Survey of Marine Scientists and Other Experts for Anecdotal Observations of Crown of Thorns Predation

Great Barrier Reef Marine Park Authority

January 1991



COASTAL & MARINE ENVIRONMENTAL CONSULTANTS a division of SINCLAIR KNIGHT & PARTNERS PTY. LTD.

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316 Sturt Street, Townsville, QLD. P.O. Box 959, Townsville, QLD. 4810 Telephone : (077) 21 1676 Facsimile : (077) 21 1723

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1. Executive Summary

- 218 marine scientists and other reef experts were surveyed by questionnaire to determine what observations had been made of predation on crown of thorns starlish.
- 90 recipients (41%) responded.
- 13 respondents had not dived or snorkelled and were therefore excluded from further analysis.
- 9 divers were too engrossed in other activities to have noticed predation and were therefore excluded from further analysis.
- The 68 respondents that had dived and would have witnessed predation had an accumulated total of ~24 173 hours of diving on reefs with low density crown of thorns populations and a further 5 125 hours diving on reefs with high density populations.¹
- 26 of the 68 valid respondents who (38%) had witnessed predation upon crown of thorns starfish.
- A total of 69 unique predation events were observed first hand, and 1 respondent reported a further 31 predation events which were assumed from gut contents inspection.
- 8 of the predation events reported were under unnatural conditions and excluded from further analysis, leaving 92 valid predation events.
- The triton, *Charonia tritonis* was the most commonly observed predator, accounting for 39 predation events (42% of all cases). Maori wrasse were responsible for 17 events (18% of all cases) Lethrinids for 13 events (14% of all cases) and toadfish for 11 events (12% of all cases). Four other predators each accounted for 1 event and in 8 cases the predator was not identified.
- 74% of recorded predation events were from high density crown of thorns populations suggesting that a predation event is witnessed approximately every 75 hours of diving on an 'outbreak' reef, whilst approximately 1013 hours of diving is required to witness a predation event on a 'non-outbreak' reef.

Range midpoints were assumed for cases where respondents gave a range of hours. 150 hours was assumed for cases where respondents said ">100 hours".

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2. Introduction

Predation of crown of thoms starfish may or may not be a rare event, but is rarely observed on the reef. Very few reef users spend long hours underwater in a situation where they could witness predation if it took place. Preliminary discussions with several reef scientist known to the proponents of this work had indicated that several have personally witnessed as many as 7 instances of predation on *A. planci*. Given that there may be almost 100 scientists in Australia that have spent a substantial amount of time on the reef, there may be several hundred observations of predation that have, thus far, gone unreported.

Whilst anecdotal evidence is usually inadmissible in scientific works, the unpublished observations of experienced scientists represents an important intellectual resource. More importantly, it is also a volatile resource, and disappears both with ageing and as various workers disappear from the scene. Hence it is important to try to permanently record any anecdotal evidence in order to preserve this valuable resource.

One crown of thorns research area identified for further work is the field of predator pressure and its potential effects upon juvenile and adult crown of thorns population dynamics. A summary of anecdotal observations is also a useful point for further research that may be undertaken on crown of thorns predation, for it provides an indication of the known range of predators, a rank order of the likelihood of witnessing each type of predator in a predation event and an approximation of the effort (hours underwater) that may be required to witness further events.

A survey of marine scientists and other experts for anecdotal observations of crown of thoms (COT) predation was proposed, designed and implemented in the hope of establishing a permanent record of previously unrecorded observations, and of providing initial information to researchers wishing to undertake further research on predators of crown of thoms starfish.

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3. Methods

The survey involved questionnaires (a copy of which can be found in **Appendix A**), being sent out to 218 people (a list of which can be found in **Appendix B**). Respondents were encouraged to reply regardless of whether they had witnessed predation, and were asked to give a description of any predation events they had personally witnessed. In addition, they were asked to estimate the number of hours spent underwater on reefs where crown of thorns starfish were present (to enable an estimation of the frequency with which predation occurs). Results were collated by the Great Barrier Reef Marine Park Authority and Marine Bio Logic and responses up to 5pm on the 2 January 1990 were analysed by Marine Bio Logic.²

Replies in which the witnessed event appeared to have resulted as a consequence of someones actions, including specifically "setup" events, where marked as "artificial" and excluded from further analysis.

Multiple range tick-boxed were provided to encourage respondents to estimate the number of hours spent underwater. In cases where respondents used these boxes (rather than specifying more precisely), the range mid-point was used to estimate observation time (">100 hours" was assumed to be 150 hours).

FoxBase (dBase-compatible) data base files were used to store and manipulate respondent information. Appendix F describes the structure and contents of each database and the programs used to generate database output. Files have also been provided to GBRMPA on floppy disk. These should facilitate regular updating or extension of this project.

² In reviewing this report all responses up to January 1991 were included in the analysis

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4. Results

The response rate to this survey was disappointingly low, with only 90 people (41%) replying. Of the 90 respondents, 13 were not in fact divers and a further 9 claimed to be too engrossed in their activities to have noticed predation. The number of valid responses was therefore 68, 26 of whom had witnessed predation (38%). A total of 100 predation events were recorded. Eight of these events were under unnatural conditions ie. involving some form of human-intervention. These events are excluded from further analysis. Appendix C summarises the data for each respondent while Appendix D summarises data specific to each predation event.

The relative frequencies of predators witnessed is contained in **Table 1**. The most frequently witnessed predator of crown of thorns is the triton, *Charonia tritonis*, (42% of observed cases). Further to these incidents (but not included in this survey) both Dr L Zann and Mr B Kettle each report that they knew of a further 4 or 5 second hand observations involving tritons. In addition, Mr L Squires reported seeing tritons eating crown of thorns on 20-30 occasions while working at the Cairns Oceanarium however these were not included due to the artificial circumstances involved. It is interesting to note that Mr Squires also observed that crown of thorns were the least preferred starfish prey of the tritons, being eaten only when the tritons were starved (a copy of Mr Squires submission is included in **Appendix E**).

The maori wrasse was the second most frequent predator, accounting for 18% of the recorded predation events. This fish was determined to be a predator of crown of thorns through studies of the gut contents of speared and line-caught fish. The respondent (Mr L Squires) is confident of the accuracy of these observations, having had substantial experience in this field.

Lethrinids were responsible for 13 of the witnessed predation events (14% of all cases) while toadfish accounted for 11 events (12% of all cases). Four other predators each accounted for 1 event. Eight of the reported cases were under circumstances where the predator was unknown but evidence indicated that predation had recently occurred.

Starfish density was reported in only 54 of the 92 recorded predation events. The total number of hours spent underwater on reefs with low density crown of thorns populations was -24173 hours, while for high density populations it was -5125 hours. On this basis a predation event is witnessed approximately every 75 hours of diving on an "outbreak" reef, whilst approximately 1013 hours is required to witness a predation event on a "non-outbreak" reef.

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 TABLE 1
 LIST OF PREDATORS OBSERVED, NUMBER OF EVENTS WITNESSED

 AND RELATIVE FREQUENCY OF PREDATION BY EACH OF THESE.

Predator	# of Observations	Relative Frequency (%)
Charonia tritonis	39	42
Maori Wrasse	17	18
Lethrinids *	13	12
Toadfish **	11	14
Balistoides viridescens	1	1
Euxiphipops sextinatus	1	1
Pomacentrus sp.	1	1
Turbellaria	1	1
Unknown	8	9
Total	92	***

 Lethrinids (13 observations) includes 10 Lethinrinus chrysostomas and 3 Lethinrus nebulosus.

** Toadfish (11 observations) includes 5 specifically attributed to Arothron hispidus.

*** Subject to rounding error.



5. Discussion

This reports suggests that the triton *Charonia tritonis* is the most commonly witnessed predator of the crown of thorns starlish. Maori wrasse were the second most commonly reported predator of the starlish although they were never directly observed in the act of predation (reports based on gut contents only). Lethrinids (specifically *Lethrinus chrysostomas* and *L. nebulosus*) ranked third with toadfish (including *Arothron hispidus*) a near fourth.

Predation by Maori wrasse was not witnessed, but observations were reliably determined by Mr L Squires who was present when the freshly speared or caught fish were gutted, and who could positively identify *Acanthaster* remnants. It would be instructive to know whether there may be other predators of *Acanthaster* that were neither witnessed not identified from gut contents studies.

Since this report is based only on anecdotal observations, it may not be viewed as scientifically robust. However it does provide a starting point for further work on likely predators. The 8 predators and 92 predation events identified in this study represent a total of approximately 29 298 hours of underwater observation. Anyone wishing to extend the list of predators, or to study predators in detail, is obviously going to face significant problems with experimental logistics.

Appendices

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Appendix A

SURVEY QUESTIONNAIRES



& Merne Environmental Science, Engineering & Applied Research

LOGIC

ite 210.7TRUSTEE HOUSE, 440 FLINDERS ST., TOWNSVILLE QLD 4810 D. Box 709, TOWNSVILLE QLD 4810 ph. (077) 21 1676 fax (077) 21 1723

27th September, 1989.

Dear Reef User,

I am undertaking, as a consultant for the Great Barrier Reef Marine Park Authority, a review of the anecdotal observations of marine scientists and frequent reef users, on predation upon crown of thorns starfish, *A. planci*.

Preliminary discussions with a number of reef scientists revealed that some have personally witnessed as many as 7 instances of *A. planci* predation. Scientists and regular reef users in Australia have spent thousands of hours on the reef and there may be several hundred observations of predation that have, thus far, gone unreported.

Whilst anecdotal evidence is usually inadmissable in scientific works, the unpublished observations of experienced persons represents an important intellectual resource. Unless such observations are recorded it is feared they will be lost as people die or move on and memories fade.

I believe that most respondents could complete the following questionnaire within 20 minutes so please consider how valuable your contribution will be. We are particularly conscious of the importance of responses from those who have never witnessed a predation event as these will allow estimates of the frequency with which predation occurs.

Since we are concerned with not just the details of predation events but with the rate of occurrence of these events we have split our survey into 2 sections. The first seeks to establish the frequency of predation whilst the second is intended to examine the circumstances of each witnessed event. It should be stressed that this survey is interested in first hand observations only.

If you believe that you will require more space for describing predation events than that provided, then please photocopy the second form before you commence. If you have any further queries please don't hesitate to call. I shall be reporting the results of this survey to the Great Barrier Reef Marine Park Authority by November 15th, 1989 and would appreciate your response by October 20th, 1989. Please indicate whether you would like a copy of the report returned at the completion of this assessment.

Yours faithfully,

Brenda Kettle Marine Bio Logic

Anecdotal survey of *A. planci* predators Form 1: Frequency of predation.

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Name:			·······
Current address:			
Contact phone number	er:		
How many hours hav starfish, A. planci?	e you spent underwater (diving/ snorkelling etc.)	on reefs w	here you have seen crown of thorns
"normal (non-outb	preak)" reefs	rea "above no	efs with "outbreaks" or or mal" numbers of crown of thorns
1	-9 hours		1-9 hours
	0-50 hours		10-50 hours
5	1-100 hours		51-100 hours
□ >	100 hours		>100 hours
	please specify if you are able to estimate more precisely.	[please specify if you are able to estimate more precisely.
Are you able to validate	ate the above estimates with dive logs/ field note	books etc.?	,
	Yes		
	No		
During this time how	many predation events upon crown of thorns die	d you see?	
If zero do you feel yo	u would have noticed any predation events (or w	ere you too	engrossed in other activities)?
	Yes	,	
	No		9

Anecdotal survey of *A. planci* predators Form 2: Predation details

Complete one form for each predation event witnessed

Site On which reef did the event occur?	·-		Date:		T	ime:
Habitat description:						
Purpose of dive:						
In order to avoid unwittingly duplicating observations, was there any other person present who is likely to include this event in their own observations?		Yes No	- Name/s?			
Predator Identify predator as far as possible.				Siz	e of preda	tor?
Were there many of these predators in the area?		Yes				
Prey		No				
State of outbreak? I low crown of thoms no	umbers		Size distribu	tion of cr	rown of th	orns populati
high crown of thorns n	umbers		<15cm	none	some	many
Size of crown of thoms being attacked?			15-30cm			
15 cm			>30cm			
15-30cm						
>30cm						
How was the crown of thoms affected by the predation of	event?					
slightly damaged	Plea	se desc	ribe (eg no arms lo	ost; dama	ge to the a	central disc et
badly damaged						
Additional details						······································

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Appendix B

LIST OF QUESTIONNAIRE RECIPIENTS

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MARINE BIO LOGIC

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Dive Officer Pro Diving Services 79 Palmer St Sth Townsville

Dive Officer Magnetic Diving Shop 4 Arcadia Complex Magnetic Island 4819

Dive Officer The Dive Bell 141 Ingham Rd. West End 4810

Dive Officer Scuba Doo Dive 'N' Sports 22 Herbert St Bowen 4805

Dive Officer M.V. Quick Cat Cnr Pacific Pde & Seaview St Mission Beach 4854

Dive Officer Hayles Outer Reef Cruises Wharf St Cairns 4870

Dive Officer Sth Molle Is Resort P.O. Box 821 Shute Harbour 4802

Dive Officer Great Keppel Is P.O. Box 108 Rockhampton 4700

Dive Officer Hayman Island Resort Hayman Island via Airlie Beach QLD 4802

Dive Officer Hamilton Island Resort Private Mail Bag Mackay 4740

Dive Officer Herron Island Resort Gladstone 4680

Dive Officer Deep Sea Divers Den 319 Draper St Parramatta Pk 4870 Dive Officer Down Under Dive Travel Cnr Aplin & Esp Cairns 4870

Dive Officer G.B.R. Diving Centre Hilton International Wharf St Cairns 4870

Dive Officer F.N.Q. Reef Cruises P/L Wharf St Port Douglas 4871

Dive Officer Marlin Coast Divers Paradise Village Williams Esp Palm Cove 4879

Dive Officer Pacific Rim Divers Shute Harbour Rd Shute Harbour 4802

Dive Officer Port Douglas Dive Centre Wharf St Port Douglas 4871

Dive Officer Pro Dive Cairns Marlin Pde Cairns 4870

Dive Officer Airlie Beach Dive Centre, Shute Harbour Rd Airlie Beach 4802

Dive Officer Barnes Reefdiving Services 153 Victoria St Mackay 4740

Dive Officer Coral Coast Diving Academy 38 Saphire Crt Nth Mackay 4740

Dive Officer Down Under Dive The Esplanade Airlie Beach 4802

Dive Officer Mackay Diving 1 Mangrove Rd Mackay 4740 Dive Officer Rockhampton Diving 61 High St Nth Rockhampton 4701

Dive Officer Rockhampton Diving 61 High St Nth Rockhampton 4701

Dive Officer Sportsworld Rockhampton 29 Denham St Rockhampton 4700

Dive Officer Sportsworld Rockhampton 29 Denham St Rockhampton 4700

Dive Officer (Returned) Dugong Diving Academy 64 Spurwood Rd Cairns 4870

Dive Officer (Returned) Reef Explorer Cruises 105 Lake St Cairns 4870

Dive Officer (Returned) The Diving Academy 24 Goondoon St Gladstone 4680

Mr G. Andrews P.O. Box 30 Townsville QLD 4810

Dr P. Arnold North Queensland Museum Wonderland Complex Townsville QLD 4810

Dr A. Ayling Sea Research P.O. Box 5645 Townsville QLD 4810

Mrs A. Ayling Sea Research P.O. Box 5645 Townsville QLD 4810

Dr R. Babcock Marine Biology Department James Cook University Townsville QLD 4811 Dr R. Bailey Zoology Department James Cook UniversityTownsville 4811

Mr S. Bainbridge A.I.M.S.P.M.B. No. 3 Townsville, M.C. 4810

Mr M. Bail Mike Ball Water Sports 252 Walker St Townsville 4810

Mr S. Balson Diving Instructor 9 Ives St Kirwan 4817

Mr D. Barnes A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Mr J. Barnett 363 Stanley St Townsville 4810

Mr I. Baxter Great Barrier Reef Aquarium Wonderland Complex TOWNSVILLE QLD 4810

Mr R. Bell Marine Bio Logic P.O. Box 5426 Townsville 4810

Dr P. Benzie A.I.M.S. PMB No. 3 Townsville M.C. QLD 4810

Mr K. Bienssen P.O. Box 847 Portland Victoria 3305

Dr C. Birkeland Marine Laboratory, Univ Guam MANGILAO GUAM USA 96913

Mr A. Birtles Marine Biology Dept James Cook University Townsville OLD 4811 Ms C. Bone P.O. Box 1859 Tonwsville QLD 4810

Mr K. Boto A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Mr R. Boundy Fitzroy Island Resort Fitzroy Island Via Cairns QLD 4870

Mr C. Boyd 28 French St Pimlico Townsville 4812

Dr R. Bradbury A.I.M.S. PMB No. 3 TOWNSVILLE M.C. QLD 4810

Mr D. Briggs QNPWS C/- QNPWS Rockhampton QLD 4700

Dr A.M. Cameron Zoology Department University of Queensland ST LUCIA QLD 4067

Mr J. Carleton A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Mr B. Chalker A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Dr J. Chisolm A.I.M.S. (Returned) PMB No. 3 Tonwsville M.C. QLD 4810

Prof J.H. Choat Dept of Marine Biology James Cook University TOWNSVILLE QLD 4811

Mr P. Christoffensen A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810 Mr N. Coleman C/- The Australian Museum 6-8 College St Sydney N.S.W. 2000

Dr J. Coli Chemistry Department James Cook UniversityTownsville QLD 4811

Mr J. Collingwood A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Dr J. Collins Marine Biology Department James Cook University Townsville QLD 4811

Mr D. Cowie Ocean Spirit Diving Services 41 Shield St Cairns 4870

Dr W. Craik GBRMPA Wonderland Complex Townsville QLD 4810

Mr T. Craske Sun City Water Sports P/L Tobruk Pool, The Strand Townsville 4810

Mr P. Crokham Sun City Water-Sports P/L Tobruk Pool, The Strand Townsville 4810

Mr I. Croli 22 Clacherty St Cairns QLD 4870

Mr B. Cropp Port Douglas QLD 4871

Mr D. Crossman Dept of Env & Conserv Marine Park Sect Nth Reg Centre Pallarenda OLD 4810

Ms RL Cumming Marine Biology Department James Cook University Townsville QLD 4811 Mr P. Daniels A.I.M.S. PMB No. 3Townsville M.C. QLD 4810 -

Mr J. Davidson A.I.M.S. PMB No. 3TOWNSVILLE M.C. QLD 4810

Mr B. DawsonSun City Water Sports P/LTobruk Pool, The Strand Townsville 4810

Mr L. DeVantier A.I.M.S. PMB No. 3 Townsville 4810

Mr B. Dean Roylen Cruises Pty. Ltd. P.O. Box 169 Mackay 4740

Mr M. Devereux A.J.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Dr Z. Dinnison Dept of Env & Conserv Northern Regional Centre Pailarenda QLD 4810

Mr P. Dixon A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Mr M. Dodd Charter skipper Whitsundays

Dr P. Doherty A.I.M.S. PMB No. 3 TOWNSVILLE M.C. QLD 4810

Dr T. Done A.I.M.S. PMB No. 3 TOWNSVILLE M.C. QLD 4810

Mr E. Drew A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Mr Z. Drzymulzki Mike Ball Water Sports 252 Walker St Townsville 4810 Mr W. Dunlap A.1.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Ass Prof R, Endean Zoology Department University of Queensland ST LUCIA QLD 4067

Miss L. Evans P.O 429 Thursday Island 4875

Mr D. Fisk Reef Research & Information Services P.O. Box 5348 TOWNSVILLE M.C. QLD 4810

Dr P. Flood Dept of Geology and Geophysics The University of New England ARMIDALE NSW 2351

Mr M. Fox

Dr E. Frankel University of Technology, Sydney P.O. Box 123 SYDNEY NSW 2007

Mr J. French Lady Elliott Island Holidays Pty. Ltd. LMB 6 Bundaberg 4670

Ms J. Fromont Sir George Fisher Centre James Cook University Townsville QLD 4811

Mr S. Fujiwara Mar. Pks Cntr, Toranomon Denki Blog 2-8-1 Toranomon, Minato-ku Tokyo 105 JAPAN

Dr M. Furnas A.I.M.S. PMB No 3 MSO TOWNSVILLE QLD 4810

Mr R. Garrick Sir George Fisher Centre James Cook University Townsville QLD 4811 Dr J. GlazebrookGrad Sch of Trop Vet Sci James Cook University TOWNSVILLE QLD 4811

Mr B. Goldman Lizard Island Research Station PMB 37 Cairns QLD 4870

Mr J. Graham Mike Ball Water Sports 252 Walker St Townsville 4810

Dr L. Hammond Vict. Inst. Mar. Sci. 14 Parliament Place East Melbourne VICTORIA 3002

Mr D. Hannan Coral Sea Imagery Clayton St Townsville 4810

Mr J. Hardman A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Ms V. Harriott Great Barrier Reef Aquarium Wonderland Complex Townsville QLD 4810

Dr P. Harrison Marine Biology Department James Cook University Townsville 4810

Dr R. Hartwick Marine Biology Dept James Cook University Townsville QLD 4811

Mr P. Harvey Friendship Cruises Clump Pt Jetty Mission Beach 4854

Mr J. Hoey Great Barrier Reef Aquarium Wonderland Complex Townsville QLD 4810

Mr M. Holme

Ass Prof D. Hopley Sir George Fisher Centre James Cook UniversityTOWNSVILLE OLD 4811

Mr R. Hore Reef Biosearch Marina Mirage Port Douglas, 4871

Mr P. Isdaie A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Mr A. Jacobsen Dept of Env & Conserv Marine Park Sect Conway Office P.O.Box 332, AIRLIE BEACH QLD 43

Ms R. James Dept of Env & Conserv Marine Park Sect Nth Reg Centre Pallarenda QLD 4810

Dr C. Johnson A.1.M.S. PMB No. 3 TOWNSVILLE M.C. QLD 4810

Mr D. Johnson A.I.M.S. PMB No. 3 TOWNSVILLE M.C. QLD 4810

Mr J. Keesing A.I.M.S. PMB No. 3 TOWNSVILLE M.C. QLD 4810

Mr S. Keilbaska Mike Ball Water Sports 252 Walker St Townsville 4810

Mr R. Kelly Dept. of Env & Conserv (Returned) Northern Regional Centre Pallarenda 4810

Dr R. Kenchington GBRMPA Wonderland Complex Townsville QLD 4810

Mr M. Kenway A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810 Mr B. Kettle Marine Bio Logic Pty Ltd P.O. Box 959 TOWNSVILLE QLD 4810

Dr D. Kinsey GBRMPA Wonderland Complex Townsville QLD 4810

Mr R. Kitchen Mike Ball Water Sports 252 Walker St Townsville 4810

Mr D. Klumpp A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Ms B. Kojis Lizard Is. Res. Station PMB 37 Cairns QLD 4870

Mr N. Land Dept of Env & Conserv Marine Park Sect Nth Reg Centre Pallarenda QLD 4810

Dr B. Lassig GBRMPA Wonderland Complex Townsville QLD 4810

Mr M. Lennard C/- Allan Diamond Sir George Fisher Centre James Cook University QLD 4811

Mr E. Longmuir Mike Ball Water Sports 252 Walker St Townsville 4810

Ass Prof J. Lucas Department of Zoology James Cook University TOWNSVILLE QLD 4111

Mr W. Mahon

Dr B. Mapstone Marine Biology Department James Cook University Townsville QLD 4811

Mrs L. Marsh Western Australian Museum Francis StPerth WA 6001 Mr P. May Dive Master Quickcat Mission Beach

Dr H. McCallum Zoology Department University of Queensland ST LUCIA QLD 4067

Mr R. McCauley A.I.M.S. PMB No. 3 Townsville M.C. 4810

Mr K. McClymont Dept of Env and Conserv P.O. Box 332 AIRLIE BEACH QLD 4802

Mr P. McGinnity GBRMPA Wonderland Complex Townsville QLD 4810

Mr T. McKenna A.I.M.S. PMB No. 3 Townsville M.C. QLD 4810

Mr J. McPherson D.P.I. Fisheries Aumuller St Portsmith, Cairns 4870

Ms J. Mellors D.P.I. Fisheries Aumuller St Portsmith, Cairns 4870

Mr B. Miller-Smith A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Dr P. Moran A.J.M.S. PMB No 3 MSO TOWNSVILLE QLD 4810

Dr J. Morrissey Great Barrier Reef Aquarium Wonderland Complex Townsville QLD 4810

Mr C. Mundy A.I.M.S. PMB No. 3TOWNSVILLE M.C. QLD 4810 Mr P. Murphy A.I.M.S. P.M.B. No. 3Townsville, M.C. 4810 ~

Mr T. Murray Mike Ball Water Sports 252 Walker St Townsville 4810

Mr K. Navin A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Mr R. Oake Bluewater Coral Supplies Perkins St Cairns QLD 4870

Mr V. Oake Bluewater Coral Supplies Perkins St Caims QLD 4870

Mr G. Oke Bali Hai II P.O. Box 692 Cairns 4870

Dr J. Oliver A.J.M.S. PMB Na. 3 Townsville M.C. QLD 4810

Dr R. Olson Hbr Brch Inst. RRI Box 196A Fort Pierce FLA 33450 U.S.A.

Dr R. Ormond Tropical Mar Res Unit, Univ York YORK ENGLAND Y01 5DD

Dr L. Owens Grade Sch of Trop Vet Sci James Cook University Townsville QLD 4811

Mr W. Oxley Marine Biology Department James Cook University Townsville QLD 4811

Mr J.C. Paterson Charonia Research G.P.O. Box 2308 TOWNSVILLE QLD 4810 Mr R. Pearson Director, D.P.I. Fisheries GPO Box 46 BRISBANE QLD 4810

Mr K. Peckham C/- 8 Diekman Ave Felixstow S.A. 5070

Dr M. Pichon A.I.M.S. PMB No. 3 Townsville M.C. QLD 4810

Mr N. Patter

Dr I. Price Botany Department James Cook University Townsville 4811

Mr F. Quintemeyer 13 Bradford St Innes Est Townsville 4810

Mrs C. Rasmussen Sir George Fisher Centre James Cock University Townsville QLD 4811

Mr G, Redfern

Dr R. Reichelt Fisheries Br, B. Rur. Res. Box 858 G.P.O. Canberra A.C.T. 2601

Mr D. Reid Mike Ball Water Sports 252 Walker St Townsville 4810

Ms J. Reising School for Field Studies P.O. Yungaburra 4872

Mr D. Reitsma Woodland Crt Deeragun Bohle 4816

Ms W. Richards Wendy Richards & Assoc P.O. Box 217 Port Douglas QLD 4871

Mr M. Riddia A.I.M.S. (Returned) P.M.B. No. 3 Townsville, M.C. 4810 Mr J. Rudmall

Dr G. Russ Marine Biology Department James Cook University TOWNSVILLE QLD 4811

Dr K. Sainsbury CSIRO Dept of Fish Res GPO Box 1538 HOBART TASMANIA 7001

Prof P. F. Sale Dept Zool Univ New Hampshire, Durham NEW HAMPSHIRE U.S.A. 03824

Mr P. Sammarco A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Ms M. Samoilys D.P.I. Fisheries Aumuller St Portsmith, Cairns

Dr D. Savage Dept of Env and Conserv P.O. Box 332 AIRLIE BEACH QLD 4802

Mr C. Shelley Tropaqua Pty Ltd 29 Pugh St Aitkenvale 4814

Dr A. Smith Zoology Department James Cook University Townsville QLD 4811

Ms S. Sorokin A.I.M.S. PMB No. 3 Townsville M.C 4810

Mr P. Southgate Tropaqua Pty Ltd 29 Pugh StAitkenvale 4814

Mr P. Spear A.I.M.S. PMB No. 3 Townsville M.C. QLD 4810

Mr L. Squire D.P.I. Fisheries Aumuller St Portsmith, Cairns 4870 Ms M. Stafford-Smith A.I.M.S.P.M.B. No. 3Townsville, M.C. 4810 -Mr R. Steene 205 Martyn Mnda

Cairns QLD 4870

Mr A. Steven Sir George Fisher Centre James Cook University TOWNSVILLE QLD 4811

Dr J. Stoddart A.I.M.S. PMB No. 3 Townsville M.C. QLD 4810

Ms H. Streiner Sir George Fisher Centre James Cook University Townsville QLD 4811

Mr R. Stump Zoology Department James Cook University TOWNSVILLE QLD 4811

Dr D.C. Sutton Sir George Fisher Centre James Cook University TOWNSVILLE QLD 4811

Mr D. Tarca Reef Link P/L (Returned) 197 Flinders St Townsville 4810

R. & V. Taylor

Mr R. Teyndall Sun City Water Sports P/L Tobruk Pool, The Strand Townsville 4810

Mr J. Thoroughgood 185 Main Rd Wellington Pt QLD 4160

Mr P. Tibbs Peter Tibbs Scuba School 370 Sheridan St Cairns Nth 4870

Mr P. Todd 28 Clifton Rd Clifton Beach Caims QLD 4870 Mr L. Trott A.J.M.S. PMB No. 3 Townsville M.C. QLD 4810

Mr R. Van Woesik Sir George Fisher Centre James Cook University Townsville 4811

Dr J. Veron A.I.M.S. PMB No. 3 Townsville M.C. QLD 4810

Dr T. Walker Dept of Env & Conserv Northern Regional Centre Pallarenda QLD 4810

Dr C. Waliace North Queensland Museum Wonderland Complex Townsville QLD 4810

Ms A. Watts Zoology Department James Cook University Townsville 4811

Mr S. Westmore Tropaqua Pty Ltd 29 Pugh St Aitkenvale 4814

Mr C. Wilkinson A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Dr D. McB. Williams A.I.M.S. PMB No. 3 TOWNSVILLE M.C. QLD 4810

Mr D. Williams A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Mr W. Williams Mike Ball Water Sports 252 Walker St Townsville 4810

Dr B. Willis Marine Biology Department James Cook University Townsville QLD 4811 Dr R. Willis Biochemistry Department James Cook University Townsville QLD 4811

Dr B. Wilson W. A. Dept of Conservation 50 Hayman Rd Como W.A. 6152

Prof M. Yamaguchi Dept of Mar Sci, Univ Ryukyus Benbaru 1 Nishihara Okinawa, JAPAN

Dr D. Yellowlees Biochemistry Department James Cook University Townsville QLD 4811

Dr Hiroyuki Yokochi Tokai Uni, Iriomote Mar Res Stat Sakiyama, Taketomi-cho Okinawa 907-15, JAPAN

Ms M. Young A.I.M.S. PMB No. 3 Townsville M.C. QLD 4810

Ms I. Zagorskis A.I.M.S. P.M.B. No. 3 Townsville, M.C. 4810

Dr L. Zann GBRMPA Wonderland Complex Townsville QLD 4810

Appendix C

RESPONDENT SUMMARIES

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MARINE BIO LOGIC

PRINTED ON RECYCLED PAPER

name	hours o n Iow density reef	hours on high density reef	validate data possible?	events witnessed	would have seen predation?
Dr A. Ayling	>100	>100	yes	6	yes
Dr R. Babcock	>100	10-50	yes	2	yes
Mr I. Baxter	10-50	0	yes	0	yes
Mr R. Bell	>100	>100	no	1	yes
Dr P. Benzie	23	60	yes	0	yes
Dr C. Birkeland	-	90	yes	0	yes
Mr D. Briggs	0	0		0	yes
Prof J.H. Choat	>100	10-50	yes	0	no
Mr P. Christoffensen	0	0		0	
Dr J. Collins	>100	51-100	no	0	yes
Mr D. Cowie	0	0		0	
Dr W. Craik	51-100	1-9	yes	0	yes
Mr T. Craske	10-50	0	yes	0	yes
Mr B. Cropp		1-9		0	yes
Mr D. Crossman	0	0		0	
Ms R. Cumming	300	100	yes	2	yes
Mr P. Daniels	0	0	-	0	
Mr J. Davidson	>100	>100	yes	1	yes
Mr L. DeVantier	>100	>100	yes	3	yes
Mr M. Dodd	50-100	50-100	no	1	yes
Dr P. Doherty	>3000	200	no	0	yes
Dr T. Done	>100	10-50	yes	0	no
Miss L. Evans	>100		ves	Ø	yes
Dr P. Flood	51-100	1-9	ves	0	yes
Mr M. Fox	>100	>100	yes	0	yes
Ms J. Fromont	10-50		ves	0	yes
Dr M. Furnas	10-50	1-9	no	1	yes
Mr R. Garrick	10-50	1-9	ves	0	yes
Mr J. Graham	500-1000		ves	0	yes
Mr D. Hannan	1000	>100	no	2	ves
Ms V. Harrlott	500	51-100	no	1	ves
Dr B. Hartwick	-	1-9	no	0	ves
Mr.I. Hoev	0	0		Ó	по
Mr M Holme	>100	Ō	ves	õ	ves
Ass Prof D. Hopley	10-50	1-9	no	ō	ПО
Mr. B. Hore	>100	0	ves	õ	ves
Mr P. Isdale	>100	10-50	Ves	õ	no
Dr C. Johnson	10-50	300	ves	õ	no
Mr.D. Johnson	540	200	ves	ō	no
Mr. L. Keesing	51-100	51-100	ves	7	ves
Mr S. Keilhaska	51 100	51-100	Ves	0	Ves
Mr B Kettle	300	200	no	ğ	ves
Dr D. Kinsev	5000	200	00	ō	Ves
Me B. Koile	×100		no no	õ	Vec
na D. Roja Dr R. Laceia	>6000	1-9	no	õ	100 VAS
Ace Prof L Lucae	51-100	51-100	VAS	õ	<u> </u>
Mas FIULU, LUUds	51-100 ⊾100	300	Vee	ň	yee Vee
Dr B. Manatana	2000	1_0	903 DO	ň	903 103
Ur b. Mapsione	5000	1-3 51_100		0	
WITS L. Marsh	91-100	31-100	yes	U	yes

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name	hours on low density	hours on high density reef	validate data possible?	events witnessed	would have seen predation?
	1661		00001010		<u>يەنىڭ ئۆتە تەرىپى</u>
Mr P. May		10-50	yes	0	yes
Dr H. McCallum	0	10-50	yes	0	yes
Mr R. McCauley	400	10-50	yes	1	yes
Mr K. McClymont	10-50	10-50	по	0	yes
Mr T. McKenna	51-100	10-50	yes	0	yes
Mr J. McPherson	0	0		0	
Mr B. Miller-Smith	>100	>100	yes	1	yes
Dr P. Moran	51-100	>100	yes	6	yes
Dr J. Morrissey	51-100	10-50	по	0	yes
Mr R. Oake	>100	51-100	yes	1	yes
Dr R. Ormond	>1000	51-100	по	3	yes
Dr L. Owens	51-100	10-50	yes	0	yes
Mr W. Oxiey	10-50	1-9	no	1	yes
Mr N. Potter			yes	0	yes
Dr I. Price				0	no
Mr G. Redfem	>100	>100	no	0	yes
Dr R. Reichelt	>100	51-100	yes	3	yes
Mr D. Reitsma	>100	51-100	no	0	yes
Ms W. Richards	>100			0	yes
Mr J. Rudmall	10-50		yes	0	yes
Dr G. Russ	1500	>100	yes	0	yes
Dr K. Sainsbury	0	0		0	
Mr P. Sammarco	>100	>100	yes	0	yes
Ms M. Samoilys	550	30	yes	1	yes
Dr D. Savage	>100	15	no	0	yes
Ms S. Sorokin	51-100	10-50	yes	0	yes
Mr L. Squire	500	500		1	yes
Mr R. Steene	>100	>100	no	1	yes
Dr J. Stoddart	51-100	10-50	yes	0	no
Ms H. Streiner	10-50	1-9	yes	0	yes
Dr D.C. Sutton	51-100	10-50	no	0	yes
Mr L. Trott	250	10-50	yes	0	yes
Mr R. Van Woesik	10-50	51-100	no	0	NO
Dr T. Walker	>100	51-100	no	3	yes
Dr C. Wallace	>100	51-100	yes	0	yes
Dr D. McB. Williams	>3000	>100	yes	4	yes
Dr R. Willis	10-50	10-50	yes	0	yes
Dr D. Yellowiees	0	0		0	no
Dr Hiroyuki Yokochi	>100	>100	yes	2	yes
Ms I. Zagorskis	0	0		0	
Dr L. Zann	>100	>100	yes	6	yes

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Appendix D

PREDATION EVENT SUMMARIES

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MARINE BIO LOGIC

PRINTED ON RECYCLED PAPER

:Arothron hispidus Outcome :killed Predator Observed by :Mr B. Kettle :fencing exercise Dive purpose Time:1015 :09/22/86 :John Brewer Date Reef -:open sand Habitat Number of predators :1 :45cm Size of predator Number of COTs :high density Size of COT :15-30cm conly fragments remained after puffer had finished Details :Arothron hispidus Outcome :killed Predator Observed by :Mr 8. Kettle :fencing exercise Dive purpose Time:1000 :09/24/86 Date Reef :John Brewer :open sand Habitat :1 Number of predators Size of predator Number of COTs :high density Size of COT conly half starfish remained Details :Arothron hispidus Outcome :badly damaged Predator :Mr B. Kettle Observed by :PhD studies Dive purpose Time:pm :09/24/86 :Helix Reef Date Reef :reef false front Habitat Number of predators :few Size of predator . :high density Number of COTs Size of COT :>30cm :2 arms lost. Event not witnessed. Suspect engorged puffer Details :Arothron hispldus Outcome :badly damaged Predator :Dr P. Moran Observed by :research Dive purpose :12/19/87Time:1445 :Little Broadhurst Reef Date Reef :Reef flat north-east Habitat Size of predator :40-50cm Number of predators :many Number of COTs :high density :15-30cm Size of COT Details :Big hole in central disc :Arothron hispidus Outcome :killed Predator :Dr R. Ormond Observed by :Field experiment on cot Dive purpose :Towartit Reef :11 Time: Date Reef 1 Habitat :40cm Number of predators :some Size of predator Number of COTs :few Size of COT :15-30cm :Base of arms demolished in sequence - tips detached Details :Balistoides viridescens Outcome :killed Predator Observed by :Dr R. Ormond :Cot survey Dive purpose :Towartit Reef Date :11 Time: Reef Habitat :40cm Number of predators :many Size of predator Number of COTs :few :15-30cm Size of COT Details :Central disc demolished

Predator Observed by	:Charonia tritonis :Dr A. Ayling	Outcome	:	
Dive purpose Reef Habitat	:	Date	://	Time:
Size of predator Size of COT Details	: :	Number of Number of	f predators f COTs	: :high density
Predator Observed by Dive purpose	:Charonia tritonis :Dr A. Ayling	Outcome	:	
Reef Habitat	:	Date	://	Time:
Size of predator Size of COT Details		Number of Number of	f predators f COTs	: :high density
Predator Observed by Dive purpose	:Charonia tritonis :Dr A. Ayling	Outcome	:	
Reef Habitat		Date	://	Time:
Size of predator		Number of	f predators	: :high density
Details	:		0013	ingri denoity
Predator Observed by Dive purpose	:Charonia tritonis :Dr A. Ayling	Outcome	:	
Reef Habitat		Date	://	Time:
Size of predator Size of COT Details	:	Number of Number of	f predators f COTs	: :high density
Predator Observed by	:Charonia tritonis :Dr A. Ayling	Outcome	:	
Reef Habitat	:	Date	://	Time:
Size of predator		Number of	f predators	:
Details	:	NUMBER		Ingri density
Predator Observed by Dive purpose	:Charonia tritonis :Dr A. Ayling :urvey COT's	Outcome	badly damag:	led
Reef Habitat	:Bowden Reef :Front Reef Slope	Date	:09/28/89	Time:1100
Size of predator Size of COT	:300mm :>30cm	Number o Number of	f predators f COTs	:many :high density

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	Predator Observed by	:Charonia tritonis :Dr R. Babcock	Outcome	:killed	
	Reef Habitat	:John Brewer Reef :Back bommie	Date	:09/29/81	Time:1400
	Size of predator Size of COT Details	:30cm :15-30cm :The last arm was bei	Number of Number of ng injested	predators COTs	:1 :medium density
	Predator Observed by	:Charonia tritonis :Mr L. DeVantier	Outcome	:killeđ	· ·
	Reef Habitat	:Rib Reef :North reef crest	Date	://	Time:pm
	Size of predator Size of COT Details	:>40cm :15-30cm :	Number of Number of	predators COTs	:few :low density
	Predator Observed by Dive purpose	:CharonIa tritonis :Mr L. DeVantier :Coral Surveys	Outcome	:killed	
	Reef Habitat	:John Brewer Reef :Lagoon	Date	://	Time:am
	Size of predator	:>40cm	Number of	predators	:few
	Size of COT Details	:15-30cm :	Number of	COTs	:low density
	Predator	Charonia tritonis	Outcome	:killed	
	Observed by Dive purpose	:Corals Surveys			
	Observed by Dive purpose Reef Habitat	:Corais Surveys :Lizard Island :Back Reef Slope	Date	://	Time:pm
	Observed by Dive purpose Reef Habitat Size of predator	:Corals Surveys :Lizard Island :Back Reef Slope :>30cm	Date Number of	://	Time:pm :few
	Observed by Dive purpose Reef Habitat Size of predator Size of COT Details	:Mr L. Devantier :Corals Surveys :Lizard Island :Back Reef Slope :>30cm :15-30cm :Starfish was being co	Date Number of Number of onsumed b	: / / f predators f COTs y Triton	Time:pm :few :low density
	Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose	:Mr L. Devantier :Corals Surveys :Lizard Island :Back Reef Slope :>30cm :15-30cm :Starfish was being co :Charonia tritonis :Mr D. Hannan :Pleasure	Date Number of Number of onsumed b Outcome	: / / f predators f COTs y Triton :Badly damag	Time:pm :few :low density ed
	Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat	:Mr L. Devantier :Corals Surveys :Lizard Island :Back Reef Slope :>30cm :15-30cm :Starfish was being co :Charonia tritonis :Mr D. Hannan :Pleasure :Line Reef (Whitsunda :Hard Corals Leeward	Date Number of Number of onsumed b Outcome Ay) d Lagoo	: / / f predators f COTs y Triton :Badly damag Date	Time:pm :few :low density ed : / / Time:
	Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator	:Mr L. Devantier :Corals Surveys :Lizard Island :Back Reef Slope :>30cm :15-30cm :Starfish was being co :Charonia tritonis :Mr D. Hannan :Pleasure :Line Reef (Whitsunda :Hard Corals Leeward :35-40cm	Date Number of Number of onsumed b Outcome Outcome ay) d Lagoo Number of	: / / f predators f COTs y Triton :Badly damag Date f predators	Time:pm :few :low density ed : / / Time: :rare
·	Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details	:Mr L. Devantier :Corals Surveys :Lizard Island :Back Reef Slope :>30cm :15-30cm :Starfish was being co :Charonia tritonis :Mr D. Hannan :Pleasure :Line Reef (Whitsunds :Hard Corals Leeward :35-40cm :15-30cm :Badly damaged	Date Number of Number of onsumed b Outcome Outcome ay) d Lagoo Number of Number of	: / / predators COTs y Triton :Badly damag Date predators COTs	Time:pm :few :low density ed : / / Time: :rare :high density
·	Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose	:Mr L. Devantier :Corals Surveys :Lizard Island :Back Reef Slope :>30cm :15-30cm :Starfish was being co :Charonia tritonis :Mr D. Hannan :Pleasure :Line Reef (Whitsunda :Hard Corals Leewand :35-40cm :15-30cm :Badly damaged :Charonia tritonis :Mr D. Hannan :Pleasure	Date Number of Number of onsumed b Outcome ay) d Lagoo Number of Number of Outcome	: / / f predators COTs y Triton :Badly damag Date f predators COTs :Badly damag	Time:pm :few :low density ed : / / Time: :rare :high density ed
·	Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat	:Mr L. Devantier :Corals Surveys :Lizard Island :Back Reef Slope :>30cm :15-30cm :Starfish was being co :Charonia tritonis :Mr D. Hannan :Pleasure :Line Reef (Whitsunds :Hard Corals Leeward :35-40cm :15-30cm :Badly damaged :Charonia tritonis :Mr D. Hannan :Pleasure :New Caledonia Is of :Hard Corals Leeward	Date Number of Number of onsumed b Outcome ay) d Lagoo Number of Number of Outcome Pines d Lagoo	: / / f predators COTs y Triton :Badly damag Date f predators COTs :Badly damag Date	Time:pm :few :low density ed : / / Time: :rare :high density ed : / / Time:
·	Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator	:Mr L. Devantier :Corals Surveys :Lizard Island :Back Reef Slope :>30cm :15-30cm :Starfish was being co :Charonia tritonis :Mr D. Hannan :Pleasure :Line Reef (Whitsunda :Hard Corals Leeward :35-40cm :Badly damaged :Charonia tritonis :Mr D. Hannan :Pleasure :New Caledonia Is of :Hard Corals Leeward :35-40cm	Date Number of Number of Datamed b Outcome Ay) d Lagoo Number of Outcome Pines d Lagoo Number of	: / / f predators COTs y Triton :Badly damag Date f predators COTs :Badly damag Date Date	Time:pm :few :low density ed : / / Time: :rare :high density ed : / / Time: :rare

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:Charonia tritonis Outcome :badly damaged Predator Observed by :Ms V. Harriott :A planci juveníle surveys Dive purpose :11 Time: Date Reef :Green is Reef :Bommy field Habitat Number of predators :rare Size of predator :25cm Number of COTs :low density :<15cm Size of COT :Half eaten at time of observation Details :Charonia tritonis Outcome :killed Predator Observed by :Mr J. Keesing :Research Dive purpose Date :11 Time: Reef :Davies Reef :Back reef flat Habitat Number of predators :35cm :rare Size of predator :15-30cm Number of COTs :low density Size of COT :Collected with only a few arms emerging Details :Charonia tritonis Outcome :badly damaged Predator :Mr B. Kettle Observed by :PhD studies Dive purpose :John Brewer Date :09/24/86 Time:pm Reef :back reef Habitat Size of predator :30cm Number of predators rare Number of COTs :low density :15-30cm Size of COT :Central disc damaged. Obvious behavioural avoidance response Details :Charonia tritonis Outcome :killed Predator :Mr B. Kettle Observed by :PhD studies Dive purpose Reef :Helix Reef Date :09/24/86 Time: :back reef Habitat Number of predators Size of predator :40cm rare Number of COTs Size of COT :15-30cm high density Details :Central disc damaged. Caeca siphoned out. Predator :Charonia tritonis Outcome :killed :Mr R. McCauley Observed by :Juvenile clam survey Dive purpose :MichaelmasCay Date :11 Time: Reef :Coral reef reef flat Habitat Size of predator :>30cm Number of predators :few Size of COT :15-30cm Number of COTs :low density Details :Over period of 2 days totally devoured, other than spines :Charonia tritonis Outcome :slightly damaged Predator :Dr P. Moran Observed by Dive purpose :research Reef John Brewer Reef Date :01/28/84 Time:1000 :Reef slope north-east Habitat Number of predators Size of predator :35cm :manv Number of COTs Size of COT :15-30cm :high density Details :Attacking one arm

:Charonia tritonis Outcome :slightly damaged Predator Observed by :Dr P. Moran :research Dive purpose Time:1500 John Brewer Reef :01/28/84 Reef Date :Reef slope north-east Habitat :35cm Number of predators :many Size of predator Number of COTs :high density Size of COT :15-30cm :Damage to central disc Details. :Charonia tritonis Outcome :slightly damaged Predator :Dr P. Moran Observed by :research Dive purpose :01/27/84 Time:1400 Reef :John Brewer Reef Date :Reef slope north-east Habitat Number of predators Size of predator :35cm :талу Number of COTs :high density Size of COT :15-30cm Details :Injested whole :Charonia tritonis Outcome :slightly damaged Predator Observed by :Dr P. Moran :research Dive purpose Time:2240 :Wheeler Reef Date :01/07/87 Reef :Reef slope west Habitat Size of predator :45cm Number of predators :rare Number of COTs Size of COT :>30cm :fewhigh density Details :One arm damaged :Charonia tritonis Outcome :slightly damaged Predator :Dr P. Moran Observed by Dive purpose :research :03/27/83 Time:1500 :Feather Reef Date Reef Habitat :Southern reef slope Number of predators Size of predator :40cm :rare Number of COTs Size of COT :15-30cm :few Details :Attacked by one arm. :Charonia tritonis Outcome :killed Predator :Dr R. Ormond Observed by Dive purpose :Towartit Teef Date :11 Time: Reef Habitat Size of predator Number of predators :some :15cm Size of COT Number of COTs :15-30cm :few Details :Tissue sucked out through large wound in side :Charonia tritonis Outcome :killed Predator Observed by :Mr W. Oxley Dive purpose :Survey DPI QLD Reef :Michealimas Cay Reef Date : / / Time: Habitat :Acropord Thicket Size of predator Number of predators :few Size of COT :15->30cm Number of COTs :low density Details

Predator Observed by Dive <u>p</u> urpose Reef Habitat	:Charonia tritonis :Dr R. Reichelt : :	Outcome Date	:	Time:
Size of predator Size of COT Details	• • • •	Number o Number o	f predators f COTs	•
Predator Observed by Dive purpose	:Charonia tritonis :Dr R. Reichelt :	Outcome	:	
Reef Habitat	:	Date	://	Time:
Size of predator Size of COT Details	: : :	Number o Number o	f predators f COTs	:
Predator Observed by	:Charonia tritonis :Dr R. Reichelt	Outcome	:badly damag	ed
Dive purpose Reef Habitat	:Measure size of A pl :John Brewer Reef :Reef slope	anci Date	://	Time:
Size of predator Size of COT Details	:2-30cm :15-30cm :Damage to the centr	Number o Number o al disc etc	f predators f COTs	:few :high density
Predator Observed by	:Charonia tritonis :Ms M. Samoilys :AIMS Survey	Outcome	:killed?	
Reef Habitat	:Hyde Reef :North east side of ree	Date ef	:06/29/84	Time:
Size of predator Size of COT Details	: : :It was half eaten	Number o Number o	f predators f COTs	:
Predator Observed by	:Charonia tritonis :Mr L. Squires	Outcome	:killed	
Reef Habitat	:Upolo Rf	Date	://	Time:
Size of predator Size of COT Details	ijuvenile :	Number o Number o	f predators f COTs	:many :
Predator Observed by Dive purpose	:Charonia tritonis :Mr R. Steene :Recreation	Outcome	:badly damag	ed
Reef Habitat	:Oyster Reef Cairns :Staghorn Patch	Date	://	Time:1400
Size of predator Size of COT Details	:300mm :15-30cm :A planci in the proce	Number o Number o ss of being	f predators f COTs g devoured	:few :low density

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Predator Observed by	:Charonia tritonis :Dr T. Walker	Outcome	:	
Dive purpose Reef Habitat		Date	://	Time:
Size of predator Size of COT Details		Number o Number o	f predators f COTs	:
Predator Observed by	:Charonia tritonis :Dr T. Walker	Outcome	:	
Reef Habitat	•	Date	://	Time:
Size of predator Size of COT Details	:	Number of Number of	f predators f COTs	:
Predator Observed by	:Charonia tritonis :Dr D. McB. Williams	Outcome	:killed	
Reef Habitat	:? Central midshelf, 1: couter reef slope	983	Date	: / / Time:
Size of predator Size of COT Details	:40cm :>30cm :all in process of bein	Number of Number of g consume	f predators f COTs ed	: :many / large
Predator Observed by	:Charonia tritonis :Dr D. McB. Williams	Outcome	:killed	
Reef Habitat	:? Central midshelf, 1 :outer reef slope	983	Date	: / / Time:
Size of predator Size of COT Details	:40cm :>30cm :all in process of bein	Number of Number of g consume	f predators f COTs ed	: :many / large
Predator Observed by Dive purpose	:Charonia tritonis :Dr D. McB. Williams :Fish census	Outcome	:killed	
Reef				
Habitat	:? Central midshelf, 1 :outer reef slope	983	Date	: / / Time:
Habitat Size of predator Size of COT Details	:? Central midshelf, 1 :outer reef slope :40cm :>30cm :all in process of bein	983 Number o Number o g consume	Date f predators f COTs ed	: / / Time: : :many / large
Habitat Size of predator Size of COT Details Predator Observed by Dive purpose	:? Central midshelf, 1 :outer reef slope :40cm :>30cm :all in process of bein :Charonia tritonis :Dr D. McB. Williams :Fish census	983 Number of Number of g consume Outcome	Date f predators f COTs ed :killed	: / / Time: : :many / large
Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat	:? Central midshelf, 1 :outer reef slope :40cm :>30cm :all in process of bein : Charonia tritonis :Dr D. McB. Williams :Fish census :? Whitsunday region :outer reef slope	983 Number o Number o g consume Outcome , 1984	Date f predators f COTs ed :killed Date	: / / Time: :many / large : / / Time:

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:Charonia tritonis Outcome :killed Predator :Dr Hiroyuki Yokochi Observed by Dive purpose :Obser nocturnal animals :12/29/82Time:2100 :Amitori Bay Okinawa Date Reef. Habitat :Reef slope ca 5m deep :manv Number of predators :35cm Size of predator :high density Number of COTs Size of COT :15-30cm :Almost entirely eaten - a few arm tips left Details :Charonia tritonis Outcome :badly damaged Predator :Dr L. Zann Observed by :RAN Cots Eradication Dive purpose :07/10/86 Time:am :Grub Reef Date Reef :Coral Pinnacles sand/cora Habitat Number of predators :many Size of predator :30cm :high density Size of COT :>30cm Number of COTs :Arms lost, central disc perforated Details :Charonia tritonis Outcome :killed/badly damaged Predator Observed by :Dr L. Zann :Cots survey Dive purpose :Vanuatu Port Patrick Date :03/10/88 Time:pm Reef Habitat :Fringing reef Number of predators :>30cm :many Size of predator Size of COT :>30cm Number of COTs :high density :Seriously damaged, certainly fatal condition Details :Euxiphipops sextinatus Outcome :badly damaged Predator Observed by :Dr R. Babcock :COT manta tow experiement Dive purpose :06/17/88 Time:0900 Reef :Bowden Reef Date :S/W inner edge of lagoon Habitat Size of predator :>30cm Number of predators :manv Number of COTs Size of COT :high density Details :Eating starfish which was already dead Predator :L. chrysostomus Outcome :killed Observed by :Mr L. Squires :spearing and fishing Dive purpose :off Cairns Date :// Time: Reef Habitat Number of predators : Size of predator Number of COTs Size of COT : :1 of 10 such observations from gut contents Details :L. chrysostomus Outcome :killed Predator :Mr L. Squires Observed by Dive purpose :spearing and fishing :off Cairns Date :// Time: Reef Habitat Size of predator Number of predators 5 : Size of COT Number of COTs :1 of 10 such observations from gut contents Details

:L. chrysostomus Outcome :killed Predator :Mr L. Squires Observed by Dive purpose :spearing and fishing :// Time: :off Cairns Date Reef Habitat Number of predators : Size of predator Number of COTs Size of COT :1 of 10 such observations from gut contents Details :L. chrysostomus Outcome :killed Predator :Mr L. Sauires Observed by :spearing and fishing Dive purpose :// Time: :off Cairns Reef Date Habitat Number of predators : Size of predator : Number of COTs Size of COT : :1 of 10 such observations from gut contents Details :L. chrysostomus Outcome :killed Predator :Mr L. Squires Observed by :spearing and fishing Dive purpose :11 Time: :off Cairns Date Reef Habitat Number of predators 1 Size of predator Size of COT Number of COTs 1 :1 of 10 such observations from gut contents Details :L. chrysostomus Outcome :killed Predator :Mr L. Squires Observed by :spearing and fishing Dive purpose :11 Time: Reef :off Cairns Date Habitat Size of predator Number of predators 5 2 Number of COTs Size of COT : :1 of 10 such observations from gut contents Details :L. chrysostomus Outcome :killed Predator Observed by :Mr L. Squires :spearing and fishing Dive purpose :off Cairns Date :77 Time: Reef Habitat Number of predators : Size of predator : Size of COT Number of COTs 1 Details :1 of 10 such observations from gut contents :L. chrysostomus Outcome :killed Predator :Mr L. Squires Observed by Dive purpose :spearing and fishing Date. :off Cairns :77 Time: Reef Habitat Number of predators Size of predator : : Size of COT Number of COTs : :1 of 10 such observations from gut contents Details

:L. chrysostomus Outcome :killed Predator Observed by :Mr L. Souires :spearing and fishing Dive purpose :11 :off Cairns Date Time: Reef Habitat Number of predators Size of predator : Number of COTs Size of COT :1 of 10 such observations from gut contents Details :L. chrysostomus Outcome :killed Predator Observed by :Mr L. Squires spearing and fishing Dive purpose :17 Time: Reef :off Cairns Date Habitat Size of predator : Number of predators 1 Number of COTs Size of COT Details :1 of 10 such observations from gut contents :Lethrinus nebulosus Outcome :killed Predator Observed by :Mr B. Kettle :fencing exercise Dive purpose Reef :09/23/86 Time:0400 :John Brewer Date Habitat :open sand Size of predator Number of predators :few Number of COTs :high density Size of COT :<15cm Details :only fragments remained :Lethrinus nebulosus Outcome :killed Predator Observed by :Mr B. Kettle Dive purpose :fencing exercise Time:1400 Date :09/23/86 Reef :John Brewer Habitat :open sand Number of predators :few Size of predator Number of COTs :high density Size of COT :15-30cm Details Predator :Lethrinus nebulosus Outcome :killed Observed by :Mr B. Kettle :fencing exercise Dive purpose :09/24/86 Reef :John Brewer Date Time: :open sand Habitat Number of predators Size of predator 2 Size of COT Number of COTs :high density :Found only three arms. Suspect nearby L. nebulosus. Details Predator :Maori Wrasse Outcome :killed Observed by :Mr R. Oake :spearfishing Dive purpose Date Reef :Upolo Reef :11 Time: Habitat :15-30cm Number of predators :few Size of predator Size of COT :15-30cm Number of COTs :high density :large amount of animal found in stomach Details

Outcome :killed :Maorl wrasse Predator :Mr L. Sauires Observed by spearing and fishing Dive purpose Date :11 Time: :Bridge Reef Reef Habitat Number of predators ŝ Size of predator Number of COTs Size of COT 1 remains found in gut contents Details Outcome :killed Predator :Maori wrasse :Mr L. Squires Observed by Dive purpose :spearing and fishing :11/15/77 :13-119 or 13-116 Time: Date Reef Habitat : Number of predators 2 Size of predator ۰ Number of COTs 2 Size of COT :medium :1 of 5 such observations from gut contents Details :Maori wrasse Outcome :killed Predator :Mr L. Squires Observed by :spearing and fishing Dive purpose :13-119 or 13-116 Date :11/15/77 Time: Reef Habitat Number of predators ŝ Size of predator • Size of COT Number of COTs :medium 2 :1 of 5 such observations from gut contents Details Predator :Maori wrasse Outcome :killed Observed by :Mr L. Squires :spearing and fishing Dive purpose :13-119 or 13-116 Date :11/15/77 Time: Reef Habitat Number of predators Size of predator 1 Number of COTs 2 Size of COT :medium :1 of 5 such observations from gut contents Details :Maori wrasse Outcome :killed Predator Observed by :Mr L. Squires :spearing and fishing Dive purpose :13-119 or 13-116 Date :11/15/77 Time: Reef Habitat Size of predator Number of predators ÷ Size of COT Number of COTs :medium ŝ :1 of 5 such observations from gut contents Details :Maori wrasse Outcome :killed Predator Observed by :Mr L. Squires spearing and fishing Dive purpose :13-119 or 13-116 Date :11/15/77 Time: Reef Habitat Number of predators : Size of predator 1 Size of COT :medium Number of COTs : :1 of 5 such observations from gut contents Details

Outcome :killed :Maori wrasse Predator Observed by :Mr L. Squires Dive purpose :spearing and fishing :Lark Reef Date :06/15/77 Time: Reef -Habitat Number of predators 2 Size of predator :medium Number of COTs : Size of COT :1 of 10 such observations from gut contents Details :Maori wrasse Outcome :killed Predator :Mr L. Squires Observed by spearing and fishing Dive purpose Time: Date :06/15/77 Reef :Lark Reef Habitat Number of predators Size of predator • Number of COTs : Size of COT :medium :1 of 10 such observations from gut contents Details :Maori wrasse Outcome :killed Predator Observed by :Mr L. Squires spearing and fishing Dive purpose :Lark Reef Date :06/15/77 Time: Reef Habitat Number of predators ; Size of predator 5 Number of COTs Size of COT :medium : Details :1 of 10 such observations from gut contents Predator . :Maori wrasse Outcome :killed Observed by :Mr L. Squires spearing and fishing Dive purpose Time: :Lark Reef Date :06/15/77 Reef Habitat Number of predators Size of predator : Number of COTs Size of COT :medium 1 :1 of 10 such observations from gut contents Details :Maori wrasse Outcome :killed Predator :Mr L. Squires Observed by Dive purpose spearing and fishing Time: :Lark Reef Date :06/15/77 Reef Habitat Number of predators Size of predator : Size of COT Number of COTs : :medium Details :1 of 10 such observations from gut contents Predator :Maori wrasse Outcome :killed :Mr L. Squires Observed by spearing and fishing Dive purpose :Lark Reef Date :06/15/77 Time: Reef Habitat Number of predators : Size of predator ŝ Number of COTs Size of COT :medium :1 of 10 such observations from gut contents Details

Outcome :killed :Maori wrasse Predator :Mr L. Squires Observed by :spearing and fishing Dive purpose :06/15/77 Time: Date :Lark Reef Reef _ 1 Habitat Number of predators 1 Size of predator Number of COTs Size of COT :medium : :1 of 10 such observations from gut contents Details :Maori wrasse Outcome :killed Predator Observed by :Mr L. Sauires :spearing and fishing Dive purpose :Lark Reef Date :06/15/77 Time: Reef Habitat Number of predators 2 Size of predator Number of COTs Size of COT :medium :1 of 10 such observations from gut contents Details :Maori wrasse Outcome :killed Predator :Mr L. Squires Observed by :spearing and fishing Dive purpose :Lark Reef Date :06/15/77 Time: Reef Habitat Number of predators : Size of predator • Number of COTs Size of COT :medium : :1 of 10 such observations from gut contents Details :Maori wrasse Outcome :killed Predator Observed by :Mr L. Squires spearing and fishing Dive purpose Time: :Lark Reef Date :06/15/77 Reef Habitat : Number of predators 2 Size of predator : Number of COTs Size of COT :medium 1 :1 of 10 such observations from gut contents Details Outcome :not effected hardly at al Predator :Pomacentrus sp Observed by :Mr J. Keesing :Look for Acanthaster Dive purpose Time: Reef :Helix Reef Date :05/22/86 :North east side Habitat Number of predators Size of predator :75mm :manv :15-30cm Number of COTs :high density Size of COT Details :Toadfish Outcome :slight damage Predator :Mr M. Dodd Observed by Dive purpose Date :// Time: :Bait Reef Reef :Reef flat/sand rubble Habitat :40cm Number of predators Size of predator Size of COT :15-30cm Number of COTs :low density photographed. Data via Mr K. McClymont Details

Outcome :killed :Toadfish Predator Observed by :Mr L. Squires Dive purpose :spearing and fishing Date :11 Time: Reef _ ^ Habitat Number of predators :many Size of predator :18-36 in Number of COTs Size of COT t :1 of 5 such observations from gut contents Details Outcome :killed :Toadfish Predator :Mr L. Squires Observed by :spearing and fishing Dive purpose Time: :11 Date Reef Habitat Size of predator :18-36 in Number of predators :many Number of COTs Size of COT :1 of 5 such observations from gut contents Details :Toadfish Outcome :killed Predator :Mr L. Squires Observed by Dive purpose :spearing and fishing Date :11 Time: Reef Habitat Size of predator :18-36 in Number of predators :many Number of COTs Size of COT : Details :1 of 5 such observations from gut contents Outcome :killed Predator :Toadfish :Mr L. Squires Observed by :spearing and fishing Dive purpose Time: :11 Date Reef Habitat Number of predators :many :18-36 in Size of predator Number of COTs Size of COT : :1 of 5 such observations from gut contents Details Outcome :killed :Toadfish Predator :Mr L. Squires Observed by Dive purpose :spearing and fishing :11 Time: Date Reef Habitat Number of predators :18-36 in :many Size of predator Number of COTs : Size of COT :1 of 5 such observations from gut contents Details :Turbellaria Outcome :killed Predator :Dr Hiroyuki Yokochi Observed by :Sampling of A planci Dive purpose Time:1100 :Iriomote Is Okinawa Date :07/27/85 Reef :Reef Flat ca 2m deep Habitat Number of predators :many Size of predator :2-3m Number of COTs :high denisty :15-30cm Size of COT Details :Internal organs lost

Observed by	:Unknown :Mr J. Keesing	Outcome	;killed	
Dive purpose Reef Habitat	:Look for Acanthaster :Okinawa, Japan :Exposed reef slope &	Date flat	://	Time:1400
Size of predator	:	Number o	f predators	:many
Size of COT	:15-30cm	Number o	f COTs	high density:
Details	:Did not see starfish a	ttack but f	ound scattered	l arm tips.
Predator Observed by	:Unknown :Mr J. Keesing	Outcome	slightly dama:	aged
Dive purpose Reef Habitat	:Monitor feeding Acar :Holbourne Island :Back reef slope	nthant Date	:03/20/87	Time:1200
Size of predator	:	Number of	f predators	:many
Size of COT	:15-30cm	Number o	f COTs	high denisty:
Details	:Found two severed a	arms neart	by an injured si	tarfish.
Predator Observed by	: Unknown :Mr J. Keesing	Outcome	:killed	
Dive purpose Reef	:Research :Little Broadhurst	Date	://	Time:
Habitat Size of predator	-Back reer slope	Number o	of predators	rare
Size of COT	:15-30cm	Number of	of COTs	:high denisty
Details	:Arm tips (ca 30mm)	remaining	only	-
Predator	:Unknown	Outcome	:killed	
Observed by	:Mr B. Kettle			
Observed by Dive purpose Reef	:Mr B. Kettle :Control exercise :Grub Reef	Date	:09/24/86	Time:
Observed by Dive purpose Reef Habitat Size of predator	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie	Date Number (:09/24/86	Time:
Observed by Dive purpose Reef Habitat Size of predator Size of COT	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm	Date Number (Number o	:09/24/86 of predators of COTs	Time: : :high density
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through c	Date Number of Number of d	:09/24/86 of predators of COTs isc.	Time: : :high density
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through c :Unknown :Dr L. Zann	Date Number of Number of centre of d Outcome	:09/24/86 of predators of COTs isc. :killed	Time: : :high density
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through c :Unknown :Dr L. Zann :Cots survey	Date Number of Number of d Centre of d Outcome	:09/24/86 of predators of COTs isc. :killed	Time: : :high density
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through c :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef	Date Number of Number of Centre of d Outcome Date	:09/24/86 of predators of COTs isc. :killed : / /	Time: : :high density Time:
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef	Date Number of Number of Centre of d Outcome Date	:09/24/86 of predators of COTs isc. :killed : / /	Time: : :high density Time:
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef :	Date Number of Number of Centre of d Outcome Date Number of	:09/24/86 of predators of COTs isc. :killed : / / of predators	Time: : high density Time: :many : high density
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm	Date Number of centre of d Outcome Date Number of Number of	:09/24/86 of predators of COTs isc. :killed : / / of predators of COTs s and spines re	Time: :high density Time: :many :high density emain
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm :One of two cases -0	Date Number of Number of centre of d Outcome Date Number of Number of niy armtip	:09/24/86 of predators of COTs isc. :killed : / / of predators of COTs s and spines re	Time: : :high density Time: :many :high density emain
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm :One of two cases -0 :Unknown	Date Number of Number of Centre of d Outcome Date Number of Number of Number of Number of Number of Number of	:09/24/86 of predators of COTs isc. :killed : / / of predators of COTs s and spines re :killed	Time: :high density Time: :many :high density emain
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm :One of two cases -0 :Unknown :Dr L. Zann :Cots survey	Date Number of Number of Centre of d Outcome Date Number of Number of Number of Number of Number of Number of Number of Number of	:09/24/86 of predators of COTs isc. :killed : / / of predators of COTs s and spines re :killed	Time: :high density Time: :many :high density emain
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm :One of two cases -0 :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef	Date Number of Number of Centre of d Outcome Date Number of Number of Number of Number of Outcome	:09/24/86 of predators of COTs isc. :killed : / / of predators of COTs s and spines re :killed : / /	Time: :high density Time: :many :high density emain Time:
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm :One of two cases -0 :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef	Date Number of Number of Centre of d Outcome Date Number of Number of Number of Number of Date Date	:09/24/86 of predators of COTs isc. :killed : / / of predators of COTs s and spines re :killed : / /	Time: :high density Time: :many :high density emain Time:
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through of :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm :One of two cases -0 :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef :	Date Number of Number of Centre of d Outcome Date Number of Number of Number of Date Date Date Date	:09/24/86 of predators of COTs isc. :killed : / / of predators of COTs s and spines re :killed : / / of predators	Time: :high density Time: :many :high density emain Time: :many
Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of COT Details Predator Observed by Dive purpose Reef Habitat Size of predator Size of predator Size of COT	:Mr B. Kettle :Control exercise :Grub Reef :back reef bommie : :15-30cm :Hole eaten through o :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm :One of two cases -0 :Unknown :Dr L. Zann :Cots survey :Fiji Suva Reef :Oceanic barrier reef : :>30cm	Date Number of Number of Centre of d Outcome Date Number of Number of Date Date Date Date	:09/24/86 of predators of COTs isc. :killed : / / of predators of COTs s and spines re :killed : / / of predators of COTs	Time: :high density Time: :many :high density emain Time: :many :high density

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Predator Observed by Dive purpose	:Unknown/?Charo :Dr L. Zann :BAN Cots Eradicatio	nla n	Outcome	:killed
Reef ⁻ Habitat	:Grub Reef :Coral Pinnacles	Date	:07/15/86	Time:
Size of predator Size of COT Details	:	Number of Number of	f predators COTs	:many :
Predator Observed by Dive purpose	:Unknown/?Charo :Dr L. Zann :RAN Cots Eradicatio	nia n	Outcome	:killed
Reef Habitat	:Grub Reef :Coral Pinnacles	Date	:07/15/86	Time:
Size of predator Size of COT Details	: :>30cm :Internal organs diges	Number of Number of sted	predators COTs	:many :high density

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Appendix E

SUBMISSION BY MR L SQUIRES

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MARINE BIO LOGIC

PRINTED ON RECYCLED PAPER

Conversation with Mr Lyle Squires re Predators of Crown of Thorns Starfish

20 November 1989

Lyle had difficulty completing the questionnaire because of his varying experiences with cots and evidence of predation. He has observations from aquarium situations, in the field and from fish gut contents (through spearing and line fishing). Lyle calculated he has spent approx 3 years of "wet time" since 1968 while collecting specimens for the Cairns Oceanarium (1968-73) and spearing. He has also spent a number of years working the reef north of Cairns as a commercial line fisherman.

Oceanarium Experiences (1968-1973)

Tritons were kept in approx 1000 gallon aquaria with cots. Tritons ate cots on 20-30 occasions, with a preference for smaller individuals. Cots were the least preferred starfish prey, eaten only when the tritons were starved. *Culcita* were by far the most favoured, followed by *Linckia*. *Culcita* elicited a feeding response from tritons as soon as they were placed in the aquarium.

During transport of cots to the Oceanarium in "ice boxes", two cots were attacked by yellow-faced triggerfish (10-12lb). The triggerfish chewed off the cots arm tips but were removed before further damage could be inflicted. If left together Lyle was sure the starfish would have been totally destroyed. Lyle believed this was a case of aggression by the fish, rather than feeding behaviour.

In 1969 on Upolo Reef a)triton was observed feeding on a juvenile cots. This was at the time of peak cots outbreaks in the area. The starfish was killed.

Fishing and Spearing: Fish Gut Contents

Maori Wrasse

Lyle has found cots spines and arm pieces in 15-20 maori wrasse stomachs. He is sure of his ability to differentiate between cots and sea urchin spines. [Every second maori wrasse caught has urchin spines in its gut] He is also confident of his memory for reefs fished and dates. Most of the wrasse caught that had cots remains in their guts were on reefs without major cots outbreaks.

Of 30 maori wrasse caught on Lark Reef in 1977; (10 had cots remains in thier guts. There were sufficient remains to indicate whole starfish had been eaten and the prey were medium size adults. Between 1977-78 on Reef 13-119 or 13-116 (Far Northern Section), 5 maori wrasse were caught with cots remains in their guts. One large maori wrasse caught on Bridge Reef in 1975-76 had cots remains in its gu.

Tricky Snapper (L. chrysostomus)

Between 1975 and 1978 on reefs off Cairns (Beaver, Adelaide, Potter, Gibley and Hal-Thomson Reefs), around 10 tricky snapper of thousands caught had cots remains in their guts. Couldn't say if they were whole starfish eaten.

Porcupine Fish/ Toadfish

At most 5 of these fish (between 18 and 36 inches in length) of hundreds caught had cots remains in their guts.

Lyle cautioned against asking professional and recreational fishermen for incidence of cots remains in fish guts because of the possible confusion with sea surchin spines. Sea urchins are frequently found in maori wrasse and tricky snapper guts. Because of his experience with cots at the Oceanarium, Lyle is sure of his identifications.

Lyle is an experience spearo and is willing to work with the Authority in future fish gut content studies.

Contact: Mr Lyle Squires Phone (070) 51 5588 (Q.DPI) (070) 56 2310 (Home)

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Appendix F

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DATABASE DETAILS

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MARINE BIO LOGIC

PRINTED ON RECYCLED PAPER

*resp_summ.prg
* lists summary of all respondents to a printable file

set talk off set echo off

```
fname = putfile("Name of file to save?","AppC","txt")
set alte to &fname
set alte on
```

```
use people
do while .not. eof()
if replied="y' then
? trim(firstname)+" "+trim(lastname)+"*"+
trim(normreefhr)+"*"+trim(cotreefhrs)+"*"+trim(validate)+"*"+str(cots,1,0)+"*"+trim(observ
ant)
endif
skip 1
enddo
set alte off
close alte
```

*list_events.prg * lists all events in the events database to a printable file * sorted by predator set talk off set echo off fname = putfile("Name of file to save?","AppD","txt") set alte to &fname set alte on use events index predator reindex set filt to natural='yes' loca do while .not. eof() ? "Predator*:"+trim(predator)+"*Outcome*:"+trim(outcome) ? "Observed by":"+trim(firstname)+" "+trim(lastname) ? "Dive purpose*:"+trim(purpose) ? "Reef":"+trim(reef)+""Date":"+dtoc(ddate)+""Time":"+trim(dtime) ? "Habitat*:"+trim(habitat) ? "Size of predator":"+trim(pred_size)+""Number of predators":"+trim(pred_numb) ? "Size of COT*:"+trim(cot_size)+"*Number of COTs*:"+trim(cot_numb) ? "Details*:"+trim(notes) ? skip 1 enddo set alte off close alte

*listpeople.prg * lists all people on the people database to a printable file

set taik off set echo off

fname = putfile("Name of file to save?","textout","txt")
set alte to &fname
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use people
do while .not. eof()
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j.	Shelley	Tropaque Pty Ltd	29 Pugh St	Altrenvale 4814		•	•	
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Williams	A. J. M. S.	P.H.B. No. 3	Townswille, N.C. 4010		•	່ວ	•
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Structure for databases	RAIDOG PROJECTS CURRENT : M
Number of data records:	22
Date of last update;	Q1/23/91
Field	Field Name Type
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