-standing traditional, pre-European, knowledge, must be treated with caution (Ch. 2.4).
- * Crown of thorns starfish abundances often led trochus divers to abandon a reef because they made swimming diving impossible, and crown of thorns starfish injuries formed part of the work-related injuries of trochus divers, ranking below coral abrasions and eel-bites (Ch. 1.3).
- * Eleven respondents indicated major populations of crown of thorns starfish prior to 1960 (Ch.1.3).
- * "Tricky snapper" (*Lethrinus chysostomus*) may be a predator of adult crown of thorns starfish (Ch. 1.4).
- * The evidence does not permit detection of patterns of outbreaks such as southward movement or short-term cycles (Ch.3).
- * The evidence for the occurrence of previous aggregations of crown of thorns starfish is not sufficiently conclusive to rule out the possibility that intensive aggregations of the scale observed since the 1960s represent a recent phenomenon (Ch.3)

1. Presentation of Data Concerning Crown of Thorns Starfish

1.1 Introducing the Sample

Of a total of 92 informants, 48 said they had seen crown of thorns starfish before 1960, and a further 14 made other observations concerning it. Respondents are classified into six categories according to the knowledge background from which they speak, and indigenous respondents are treated separately because of the potential significance attached to traditional knowledges. A separate chapter deals with the specific experience of indigenous interviewees. This chapter deals with all six groups.

Non-indigenous respondents are classed as those from a fishing background, those connected with the shelling industries, and Others; and indigenous respondents are differentiated according to whether they are mainland Aborigines, Eastern Torres Strait Islanders (Meriam speakers), or from other Torres Strait Islands (Western and Central Islands).

39 informants had experience of the Great Barrier Reef before World War II, and a further 3 became involved in the shelling industries on a local scale during World War II. Four interviews are treated as confidential and names are replaced with pseudonyms, and a passage in tape 49 is also confidential.

As far as can be established from the report of the previous oral history project, which does not comprise a complete list of interviewees, 5 informants of that project were again visited (Col Jones, Jack Kennell, Bob Hall, Neal Whittaker, and Stephen Nona). Bedford, Newitt, SeePoy, Waia, and "Murray Island", and possibly Bradford, Ellis and Grigg have also made previous statements concerning crown of thorns starfish which had come to the notice of the Great Barrier Reef Marine Park Authority.

Table 1
Crown of Thorns Starfish (*A.pl.*) Experience According to Background of Interviewees

Backgrounds of Respondents	reportedly saw <i>A.pl.</i> before 1960	made other comments re. <i>A.pl.</i>	made no relevant comments re. <i>A.pl.</i>	total
Fishing Industry	6	4	9	19
Shelling Industries	3	2	8	13
Other	5	3	8	16
Aborigines	11	2	2	15
Meriam Speakers	11	-	-	11
Other Torres Strait Islanders	12	3	3	18
Totals	48	14	30	92

Table 1 reveals that the proportion of those who said they had seen crown of thorns starfish prior to 1960 is much higher among indigenous informants, all of whom had been engaged in the trochus, beche-de-mer or pearl-shell industries. Trochus divers especially were not casual visitors to the reef. They

followed familiar routes from one year to the next, and the reef was their working environment. Crown of thorns starfish stings were among their work-related injuries, and the relative abundance of crown of thorns starfish on a reef was a factor in their daily decision-making process - whether to work on a reef or abandon it. Their testimony may be more heavily weighted as an authoritative statement about the reefal areas they knew.

1.2 Crown of Thorns Starfish Sightings

Two major difficulties pertain to the gathering of data on crown of thorns starfish from untrained observers. The first difficulty is to establish where and when respondents have encountered normal crown of thorns starfish populations. Most respondents considered crown of thorns starfish a normal part of the reef and took no particular notice of them. Some had seen them so frequently that they could not specify their experience, e.g.

- Bradford said there were not many reefs where one did not find some crown of thorns starfish (around 1956-58)
- Isbel saw them virtually anywhere between Thursday Island and Cairns (1951-54)
- Busuttin saw them anywhere, from the Swain Reefs to north of Cairns
- Saylor said there had always been one or two all along the Barrier (ca. 1946-ca.1957)
- Matt knew them ever since he fished on reefs (since 1954)

Others attested to the rarity of crown of thorns starfish, e.g.

- Namok saw only a few in the area between Thursday Island and Mackay (1934-42, 1957)
- Nona found them "relatively scarce" compared to recent reports (since 1936)
- Cook, a diver, only ever saw one (in 1954 on Keeper Reef)
- Whittaker saw only odd specimens (postwar)
- Ah Mat, a pearl-shell swimming diver, never saw any and believes other trochus divers would not have seen any, either (1950s, 60s)

The second difficulty lies in differentiating normal populations of crown of thorns starfish from crown of thorns starfish abundance. Although this is a difficult issue even for marine scientists, the problem surfaced mainly in interviews with indigenous respondents, e.g.

- "Hopevale" saw such "a lot" that one had to be careful not to step on them (1930-postwar)
- Kaddy saw "a lot" but never in aggregations (1951-?'58)
- Maza saw "many", they were growing together in patches in Torres Strait (ca. 1938-51)
- Pitt saw "many" outside Mackay, they were a hazard for divers, forming mats of up to an acre (1950s)
- Singleton and Stanley saw "many" sitting on rose corals and Christmas corals in the Cairns area (immediate postwar years)
- Hobson saw "plenty", so that one could notice the coral die away
- Sandy saw "plenty" - some here, some there, inside the Barrier (1929-52)
- Elu saw "plenty", perhaps 2 or 3 in the area of a room between Saibai and Cairns (pre- and postwar experience)
- Jacob saw "plenty", 1 or 2 together, and thinks he may have seen aggregations as in Photograph A (1937- postwar).

The problem lies firstly in the need to express quantities in qualitative terms in the absence of 'hard data', and applies equally to the issue of the relative abundance of triton shells. In both cases the qualitative expression is made

against the background of other values. For example Playo found "many triton shells" - for him they were good pocketmoney (1924-29), but Bradford, finding perhaps one triton per reef, thinks them rare, because he sees them as the hypothesized predator of crown of thorns starfish.

Secondly, and more importantly, the problem lies therein that these qualitative terms are often meant as a statement about the whole or a large section of the Barrier Reef, rather than about individual reefs. To attempt a statement concerning the distribution of crown of thorns starfish over a large section of the Great Barrier Reef is meaningless, since "starfish do not occur evenly over the surface of reefs but tend to form localized concentrations or aggregations" (Moran, 1986:40).

The relative abundances of crown of thorns starfish have been defined by various standards, e.g. Chesher (1969) distinguishes between "normal populations" (1 per hour dive) and "epidemics" (5 or more per hour dive), Vine (1970) describes crown of thorns starfish as "scarce" (1-5 in 20 minutes' dive) and "common" (more than 5 in 20 minutes' dive), and reinterprets Pearson's definition of "infestation" (more than 40 in 20 minutes' dive) as "modest densities". Other definitions based on the number of starfish by time or by area are listed by Moran (1986, table X). The Great Barrier Reef Marine Park Authority takes as the parameter for "normal populations" less than 40 in 15 minutes' dive ("uncommon" - less than 10 on a reef; "common" - 10-39 on a reef). The following sightings may safely be presumed to constitute normal populations of crown of thorns starfish.

Table 2
Sightings of Normal Populations of Crown of Thorns Starfish

Period	Area and Description	Approx.Lat.S.	Informant
ca.1944-ca.'53	around Murray and Dowar individuals	10°	Tapau
1958-67	Warrior Reef a few	9°-10°	Kyozo
1933-57	e.g. Turtle Group ca. 1 in the area of a room	14°40'	Waia*
1930s, ?'40s	Batt Reef, Ribbon Reef just a few	16°25', 14°-15°	Newitt*
Nov. 1946	Sudbury Reef, Moa (Maori?) Reef occasional specimens	16°57', 17°05'	Dan
1946-60	e.g. Keeper Reef not prolific, but more than one per reef	18°44'	Thorogood
1954	Keeper Reef only one	18°44'	Cook
1950-55	Rib Reef, Bramble Reef in 4.5 m depth, dinnerplate size, on outside of reefs	18°30', 18°25'	Hansen
1950s	everywhere up and down the Barrier e.g. Hook Reef, Black Reef	19°50'	Pitt
before WWII	Swain Reefs some	ca. 21°-22°	Kennell
1933-61	Swain Reefs odd specimens	ca.21°-22°	Leach

*Waia had previously indicated that he had seen crown of thorns starfish since 1934, particularly on the reefs south of Cooktown, where some reefs had more than one in the area of a room, e.g. "Moon Reef" off Cooktown (Zann, pers.comm.)

*Newitt had told Peter Saenger that he had seen many crown of thorns starfish, but not in thousands, e.g. in the Green Island area in 1937-40.

Three further sightings of normal populations are not included in Table 2 because the familiarity of the informants with crown of thorns starfish could not be satisfactorily established:

- Flinders believed he had seen one or two crown of thorns starfish on H-Reef (Helsdon Reef - 14°56') but did not know what they were and learned of crown of thorns starfish through the media. His experience of the reef refers to the period from 1937 to ca. 1942.
- Bowen said he saw crown of thorns starfish on every reef after World War II, between Cairns and Noble Island, e.g. on H-Reef and Two Island (Two Isles 15°01'). He did not know that they were poisonous and had obviously learned about crown of thorns starfish through the media or other informers.
- Playo said he saw odd specimens outside Townsville while trochus diving between 1925-29, but took no notice of them, and does not remember seeing them on corals.

Table 3
Crown of Thorns Starfish Sightings Reported by Burns

Period	Area and Description	Approx.Lat.S.	Informant
ca. 1918-26	Yorke Island	9°-10°	Mosby
1936	Cairns to outside Townsville small number	16°56'-18°46'	Drummond
1936	Cape Tribulation fringing reefs	16°05'	Mason
mid to late 30s	Green Island	16°46'	Cummings
1941	Lizard Island first seen	15°27'	Vlasoff
late 50s	Euston Reef pulled one up from 64 m	16°39'	Ernst/Baker
late 50s	Michaelmas Cay regularly seen	16°35'	Oke
1954	Lodestone Reef first seen	18°42'	Tarca
1955	Bushy Island second sighting	21°	Tarca

less area-specific statements:

- Abednego saw small numbers everywhere from Murray Island to the Swains, ca. 1927-40
- Mills saw small numbers along the entire lengths of the reef, from the 1930s onwards
- Nona saw small numbers from Cape Grenville to the Swain Reefs

1.3 Crown of Thorns Starfish Aggregations

In the light of the definitional difficulties outlined above, reports from untrained observers must be interpreted with caution. "In Hawaii reports by local divers of numerous starfish in a specific area have, upon checking, almost invariably turned out to involve only a few individuals. Even a scientific observer used to the sporadic occurrence of *A. planci*, would be inclined to report several starfish in an area as common or abundant, for in a relative sense they would be" (Randall, 1972). The following sightings may have constituted aggregations of crown of thorns starfish.

Table 4
Sightings of Potential Aggregations of Crown of Thorns Starfish

Period	Area and Description	Approx. Lat. S.	Informant
pre-1945	Tattersall Reef, Lagoon Reef, Simon Reef, Copeland Reef so many as to make walking impossible	(not known) (12°23')	Doctor
1937-42, 1946-	Cooktown to Lizard Island like Photo A could notice coral die away on some reefs	14°40'-15°27'	Hobson
pre-and postwar	saw plenty, usually 1 or 2, but perhaps also as in Photo A		Jacob
WWII	Eastern Islands 3-7 adults in a staghorn not as many as now not like Photo A	9°-10°	Sailer
1946-52	Low Islands noticed steady increase over time	16°22'	Ellis
1947-early 60s	all along Barrier, Swain Reefs, between Cape York and Cape Melville like Photo H, but not like Photo A "could have been millions" 5-10ft deep (1.5 - 3 m), swimming impossible left dead patches of reef up to 15m across		Sailor
Jan. 1951	Howick Group swimming impossible	14°25'	Kennell (for Williams)
1950s	outside Mackay forming mats of up to an acre, a hazard for divers, less dense than on Photo A		Pitt
1956/57	always one reef or another infested e.g. Rib Reef, Eel Reef	18°30', 12°30'	Bedford

Table 4 contd.
pre-1962

	Murray Island formed mats	10°	Kiwat
	Britomart Reef more than anywhere else, close together, impossible to count	18°15'	
1959	Green Island witnessed beginning of first infestation gradual increase	16°46'	Grigg
July 1966	Fitzroy Reef all bunched up together more than 10 per foot sq.	16°55'	Wickham and McDermott
late 1960s	Gibson Reef "so thick, you couldn't put a finger between them" reef looked "dead and eerie"	17°20'	Ellem
1985	Gannet Cay one reef devastated brown algae developed recently but not soft coral	22°	Isbel
(1986)	thousands on High Stone Reef	(Torres Strait)	Sailer

- Nandy also saw a "big mob" on "Patrick Reef" (not known - ca. 16°-17°30') in 1946/47. However, he believed they were lethal and found they occurred especially in rough weather, so that it is possible that he wrongly identified crown of thorns starfish.

- "Murray Island" had told Bob Johannes that he had seen "many, many crown of thorns starfish in the Green Island/Hinchinbrooke area in 1935/36". In this interview it appeared that his experiences related mainly to the area between Torres Strait and Lockhart River, and that he had only once travelled as far as Townsville, during which time he was incapacitated from swimming by an injury which he attributes sometimes to a sea urchin and sometimes to a crown of thorns starfish, and when shown Photo C he interpreted it as a jellyfish. In other respects this interviewee was lucid.

During the first infestation at Green Island, 132 starfish were killed per hour per diver at one stage (Kenchington and Pearson, in Moran, 1986:87), and "approximately 44,000 starfish were recovered from a small area on Green Island over about 18 months" (Moran:40). It is unlikely that any of the sightings prior to that at Green Island listed in Table 4 except Sailor's refer to aggregations of comparable scale. None except Sailor refer to large-scale devastation of coral before 1960.

Aggregations Reported in Other Sources

Doug Tarca publicized in the Sunday Mail (7/9/1969) that he had seen large numbers of crown of thorns starfish on the south-east side of Lodestone Reef in 1954. This statement has been interpreted as an aggregation of crown of thorns starfish and has been widely cited in support of the contention that not crown of thorns starfish aggregations, but the reports of them are a recent phenomenon (e.g. Vine, 1970, 1973). In an interview with Burns (1982), Tarca stated that he had seen crown of thorns starfish for the first time at Lodestone Reef in 1954, and again at Bushy Island in 1955, and thereafter in "staggering numbers" on some reefs between Mackay and the Swain Reefs (Burns, 1982:19, 22, tape 9, A/85, A/108). Moran reports Tarca as saying that the Swain Reefs had been infested in 1957 (1986:66). If what Tarca really saw were aggregations comparable to that at Green Island in 1962, his statements about them seem surprisingly varied. None of the statements by interviewees of this or the previous oral history study can serve as a direct corroboration of Tarca's sightings.

The only other aggregation reported by Burns as having been observed prior to 1960 referred to an account by a third person: "In 1968 Adrian Cummings was told by his father-in-law Mical Newie, a trochus diver, of an infestation that had occurred around St. Pauls (Moa Island) twenty years before." (1982:22).

Richard Lurie found Second Ribbon Reef "dreary" and dead (presumably between 1961 and 1965) whereas other nearby reefs were "very prolific with coral life". He found that the coral "had been completely stripped, very much as the Crown of Thorns removes all the inhabitants of a coral clump it feeds upon", but thought that the "amorphous puckered covering" of "leathery textured material" of light green and ivory colours, which covered the coral "for hundreds of yards" was responsible for the devastation. He believed the growth to be a giant form of anemone, but it was quite possibly a soft coral or algal growth which opportunistically spread after a crown of thorns starfish aggregation (Lurie 1966:89-90).

1.4 Other Observations Concerning Crown of Thorns Starfish

Relationship between Trochus and Crown of Thorns Starfish

Trochus niloticus feed on algae, and several interviewees referred to the habitational proximity of crown of thorns starfish and trochus.

- Bedford stated that crown of thorns starfish are found in the staghorn corals where the trochus are
- Bradford finds that reefs which were formerly prolific trochus grounds are now inhabited by crown of thorns starfish
- Isbel noticed crown of thorns starfish especially on dark tides when trochus are up in the shallow water - they were sheltering from sunlight under the coral overhangs
- "Hopevale" found that especially when breaking off corals to get to the trochus shell one had to be careful not to step on crown of thorns starfish
- Sailer said when trochus swimmers broke off corals they sometimes had to dispose of crown of thorns starfish

- Sailor often saw patches with up to 100 crown of thorns starfish which had disappeared on subsequent visits, and trochus shell had congregated on those dead patches of reef. He also finds many trochus after a cyclone, especially on the breaker side, and believes trochus prefer dead coral
- Hobson found that trochus shell congregate on dead patches of reef after a crown of thorns starfish presence, when a "muddy" growth (algal cover?) appears
- Wosoop indicated that trochus congregate on dead patches of reef
- Akiba found that crown of thorns starfish behave much like trochus, they move very slowly, crawl up coral to feed, and can be seen especially at high tide in the cold months June/July
- Sailor was the only informant who said that trochus shell are not found once a patch of coral is dead, because they live on coral. A normally prolific trochus patch might be found to be dead with only some crown of thorns starfish on it.

Predation

See Poy, a fishing charter operator reported finding crown of thorns starfish spines in the stomachs of tricky snapper (red sweetlip, red throat - *Lethrinus chrysostomus*) recently. He was open to the suggestion that these may have been the spines of sea urchin, but is concerned about the possibility that harmful quantities of copper sulphate may enter the food chain if used in eradication programmes. Newitt, a retired fisherman also reported regularly finding crown of thorns starfish spines in the stomachs of grey snapper and tricky snapper near Bramble and Britomart Reefs before World War II. He was adamant that they were the spines of crown of thorns starfish and not of sea-urchin.

- Newitt believes the depletion of surface fish might be linked to crown of thorns starfish outbreaks
- Kennell believes the decimation of fish populations through trawling may have allowed crown of thorns starfish numbers to increase
- Kiwat sometimes found crown of thorns starfish spines extruding from triton shells
- Ellem once observed an 18-inch triton consuming a crown of thorns starfish of about equal size (ca. 46 cm) within 4 days
- Sailer found crown of thorns starfish on the lee side of reefs, rarely on the weather side, whereas tritons are found on sandy hard bottom on the breaker side
- Bradford believes that trochus are a more likely predator than triton for crown of thorns starfish, because of their larger number, and because they appear to compete for the same habitat.

Of the 48 interviewees who said they had seen crown of thorns starfish before 1960, 6 said they knew then that it fed on corals (Busuttin, Hobson, Kaddy, Sailor, Aliba, Williams), and 11 indicated that they did not know at the time (Hansen, Isbel, Hansen, Leach, Flinders, Singleton, Stanley, Dan, Elu, Maza).

Size, Habitat and Behaviour of Crown of Thorns Starfish

Crown of thorns starfish are usually between 250 and 350mm, and individuals up to 700mm in size have been found. The variation in their colour has been stipulated to be a result of diet (Branham, 1973, in Moran, 1986:7).

Aggregations have been found to depths of 30m, individuals in up to 40m depths (Moran), and Burns reports one crown of thorns starfish pulled up from 64 meters at Euston reef (Burns, 1982:20, Moran 1986:9). They prefer sheltered positions, such as lagoons, and are also found in the deeper water of windward slopes. They avoid shallow and exposed locations with wave action (Moran, 1982:9). It has been found that at the start of an outbreak they are concentrated on the fore-reef slopes, and over a period of (9-12) months become more abundant in the sheltered back-reef areas (Moran, 1986:41), and that on exposed reefs they are found mostly on the leeward side (Dana et al. 1972, in Moran 1986:103).

- Dan saw occasional crown of thorns starfish ranging in size from a dessert plate to larger than a dinner plate, in ca. 5 fathoms of water (9 m)
- Busuttin saw perhaps a few 100 specimens of up to 18 inches in size (46 cm), but not aggregated, sometimes on the sandy patches between corals
- Bowen believes he saw groups of 3 or 4 manoeuvring on sandy bottom in 15 to 20 feet (ca. 4 1/2 to 6 m) of water (his familiarity with crown of thorns starfish was not satisfactorily established)
- Kiwat saw them all year round, on any tide, but not on sandy bottom
- Hobson saw them all year round, on any tide
- Pitt found they occurred at any time. Individuals are found on top of the reef, but mostly they are "at the back" of the reef where the coral is dead
- Akiba found them especially in June/July at high tide feeding on coral
- Sailor believes they occur seasonally, especially in October/November. They roll up into balls and float away on strong tides until they come to live coral and crawl down it. When the tide slackens they come up and sit all over the coral, clinging hard. They occur in all sizes, big and small together, reddish or purple, the little ones are yellow. Sometimes they are touching each other, but not as in Photograph A. He found them in depths of 5 and not more than 10 feet.
- Williams said that their larvae float with the tide and so spread for miles
- Flinders found that they were usually rolled up (perhaps as in Photograph H) (not considered reliable)
- Wosoop said that sometimes they bunch up (as in Photograph A), maybe at feeding time. He saw blue, white or red crown of thorns starfish, and they leave the reef looking bluish with slime on top, and later it turns white (not considered reliable)
- Kepa said one usually sees a larger one by itself or a smaller one with a larger one
- King thinks they must come up from deep water (not considered reliable)
- Newitt believes they must live in great depths because he once pulled up a piece of dead coral from 135 m at Euston Reef
- Nandy said they occur especially in rough weather (not considered reliable)
- Waia said they prefer "dirty" (muddy) water with subdued current. The small ones shelter at the back of the reef and come out in calm weather. They are not as mobile as octopus. The spines erect themselves when touched
- Tapau found them in the shallower waters on the Murray Island home reef, especially at the back of the island, everywhere around Murray and Dowar, and on the outside reefs
- Kaddy always found a lot, especially on the reef bottom, and dead coral is always associated with them, but most reef damage occurs on the breaker side where crown of thorns starfish are not found
- Saylor found them especially on the breaker side of reefs
- Hansen saw individuals on the outside of reefs, not in the lagoons, in ca. 15 feet of water (ca. 4.5 m). He did not notice any coral damage.

- McGree has been observing resident populations in the lagoons of Fitzroy, Musgrave and Llewellyn reefs. They are more than 22 inches across (56 cm), and there is perhaps one crown of thorns starfish every 100 yards, and 3 or 4 can live in the holes which sometimes occur on top of the reef of about an acre in extent and perhaps 3.5 m deep, without affecting the area beyond (cf. also Pearson, 1972).

Patrick Danaher reported that in an interview with Robert Cook (born 1921) in 1981 at Darnley Island, Cook said he had seen "plenty of crown of thorns starfish on the seabed - sometimes they hid and sometimes they came up in the season and stretched themselves" (GBRMPA, unpubl. data).

1.5 Crown of Thorns Starfish-Inflicted Injuries

One of the earliest recorded and authenticated crown of thorns starfish injuries was reported to produce sharp and intense pain and bleeding from the puncture. C. Marston sucked his wound and spat out the blood, and felt some slight tingling around the lips, which he said could have been due to nervousness. The area around the wound remained tender for several weeks. At a second occasion the injury was treated by sucking and washing in hot water with soap. "Some pus gathered the next day but cleared up after treatment, and a week later a small, brown, hard, foreign body - the size of a pin-point - was seen below the skin and removed with a needle. No lasting ill-effects followed the second wounding." (Pope, 1965).

In the literature, crown of thorns starfish has been described as capable of inflicting a painful wound, which could produce several other symptoms including nausea, vomiting, and swelling. The inflammation can be treated with anti-histamines, but the saponin contained in the tissue overlying the spines (the only toxic material which has been found) have not been considered sufficient to account for the toxic reactions (Croft et al. 1971, in Moran 1986:8).

According to the statements by respondents, the effects of sting, apart from pain and swelling, appear to vary, possibly dependent on whether the wound gets infected. Waia "went giddy from the poison", elsewhere he elaborated that the symptoms were similar to influenza: headaches, joint pains, "shakes" (Zann, pers. comm.). Jacob continued work after a crown of thorns starfish injury, whereas Dan witnessed a crew member incapacitated for days from a crown of thorns starfish injury. Doctor's wound was heated over a fire and had to be cut, and his foot turned black. Sailor found the sting from a crown of thorns starfish more painful than a jellyfish sting.

Burns reports that Derek Scott sucked a sting and experienced swelling to the mouth and breathing difficulty, that a stinging made Ben Nona want to urinate, and that Tarca who was pierced by 22 spines was hospitalized for two weeks. "Spines always broke off and had to be removed from the wound. Gross swelling usually resulted" (Burns 1982:32).

Bedford has unsuccessfully applied vinegar to crown of thorns starfish injuries; Kyozo recommends it for stingray injuries, and tea from a Japanese tree relieves fish poisoning. For crown of thorns starfish injuries Kyozo recommends

grass ashes mixed in hot water. Busuttin has seen indigenous people use a twist of tobacco, the chewed bark of a tree, or boiling hot water for stingray injuries. (Treatments cf. Ch.2).

2. Experience of Crown of Thorns Starfish among Indigenous Informants

2.1 About Indigenous Respondents

Indigenous respondents were sought who had been significantly involved in the trochus, pearl-shell and beche-de-mer industries before the 1960s. It was found that a considerable status distance exists between pearl-shell divers, who used "hard-head" diving equipment (brass helmet with air supply) and were in (first, second or third) command of their luggers, and trochus divers ("swimming divers", "naked divers") who used facemasks or goggles for shallow diving. Successful pearl-shell divers did not normally sign up with trochus luggers, whereas deck-crew of pearl-shell luggers did.

Most trochus divers had also spent some time on pearling luggers and had collected beche-de-mer seasonally, but it was often stated that crown of thorns starfish were observed while picking trochus shell. 39 indigenous informants had been trochus diving, and 5 had only pearl-shell diving experience. Of these 5, 3 had never observed crown of thorns starfish and gave as the reason that they had only dived on sandy bottom (mostly on 'Old Ground', a shallow area west of Badu Island, or at 'Darnley Deeps' at great depths).

Of a total of 44 indigenous respondents, 35 indicated that they had seen crown of thorns starfish prior to 1960, and 9 that they had not. However, in spite of the visual material presented to them, some interviewees may have wrongly identified crown of thorns starfish, e.g. one stated that they were 'lethal', others were unfamiliar with their toxic properties, and in a few cases the distinction from sea-urchins could not be satisfactorily established. Most of these informants do not use standard English as their first language. A critical reading of informants' statements suggests that 24 of 44 indigenous informants could definitely establish their familiarity with crown of thorns starfish prior to 1960.

Table 5
Crown of Thorns Starfish Sightings among Indigenous Divers prior to 1960

Respondents	have seen	have not seen	(not reliably established)	total
with trochus diving experience	22	7	10	39
with pearl-shell diving experience only	2	3	-	5
totals	24	10	10	44
Aborigines	5	5	5	15
Eastern Torres Strait Isls.	9	1	1	11
Other Torres Strait Isls.	10	4	4	18
totals	24	10	10	44

Definite familiarity of crown of thorns starfish prior to 1960 was very high among Eastern Islanders (9 out of 11) and low among Aborigines (5 out of 15). 10 out of 18 interviewees from other Torres Strait Islands had definitely known crown of thorns starfish prior to 1960.

Birkeland (1981) suggests that in Micronesia, Melanesia and Polynesia, crown of thorns starfish "may be more common around high islands". All Torres Strait Islands have fringing reefs, but Murray Island is situated directly on the northern extreme of the Great Barrier Reef. The Eastern Islands are volcanic islands with dense vegetation. The other Torres Strait Islands are swampy low-lying (Saibai, Boigu) or rocky granite islands (Western islands) and low sandy islands (Central islands) (Beckett, 1963, 1972). A comparison of Birkeland's hypothesis with the conditions in the Torres Strait Islands is outside the parameters of this study.

2.2 Indigenous Terms for Crown of Thorns Starfish and Other Marine Creatures

Specific names for crown of thorns starfish have been reported from Samoa (*alamea*), the Cook and Society Islands (*taramea*) (Flanigan and Lamberts, 1981), Palau (*rrusech*), Fiji (*bula*) and Mokil near Ponape (*larni*) (Birkeland, 1979, 1981).

It is not warranted to infer, as Birkeland does, from a linguistic and folkloristic familiarity with crown of thorns starfish alone that outbreaks of crown of thorns starfish have previously occurred in those locations, or to speculate on their higher or lower frequency. Nor can their cause be considered natural on that basis. All that can be inferred from linguistic and folkloristic familiarity with crown of thorns starfish is that they have been present for a considerable period of time. If a specific term exists for them, they may have had some special importance, such as their capacity to inflict pain. A statement of relative densities of crown of thorns starfish can not be safely extrapolated from the existence of a specific term.

No reference to crown of thorns starfish was encountered in the traditional folklore of indigenous populations in Queensland, but a specific term for them exists in the Meriam language of the Eastern Torres Strait.

- a) Most Aboriginal respondents referred to crown of thorns starfish as porcupine, translated as *balin'ga* (Guugu Yimidhirr), *kaa'uma* (Kuuku Ya'u - also recorded by Chase (pers. comm.) and Thompson), or *jalan* (Kuku-Yalanji). (One respondent from Mabuiag also referred to it as porcupine - tape 21.) To derive the nomenclature of an unfamiliar marine creature from a familiar land animal on the basis of striking physical properties is not entirely surprising, for example the Luchuans of the Ryukyu Islands initially referred to crown of thorns starfish as "habu of the sea" after a venomous land snake (Raymond, 1986:15).

One Aboriginal respondent described crown of thorns starfish as looking "like a star" (*thiithi* means "star" in Kuuku Ya'u - Thompson (1987) whereas another Kuuku Ya'u speaker gave *walang kay* as the term for starfish. (Thompson (1987) records this word as meaning pearl-shell.) Sea-urchin (*wuungku* - also recorded by Thompson) is definitely differentiated from crown of thorns starfish in the Kuuku Ya'u language of Lockhart River.

It seems improbable from the existing linguistic evidence that an indigenous term for crown of thorns starfish exists in the Aboriginal languages represented in the sample.

- b) Respondents from the Western and Central Torres Strait Islands, who share a common language with regional variations (Kala Lagaw Ya), show little agreement on an indigenous nomenclature for crown of thorns starfish. Two Saibai respondents referred to it as "naily" (Elu and Waia), one of whom used the indigenous term *patalai* (a derivative of "nail") . The term *iruk* used by another Saibai respondent was not offered as definitive. (It was listed as "yellow-plumed beche-de-mer" (*holoth. coluber*) by Ray (1907), and *patal-iruk* was translated as "lollyfish - *holoth. saguine lenta*").

One Badu Islander used *dikeri* to refer to crown of thorns starfish. This word probably corresponds with the terms rendered as "ni-krim" and "dee-kree" by Vince Burns. "Dee-kree" was obtained by Burns from another Badu Islander who ascribed it to the Meriam language. "Ni-krim" was obtained from a Yorke Islander and considered "by a James Cook student" as a term belonging to the Western language (Burns, 1982:34). However, that language does not allow such consonant clusters (Shnukal, Rigsby, pers. comms.) Because it appears to be a loan-word from another language, it occurred to this researcher that the term may have been borrowed from Japanese, through close contact with Japanese skippers on trochus boats, because some Islanders did acquire a small working vocabulary of Japanese, but no substantiation for this hypothesis has been found.

- c) All Meriam-speaking respondents (from Murray, Darnley and Stephen Islands) who were able to indicate an indigenous term for crown of thorns starfish, referred to it as *urmemeg*. (*Wanwan* for sea-urchin was also widely known among Meriam speakers.) Kaddy translated *urmemeg* as "fire place", Kiwat translated *ur* as "fire" and *memeg* as "closer", and Burns obtained the translation of *ur* as "fire" and "me-meg" as "carrier" or "follower" from Kennell, all of which appears as a linguistic reference to the painful sting. Also significant in this context is perhaps the practice to treat crown of thorns starfish injuries and other stings with heat from a fire. (Ray, 1907, gives *ur* as "fire" and *memeg* as "serving".)

Murray Island was once the centre of the powerful Bomai-Malu cult, and Eastern Islanders have retained a strong cultural awareness and pride. Meriam culture is more closely defined geographically, culturally and linguistically than the culture of the Central and Western Islands. Both

urmemeg and *wanwan* were remembered frequently and without hesitation.

The linguistic evidence collected would suggest that crown of thorns starfish have for a long time been a familiar sight in the Eastern Islands and were less well known in the reefs of other Torres Strait Islands. Aborigines who have traditionally exploited coastal resources but whose contact with reefal locations was infrequent, do not appear to have a specific term to refer to crown of thorns starfish, and the use of the term for "porcupine" to refer to the starfish would suggest that their familiarity with it is more recent, presumably from work on the luggers.

Table 6**Indigenous Terms for Crown of Thorns Starfish and other Marine Creatures**

Informant	Language	Term	Translation
Ted Bowen	Guugu Yimidhirr ^{a)} (Hopevale)	<i>balin'ga</i>	porcupine - for <u>A.planci</u>
Dicky Nandy	Kuku-Yalanji ^{b)} (Rossville)	<i>jalan</i>	for <u>A.planci</u>
Lorraine Baird	Kuku-Yalanji (Rossville)	<i>jalan</i>	"like porcupine" - for sea-urchin
Sandy Yielá	Kuuku Ya'u ^{c)} (Night Island)	<i>kaa'uma</i> <i>walang kay</i> <i>wuungku</i>	porcupine - for <u>A.pl.</u> starfish sea urchin
Jimmie Doctor	Kuuku Ya'u ^{d)} (Pascoe River)	<i>wuungku</i> <i>thiithi</i>	sea urchin "like a star" -for <u>A.pl.</u>
Mara Williams (Badu)	Kala Lagaw Ya ^{e)}	<i>dikeri</i>	for <u>A.planci</u>
Saulo Waia	Kala Lagaw Ya (Saibai)	<i>patalai</i> <i>patal, pat</i>	starfish - for <u>A.pl.</u> nail
Imasu Waigana	Kala Lagaw Ya (Saibai)	<i>upur</i> <i>inuk</i>	sea urchin - for <u>A.planci</u> ?
George Kaddy	Meriam	<i>urmemeg</i> <i>wanwan</i>	fire-place/ <u>A.planci</u> sea-urchin
Douglas Pitt	Meriam	<i>urmemeg</i>	<u>A.planci</u>
Jack Kennell	Meriam	<i>urmemeg</i> <i>wanwan</i> <i>burbur</i>	<u>A.planci</u> sea-urchin three-penny, six-penny shell razor sharp shell
Jardine Kiwat	Meriam	<i>pinpin</i> <i>urmemeg</i> <i>ur</i> <i>memeg</i> <i>wanwan</i>	<u>A.planci</u> fire closer sea urchin
Bill Hayes-Saylor	Meriam	<i>urmemeg</i>	<u>A.planci</u>
Jim Tapau	Meriam	<i>urmemeg</i> <i>wanwan</i>	<u>A.planci</u> sea-urchin
"Murray Island"	Meriam	<i>urmemeg</i> <i>pupwag</i> <i>mi</i> <i>aber</i> <i>wanwan</i>	<u>A.planci</u> jellyfish giant clam beche-de-mer sea-urchin

Notes:

a) Pronounced as *kuku imiji*. Spelling according to Haviland (1985).

b) Pronounced as *kuki yelengi*. Spelling according to Anderson (1984).

c) Language identified according to Thompson (1976, 1987). Night Island belongs to the Uutaalnganu language area, which is however closely related to Kuuku Ya'u.

d) Language identified according to Thompson (1976).

e) Shnukal (1985). According to Shnukal, Torres Strait Creole has displaced traditional languages everywhere in the Torres Strait.

2.3 Treatments for Injuries Inflicted by Crown of Thorns Starfish and Other Marine Creatures

In Samoa, Fiji, the Solomon Islands, New Britain, Manus, the Gambier Islands, Ponape, Palau and Tonga, the cure for crown of thorns starfish-inflicted injury has been reported to consist in placing the mouth of the same starfish which caused the injury on the wound. In Samoa, this cure is expressed in the proverb "the *alamea* is its own doctor" (Flanigan and Lamberts, 1981). This cure appears to be highly specific to the crown of thorns starfish. Only one respondent in this study knew this cure, which he had learned from his Fijian son-in-law.

The treatment usually suggested by indigenous informants was to apply heat from a fire "to draw the sting out", and some informants added other treatments. It was frequently stated that the spines of the starfish tend to break off and are difficult to extract from the wound (cf. also Burns, 1982:32). The cures reported do not appear to be specific to crown of thorns starfish injuries. Two types of treatments can be discerned, those which can be administered with the limited resources on board a lugger - and which may be experimental rather than traditional - and those which require the vicinity of certain plants.

Six respondents recommended only the application of heat or fire (Doctor, Sandy, Kaddy, Pitt, Sailer, Tapau), which is not always successful (Doctor, Pitt, Dan). Sailor suggested to also remove the spines with tweezers. Alternative treatments available on luggers were Condy crystals (Namok, Sailer), methylated spirits (Kepa, Williams), and squeezing the slime and blood out of the wound (Williams). On one occasion an *ad hoc* administering of Vicks Vapo Rub was found ineffective (Dan). "Land-based" treatments suggested were the milk from ti-tree leaves against swelling and infection (Sailor), or to nick the wound with a sharp implement and squeeze the chewed root of a certain tree into the wound, then wrapping it with calico and warming it over a fire (Sailer). Some cures were explicitly ascribed to the Japanese skippers, namely to blacken rice in a saucepan and infuse it with water to immerse the wound (Jacob, Doctor) which also helps for stonefish and stingray injuries; or to rub the wound with grease drippings and put it over fire (Akiba); or to immerse the wound in warm water with Bluo (Waia).

According to Sailer, Condy crystals (potassium manganate used as a disinfectant) are also good for stingray and stonefish injuries, or a chewed twist of tobacco can be applied to stonefish injuries, but he himself recommends hot water with eucalyptus oil. Baird said that box jellyfish injuries can be treated by rubbing with salt, and "Hopevale" knows how to apply the root bulb of a beach vine for snake-bites. The treatments reported by Burns (1982) are the milk of mangroves (ascribed to Malays), a vine which grows on the beach, milk of the frangipani, centipede oil, and baking powder. Some of these treatments would seem to be opportunistic rather than traditional, and none appears as specific to crown of thorns starfish-inflicted injuries.

2.4 Concluding Observations

The familiarity with crown of thorns starfish among indigenous informants appears to stem primarily from trochus diving, in which they participated for at least two generations.

For example, Pitt (ca. 50) from Darnley Island only realized what they were after some of his crew members were injured by crown of thorns starfish, and Dan (58) was on a trochus lugger with other Torres Strait Islanders when someone stepped on a crown of thorns starfish and they "didn't know how to treat it" because no-one knew the animal. Waia (69) from Saibai learned to look out for crown of thorns starfish after he stepped on one; and Jacob (69) from Saibai, learned about them, and other dangerous marine creatures, from his Japanese skippers. There were no crown of thorns starfish around Badu (Nona), Saibai (Jacob) and Moa (Namok). Doctor from Lockhart River also learned to treat crown of thorns starfish injuries on a trochus boat.

Even in the Eastern Islands, crown of thorns starfish sightings are correlated with trochus diving: Sailer stated that crown of thorns starfish were common in the Eastern Islands, because in the postwar era when shell was scarce, trochus swimmers had to break off coral and dispose of crown of thorns starfish in order to get to the shell. He said they were much more profuse now than formerly, they never used to occur in the Darnley village reef, only towards Yorke Island. (Trochus shell was abundant in the immediate postwar years. Sailer may be referring to wartime, when most luggers had been confiscated and trochus shelling became the prerogative of Torres Strait Islanders under the Papuan Industries scheme.) Similarly, an elderly woman from Murray Island (Tape 91) swam for trochus on the Murray Island reefs as a teenager and sometimes speared crown of thorns starfish and threw them out of the water. (Tapau refers to the same practice of reef husbandry on Murray Island.)

The high correlation between a familiarity with crown of thorns starfish and trochus diving allows two conclusions. Firstly, traditional activities may not have engendered contact with crown of thorns starfish if they were permanently present, so that an apparent lack of familiarity (no folklore, no cure, no specific term except in the Eastern Islands) does not rule out the possibility of a long-standing presence of crown of thorns starfish. Secondly, the implication that Eastern Islanders have always been familiar with crown of thorns starfish because they have given it a specific name, should be treated with caution because languages are living systems capable of innovation. Presumably though, the integration of "crown of thorns starfish" into the language took place before the 1950s, since which time Meriam was superseded by Torres Strait Creole and became a dying language (Shnukal, pers.comm.).

3. Oral History and "Outbreak Hypotheses"

The most contentious debate in the crown of thorns starfish issue has been whether aggregations are somehow man-induced, or are a natural, and perhaps cyclical, phenomenon. Suggestions that outbreaks are unnatural are normally based on the contention that they are a recent phenomenon, and vice versa, those who hold the phenomenon to be natural, base this view on evidence which points to previous outbreaks. In this debate the notions of "naturalness" and "European industrial society" form a binary opposition, so that pre-industrial, pre-European society and its effects are somehow relegated to the sphere of nature. Thus the 1985 Crown of Thorns Starfish Advisory Committee expected that

"Conclusive evidence of major populations prior to human impact or involvement with the Great Barrier Reef would alleviate concern that they represent a totally new, man-induced alteration to the ecological dynamics of the system"

and suggested to investigate "whether major populations occurred prior to European settlement." The implication that pre-European aggregations of crown of thorns starfish are *ipso facto* natural occurrences may be questioned (cf. Ch. 4-4 below).

An assessment of crown of thorns starfish presence prior to European or human involvement with the Great Barrier Reef is outside the time scale accessible to oral history, and is addressed through a separate study of skeletal elements in surface sediments and soft sediment cores.

The aim of this study was to provide evidence of crown of thorns starfish outbreaks in the Great Barrier Reef province prior to that at Green Island. Some of the sightings in Table 4 may be taken as a confirmation that there had been primary outbreaks north of Green Island in the mid 50s (Kennell, Ellis, Hobson), but the overall picture which emerges from the statements does not encourage the view of a southward movement.

The sample does not permit the detection of more differentiated patterns of crown of thorns starfish occurrence. For example, the higher frequency of sightings in the 1950s is not independent of the higher number of experiences referring to the 1950s.

The notion of a short-term cyclical occurrence of crown of thorns starfish was tested against statements made by Darnley Islanders, but no uniform picture emerges: Patrick Danaher interviewed Pastor Harry Kiwat (born 1909) who used to see plenty of crown of thorns starfish when spearfishing on the home reefs in his youth; and Ettikai Pau (born 1927) used to see crown of thorns starfish when spearfishing on the home reefs in his childhood. He added that crown of thorns starfish were very rare now. (GBRMPA, unpubl. data. Both Islanders have since died.) In this study, Sailer (born 1928) said that crown of thorns starfish never used to occur in the Darnley village, only towards Yorke Island, and that there are a lot more in the Eastern Torres Strait now; and Saylor (born 1927) also said they had increased in numbers. Etti Pau, interviewed by

Burns, stated that there were very few crown of thorns starfish in the late 1930s and that their numbers increased as the trochus industry declined, and that there were a lot more today (Burns, 1982).

It is extremely difficult to draw conclusive evidence from eyewitness accounts to support any of the outbreak hypotheses. The statements collected yield no indication of the incidence of crown of thorns starfish in deeper water (some trochus swimmers could dive to 9 meters, but mostly it was 'dry picking' at low tide and shallow diving), or of crown of thorns starfish migration, longevity or seasonality. Since this type of inquiry can expect no evidence concerning water salinity, temperature changes or larval predation and survival, the only hypotheses upon which it may have a bearing are those which comprise central notions of adult predation (e.g. "predator removal hypothesis" - Endean, 1969) and normal population sizes (e.g. "adult aggregation hypothesis" - Dana et al., 1972).

On the basis of the eyewitness accounts given, it is possible to support the assumption that crown of thorns starfish have been "more common on reefs than is generally believed" (Weber and Woodhead, 1970; Dana and Newman, 1972; Dana, Newman and Fager, 1972; in Moran, 1986:102), and to counter the opinion that crown of thorns starfish are a normally rare animal (Pearson, 1975b; Endean, 1977; Cameron 1977; Cameron and Endean, 1982; in Moran 1986). This observation lends support to the "adult aggregation hypothesis" which suggests that a normally high abundance of starfish (0.5 - 1 per 100m²) is sufficient to cause outbreaks when adults gather on healthy patches of coral after coral destruction from other causes such as cyclones.

The "predator removal hypothesis" based on the giant triton was the earliest explanation suggested to account for crown of thorns starfish outbreaks. The popular rejection of this hypothesis takes as given a large population of crown of thorns starfish (such as the outbreaks reported in the media) and a very small population of giant tritons, so that the number of predators is not seen to be comparable to the number of prey. However, if 0.5 starfish on 100 m² of reef is taken as a minimum abundance required as a basis for outbreaks, then a very minute predatory influence may inhibit outbreaks. The "predator removal hypothesis" postulates two processes, firstly an increase in number or extent of crown of thorns starfish aggregations in the 1960s, and secondly a decrease in triton populations prior to the 1960s.

The postwar proliferation of island tourism provided a ready market for reef souvenirs, and lugger crews took advantage of the extra source of cash income from the sale of pretty shells. The statements made by trochus divers indicate that they picked up triton shells whenever they found any. They attest not so much to an abundance of triton shells, as to their intensive collection:

- Playo said he saw lots of tritons, and made "a bit of pocketmoney" by selling them in Townsville for half a crown each. Helmet shells fetched 2/6 and cowries a shilling. He said lugger crews used to bring in a lot of shells, they had perhaps some 10 or 12 tritons when they came into port (A560)
- King/Bremmer said he used to collect triton shells and received up to \$10 for a big specimen

- Jacob said he used to collect pretty shells and sold them to tourists "down the coast" (Cairns, Cooktown?). He picked up bugle shells if he came across them while trochus diving, and sold 1 or 2 at a time (B364)
- Namok sold bugle, bailer, spider, helmet and cowrie shells to tourists at Hayman Island and Palm Island at 2 to 10 shillings a piece
- Akiba used to sell bu-shells at Hayman Island and Lindeman Island (A478)
- Kepa picked up tritons because they were used as trumpets (B61)
- Elu probably referred to tritons (he was shown a photo of a triton shell) when he said he used to find the trumpet shells "further south on the reef" (towards Cooktown?) (B632)
- Hobson said he found a lot of bugle shells for pocketmoney (B215)
- Waigana ate the meat from bu-shells and sold the shells for ca. \$5 or \$10 at Green Island. He did not find them plentiful, and said one only finds one at a time (B60)
- Flinders also found them scarce, he only picked up one or two

Waia also indicated that he saw plenty of bu-shells north of Cooktown, but never many off Townsville, and used to collect them to sell to tourists (Zann, pers.comm.) According to Singleton, 2 or 3 boats from Yarrabah collected coral, trochus and other shells for necklaces for Jack Hogestone (?Oakston?) in Cairns after WWII. They were paid £20 per bag of shells, and £10 per tea-case of coral. They filled 5 tea-cases on a weekend trip, mainly around Fitzroy Island, Green Island, Oyster Cay, and Cape Grafton, and Stanley said they collected coral on Fitzroy Island "until there were none left". A Mr. Cook brought tourists to Yarrabah on a regular basis. A similar system of weekly tourist visits was in operation at Palm Island, where residents sold souvenirs made of shells and other materials (Monty Prior, not taped). Mass, a former trochus boat operator (Tape 2-B315), said tritons are easy to find, they live on top of the reef, and were sold at Thursday Island and Cairns, sometimes as lamps. Hansen, a fisherman, only ever saw two tritons, which were too old to keep, but said that "the trochus boys were constantly on those reefs picking up shells". Bradford, a recent operator of trochus boats, finds perhaps one giant triton per reef and thinks them rare. Ellis, a former lighthousekeeper who nurtured an interest in the reef, spoke about an upsurge in shell-collecting after WWII, and saw bagfuls of tritons selling at 10s each or £15 per sack containing some 40 to 50 shells during his service at Low Isles (1946-52). He said he was not at all surprised to hear that trochus were now considered rare.

Two interviewees witnessed crown of thorns starfish predation by triton shells, and two interviewees suggested that tricky snapper may be a predator of crown of thorns starfish (cf. Ch. 1-4 - Predation). The complaint about dwindling fish populations is a recurrent feature in interviews with fishermen.

The most embattled hypothesis, that crown of thorns starfish outbreaks are a recent phenomenon, ought to be most easily dispelled by historical inquiry. However, according to Moran's list of distributions of crown of thorns starfish in the Indo-Pacific region, nowhere were crown of thorns starfish reported as "abundant or common" prior to 1957, and the only reported aggregation before 1960 was that of the Ryukyu Islands in 1957-58 (1986, Table IX). Nothing in the evidence presented here can reliably refute the contention that crown of thorns starfish outbreaks of the extent observed at Green Island, John Brewer Reef or Feather Reef, causing coral mortalities of around 80% and involving millions of starfish, are a recent phenomenon.

4. Proposals for Further Study

1. Number of Divers on the Great Barrier Reef

To answer the question whether the increased number of reports of crown of thorns starfish outbreaks since the 1960s merely reflects an increased number of divers on the reef, it is necessary to gain an informed estimate of the increase in number of SCUBA divers on the one hand, and of the decrease in number of trochus and beche-de-mer gatherers on the other hand. The Institute of Applied Environmental Research at Griffith University is currently examining the possibility of gaining data on the number of SCUBA divers. The number of trochus divers is difficult to establish, because the trochus, pearl-shell and beche-de-mer industries were administered under a single legislation and official reporting practices comprised only erratic reference to the trochus industry separately. A clearer indication of the decrease in the number of trochus divers should be gained through the careful evaluation of archival resources in the course of this researcher's doctoral dissertation.

2. Knowledges of the Great Barrier Reef Among Former Japanese Divers and Skippers

Until World War II the positions of authority and knowledge in the pearl-shell and trochus industry were dominated by Japanese. From 1925 to 1935 all divers licenced at Thursday Island were Japanese, and up to World War II Japanese made up some 90% of divers, and in the immediate pre-war years around half of all 'in-charge' (skippers) licences at Thursday Island were issued to Japanese. Some of these men have achieved almost legendary recognition among Australian reef-users for their intimate knowledge of the Great Barrier Reef, such as Captain Kono, who reportedly filled in blank spaces on the Admiralty Charts for Australian fishing pioneers. War veterans ruefully remark how, as a result, Japanese maps of the Barrier Reef were superior to those used by the Australian forces.

Trochus divers learned from their Japanese skippers where to look for shell, what dangers to avoid, and how to treat injuries. Some of the crew had long-standing relationships with particular skippers and addressed them as *nissan* (Japanese for "elder brother"), and acquired a small vocabulary of Japanese expressions.

Several Japanese words were obtained from Thomas Lowah and Jack Asai Warusam (not taped) which were confirmed by a native Japanese speaker. Chase (1981) made the same observation at Lockhart River, and Shnukal found half a dozen words in Torres Strait creole to be derived from Japanese, all in some way related to lugger work (pers.comm.). Kyozo, the only Japanese respondent in the present sample, said he knew crown of thorns starfish from Okinawa before he came to Australia in 1958. Unfortunately it was not possible to include a visit to Japan in the fieldwork for the present study.

This researcher proposes to visit Ehime and Wakayama, and possibly other centres in Japan, in late 1987 to speak to surviving divers and skippers who have responded to a request widely circulated in Japanese newspapers.

Professor Masashi Yamaguchi has already offered his generous assistance in this undertaking. Since interviews will very likely be mediated by interpreters, they will be less open than the Australian interviews and more akin to an administered questionnaire. Because of the multicultural nature of the shelling industries, this researcher finds it essential to contact Japanese participants, and will also seek to follow up incidents gathered from Australian respondents. It is proposed to investigate whether *dikeri* may be a term occurring in local Japanese dialects, and to obtain an indication of the collection and sale of giant tritons before World War II, if the GBRMPA sustains its interest in and support for this research. In that case, the GBRMPA may wish to formulate questions to contribute to a questionnaire.

3. Bicentennial Reef Note

This researcher is interested in the preparation of a script for an issue of Reef Notes (e.g. "Reef Use and Management in the Past - The Trochus and Pearl-Shell Industries") outlining the historical significance of the trochus and pearl-shell industries (early Queensland border issues, first protective legislation for Aborigines, multiculturalism), the recurring problems of resource depletion in the trochus industry and demands for government regulations, the familiarity of trochus divers with crown of thorns starfish, and perhaps ending with a call to volunteer information concerning crown of thorns starfish sightings.

4. Reef Uses In the Eastern Torres Strait - A Case Study In the Impact of Traditional Societies on their Environment

Among the Australian indigenous groups, Eastern Torres Strait Islanders are most familiar with crown of thorns starfish. A historical inquiry into pre-European abundances of crown of thorns starfish could fruitfully emanate from a case study of the reef uses of traditional societies, located in the Eastern Torres Strait Islands. Such a study could address the question of impact of pre-European societies on reef systems through resource extraction and reef husbandry, and would require a combination of anthropological sensitivity and environmental impact analysis. With a careful formulation of a set of relevant questions and close guiding supervision, this problem could be offered as an Honours topic in the School of Australian Environmental Studies at Griffith University.

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ORAL HISTORY OF
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