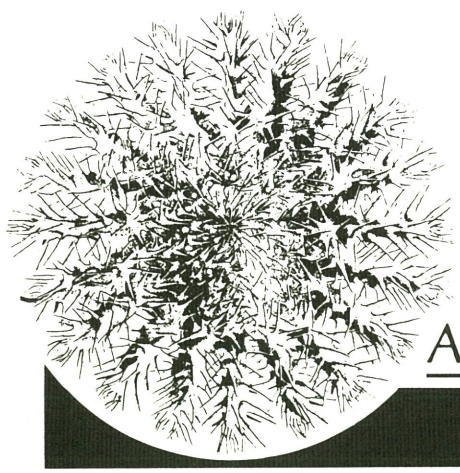
Proposed Allocation of COTSAC Funds to Ecological Projects in 1986/87: Recommendations to Assessment Panel

P. Moran, Study Leader & C. Ridgwell, Administrator



Australian Institute of Marine Science
The Crown-of-thorns Study

Crown-of-thorns Study Report 6

September 1986

Proposed Allocation of COTSAC Funds to Ecological Projects in 1986/87: Recommendations to Assessment Panel

P. Moran & C. Ridgwell

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Australian Institute of Marine Science
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RECOMMENDATIONS

As part of the COTSAC Program, funds totalling $505,000 are to be allocated by the Great Barrier Reef Marine Park Authority (GBRMPA) to the Australian Institute of Marine Science (AIMS) to support "mainly ecological projects" on the crown-of-thorns starfish, Acanthaster planci, during the 1986/87 fiscal year. The final amount given is approximately 23% less than that which was expected under the Record of Understanding established between the two institutions prior to the start of this Research Program ($658,000).

In terms of the overall Study (designated the Crown-of-thorns Study) which AIMS is coordinating these reductions in funding are substantial and are likely to affect the scientific objectives of certain projects. In order to minimise the extent to which this occurs careful consideration must be given to the way in which funds are distributed to projects over the ensuing year. In view of the reduction in funds for 1986/87 there would appear to be two possible options for allocating funds to projects. Firstly, to fully fund only those projects that are deemed to be of high calibre (i.e. those that address ecological questions of importance and are producing, or are capable of producing, exciting results) . Secondly, to implement cuts in funds to all projects after discussion with applicants. The second of the two options is most favoured and is the course of action recommended in this document. This is for the following reasons:

1. Many of the projects (particularly those being carried on outside the Institute) have been underway for only a relatively short period of time and it is very difficult to judge their scientific value (i.e. in terms of the results produced thus far) or potential value.

2. As the progress of most projects has gone according to plan it is difficult to prioritise projects on this factor alone. Progress reports for each of the 36 projects recommended for support by the Assessment Panel are given in the attached document (The Crown-of-thorns Study: Progress Report on Research. September 1, 1986).

3. Many of the projects recommended for support by the Assessment Panel in February 1986, were proposed as projects that

would proceed over 2-3 years. Given that many were supported, in principle, as long term studies originally by the Assessment Panel it would seem undesirable and indeed unfair to many researchers who have spent considerable efforts in formulating and committing themselves to such research to have their projects scrapped at this early stage.

On the basis of these arguments it is recommended that funding to all projects be cut, where possible, to a level approximating the overall cut applied to the Study. This would allow all projects to proceed (some perhaps with minor modifications to their original objectives) to a stage where their scientific merits can be judged more effectively and accurately. Obviously, it may not be possible to apply the same level of funding restrictions to all projects due to rises in costs (e.g. shiptime) or because such cuts could seriously jeopardise the original scientific objectives of certain projects. In order to overcome these potential problems the Study Leader has conferred with all Chief Investigators of projects to determine the minimum amount of funds required to enable these projects to continue, as planned, over the next 12 months.

As a result of these discussions a total allocation for each project has been formulated. These figures are given in Table 1 and it will be noted that the total amount allocated is in line with the amount of funds that are to be received from the Authority. It should also be noted that while funds to all projects have been reduced (with respect to that which was originally requested) these reductions have not been applied at the same level to all projects for the reasons given previously. A breakdown (into expenditure headings) of the funds recommended for each of the external projects and the AIMS program are given in Tables 2 and 3 respectively. A more detailed breakdown of the costs for each of the AIMS projects has been given in Table 4.

From the information given in Table 1 it will be noted that it is proposed that funds not be given to some projects in 1987. This is because:

1. The project proposed by Hartwick was to be conducted over only 1 year.

2. Considerable savings were made during the year by Parslow and Gabric to the extent that no funds are required for their project for the major part of 1987. This situation can be reviewed by the

Assessment Panel when it next meets.

3. The results achieved by Hopley whilst important suggest that the project is of more relevance to management than ecology. Therefore it will be considered for support within the group of projects currently funded by GBRMPA (this has been agreed to by Dr L. Zann).

4. Due to unavoidable delays in the production of larvae (by AIMS) the project of Hanna et al. has not commenced. A new allocation of funds is not required for this project for 1987 as that given in March this year will be used to continue the project through until the end of next year. Progress of this project also need to be reviewed by the Assessment Panel when it next meets.

In general, reductions in expenditure have been achieved for the remaining external projects (whose funding was on a calendar year basis: see COTSAC Integrated Scientific Research Allocations, 1986) as contracts were not exchanged until early March 1986 and there are sufficient funds available to allow them to continue until February, 1987. Consequently, the salary components of most projects could be reduced by generally 25% for the 1987 calendar year. This was not the case with the projects of Doherty (see Status Report: 4/6/86) and Lucas (part time salary only).

More specifically, savings have been made in some 1987 budgets since the scientific objectives of certain projects have changed. This has occurred in those being carried out by Doherty (who is to concentrate his surveys of juvenile starfish on reefs between Townsville and Mackay in the likely event that outbreaks continue in a southward direction over the next few years) and Harriott and Fisk (who have reduced the number of coral surveys to be undertaken on Upolo and Michaelmas reefs in order to concentrate on surveys of juvenile starfish on Green Island). The project being undertaken by Doherty was not cut as heavily as the others because it is very reliant on shiptime which has increased markedly in cost over the last year.

It will be noted from Table 1 that it is proposed that two new projects be funded in 1987, one being incorporated into an already existing project (i.e. the project being conducted by Lucas). As funds are in extremely short supply it is extremely difficult to fund these projects fully without affecting the viability of those already underway. To overcome this reduced funds have been allocated in

conjunction with the facilities available through AIMS (e.g. shiptime, equipment) which should enable them to proceed during 1987.

With the occurrence of relatively large numbers of juvenile starfish on reefs off Townsville it is proposed that funds be given to establish a Postgraduate Scholarship at James Cook University (tenable at the Department of Marine Biology) for a Ph.D student to investigate this most important aspect of the life cycle of A. planci. The amount of funds given for this project is in accord with the level of funding for AIMS Ph.D studentships, as discussed between the Director of AIMS and the Vice Chancellor of James Cook University. Whilst only a relatively small amount of funds has been given to support the project it is anticipated that the successful candidate will be able to obtain shiptime by "piggybacking" on research cruises at AIMS. Also, the student will be able to work with researchers at AIMS to culture large numbers of juvenile starfish (see Project 1(f)) for experimental studies in the field.

The new component of the research project being headed by Lucas involves determining whether it is possible to age starfish through a variety of methods. This research is particularly important as no satisfactory method of determining the age of starfish is available. Age determination is essential for the successful modelling of the population dynamics of A. planci. Since the objectives of the overall project have been extended a copy of the proposal submitted by Lucas for the 1987 period has been included in Appendix 1. In view of the funding restraints imposed for 1987 and the fact that this project is already being funded in part by other sources (MS&T), and also that the aging component of the project is a "high risk" venture it is proposed that funds be given to enable the project to proceed for at least 8 months (by which time it is anticipated that Lucas' student, Mr B. Kettle, will have completed the major part of his project). This can be reviewed by the Assessment Panel at a later date to determine whether additional funds (from those which may be given for the 1987/88 fiscal year) be allocated to continue the project until the end of next year. In order to decrease costs in this project it is proposed that funds for certain equipment (i.e. sonicator with microtip) not be given but that the project make use of that which is available both at James Cook University and AIMS (where this piece of equipment is available for use at regular periods of time).

Approximately 25% of the funds given to AIMS are designated for external projects in the 1987 calendar year. This level of external

support is similar to that which was given to external projects during 1986. The remaining amount of funds for the 1986/87 fiscal period are to be used to support the many projects being undertaken at AIMS. This amount is much less than that which had been originally budgeted for at the commencement of the Study (see AIMS Proposal: December, 1985). As a consequence, extensive reductions in expenditure have had to be made which approximate 40%. In order to achieve this level of reduction 2 projects (2(g) and 2(h))(see AIMS Proposal: December, 1985) have been dropped from the AIMS program which involved the employment of 2 Research Scientists. Further savings were made during the 1985/86 fiscal year, so much so, that by the end of this period approximately $134,000 were carried through to the new fiscal year. The amount of funds available at the end of June, 1986 is given in Table 5. The reasons for these savings in expenditure are as follows:

1. As funds for the 1986/87 fiscal year were unknown expenditure (particularly in such areas as stores and equipment) was kept to an minimum.
2. Extensions to the outdoor aquarium (where the culturing of larvae is being undertaken) were not undertaken.
3. Expenditure in Project 1(a) was reduced in areas such as; salaries, stores, vessel charter and equipment due to the late commencement of Dr J. Benzie (Research Fellow).
4. Expenditure concerned with establishment costs and relocation and medical expenses were minimal as fewer than expected staff appointments were made.
5. Chartering of vessels for completed field trips had not been paid for up to the end of the fiscal year.

Even with these savings in the 1985/86 period it has still been necessary to reduce expenditure in all projects by an average of 15% to meet the amount of funds available for the next fiscal year. This has been a difficult task given the number and variety of projects being undertaken. This would not be possible if it were not for the support of AIMS which notionally is providing a large amount of funds to the program (by providing shiptime and other facilities to staff members involved in the program). It should also be mentioned that AIMS is providing facilities and other support on a permanent basis to personnel from other external projects (e.g. Doherty and Endean).

Whilst 2 projects have been deleted from the AIMS program, one new project has been initiated in place of Project 1(d) (Fertilisation rates of Acanthaster planci in the field). This change in the objectives of the project has been made as a result of the findings of Project 1(c). A summary of the aims of this new project are given in Appendix 2. Apart from this all other projects are to continue into the next fiscal year and some are due to be completed by the middle of 1987 (e.g. Project 4(a)).

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TABLE 1

PROPOSED ALLOCATION OF COTSAC FUNDS TO ECOLOGICAL PROJECTS FOR 1987

	Project	Allocation ($) Given 1986	Requested 1987	Proposed 1987
	JAMES COOK UNIVERSITY			
1	James, Bode, Stark and Marsh	32,697	28,893	24,360 (15.6)
2	Lucas	19,352	25,990*	16,000 (38)
3	Hartwick	5,000	-	-
4	Hopley	2,000	10,104	GBRMPA study
5	Scholarship (new project)	-	-	10,000
	UNIVERSITY OF QUEENSLAND			
6	Endean and Cameron	22,000	20,500	15,500 (24)
	GRIFFITH UNIVERSITY			
7	Doherty	49,797	47,427	44,000 (7.2)
8	Parslow and Gabric	4,000	4,500	Continuing
	DEACON UNIVERSITY			
9	Hanna, Lee and Richardson	16,078	17,686	Continuing
	REEF RESEARCH AND INFORMATION SERVICES			
10	Harriott and Fisk	12,000	22,800	17,000 (25)
	TOTAL EXTERNAL PROJECTS			126,860**
	AUSTRALIAN INSTITUTE OF MARINE SCIENCE***			
11	Research program	395,076	630,331	378,140 (40)
	TOTAL	558,000	803,241	505,000

* Includes new project on aging starfish.
** Figure represents 25% of total funds.
*** Funds given for 1986/87 fiscal year.

NB Figures given in brackets indicate the percentage reduction in allocation.

TABLE 2

BREAKDOWN OF PROPOSED FUNDS TO EXTERNAL PROJECTS

	Project	Expenditure Heading	Amount $	Total $
1.	James et al.	Personnel	23,360	-
		Equipment	-	-
		Travel	-	-
		Vessel	-	-
		Maintenance	1,000	24,360
2.	Lucas	Personnel	10,200	-
		Equipment	2,400	-
		Travel	800	-
		Vessel	-	-
		Maintenance	2,600	16,000
3.	Hartwick	Not applicable		
4.	Hopley	Not applicable		
5.	Scholarship	Personnel	8,500	-
		Equipment	-	-
		Travel	-	-
		Vessel	-	-
		Maintenance	1,500	10,000
6.	Endean and Cameron	Personnel	10,500	-
		Equipment	500	-
		Travel	4,500	-
		Maintenance	-	15,500

TABLE 2 (cont'd)

Project	Expenditure Heading	Amount $	Total $
7. Doherty	Personnel	21,000	-
	Equipment	-	-
	Travel	1,000	-
	Vessel	21,500	-
	Maintenance	500	44,000
8. Parslow and Gabric	Not applicable		
9. Hanna et al.	Not applicable		
10. Harriott and Fisk	Personnel	14,000	-
	Equipment	1,000	-
	Travel	1,000	-
	Vessel	-	-
	Maintenance	1,000	17,000
	TOTAL	-	126,860

TABLE 3

BREAKDOWN OF PROPOSED FUNDS TO AIMS PROGRAM

	Acc. Code	Sum Allocated ($)
SALARIES & ALLOWANCES	1000	301,077.00
TRAVELLING & SUBSISTENCE		
Field Travel	1110	18,000.00
Domestic Travel	1120	15,060.00
Overseas Travel	1140	5,000.00
Interview & Appt - expenses	1150	2,000.00
STORES	1500	30,000.00
FREIGHT & CARTAGE	2000	1,700.00
COMPUTER SERVICES	2200	1,000.00
VEHICLE OPERATING COSTS	2400	16,200.00
CHARTER OF SHIPS	3000	50,750.00
INCIDENTALS		
Advertising	3510	500.00
Dive ops & medical	3550	1,500.00
Equip. Hire & Other	3610	1,000.00
Maps, Charts, etc	3656	200.00
COLLABORATIONS		
Fares & Travel Cost	3971	2,500.00
Accommodation	3972	1,500.00
Salaries & On-Costs		
- external	3973	20,500.00
- AIMS	3974	41,250.00
NON-CONSUMABLE EQUIPMENT		
Scientific	3978	5,000.00
OTHER COLLABORATION COSTS	3981	2,500.00
TOTAL		512,735.00
LESS CASH IN BANK 1-JUL-86		134.595.00
TOTAL ALLOCATION		378,140.00

TABLE 4

BREAKDOWN BY PROJECT OF PROPOSED FUNDS TO AIMS PROGRAM

		Sum Allocated	Sum Commit.	Balance
PROJECT 1A (221051)				
1000	Salaries & Allowances	27,626.00		27,626.00
1110	Travelling & Subsistence - Field Travel	220.00		220.00
1120	Travelling & Subsistence - Domestic Travel	2,053.40	1,053.40	1,000.00
1500	Stores (Chemicals)	6,011.90	11.90	6,000.00
3000	Hire of Aircraft & Ships - Vessel Charter	3,300.00		3,300.00
		39,211.30	1,065.30	38,146.00
PROJECT 1B (221052)				
1500	Stores	145.80	145.80	0.00
		145.80	145.80	0.00
PROJECT 1C (221053)				
1000	Salaries & Allowance	53,074.00		53,074.00
1110	Travelling & Subsistence - Field Travel	6,850.75	50.75	6,800.00
1120	Travelling & Subsistence - Domestic Travel	600.00		600.00
1550	Stores	1,542.20	42.20	1,500.00
2000	Freight & Cartage - Freight for field trips	1,000.00		1,000.00
3000	Hire of Aircraft & Ships - Vessel Charter	4,850.00		4,850.00
3610	Incidentals - Equipment Hire & Other	75.00	75.00	0.00
3978	Non-consumable Equipment -Scientific	353.00	353.00	0.00
		68,344.95	520.95	67,824.00

TABLE 4 cont'd

		Sum Allocated	Sum Commit.	Balance
PROJECT 1D (221054)				
1500	Stores	500.00		500.00
3978	Non-Consumable Equipment - Scientific	900.00		900.00
		1,400.00		1,400.00
PROJECT 1E (221055)				
1500	Stores	500.00		500.00
		500.00		500.00
PROJECT 1F (221056)				
1000	Salaries & Allowances	19,940.00		19,940.00
1500	Stores	1,150.00		1,150.00
3978	Non-consuamble Equipment - Scientific	1,175.00	1,175.00	0.00
		22,265.00	1,175.00	21,090.00
PROJECT 1G (221057)				
1110	Travelling & Subsistence - Field Travel	823.00		823.00
1500	Stores	1,788.47	888.47	900.00
3000	Hire of Aircraft & Ships - Vessel Charter	10,000.00		10,000.00
3973	Collaborations - Salaries & On-costs	10,000.00		10,000.00
		22,611.47	888.47	21,723.00
PROJECT 1H (221058)				
1110	Travelling & Subsistence - Field Travel	580.00		580.00
1500	Stores	531.60	31.60	500.00
3979	Non-consumable Equipment - Computer	130.00	130.00	0.00
		1,241,60	161.60	1,080.00

TABLE 4 cont'd

	Sum Allocated	Sum Commit.	Balance
PROJECT 1I (221059)			
1110 Travelling & Subsistence - Field Travel	100.00		100.00
	100.00		100.00
PROJECT 1J (221060)			
1120 Travelling & Subsistence - Domestic Travel	780.00		780.00
1500 Stores	878.54	78.54	800.00
3973 Collaborations - Salaries & On-costs	10,000.00		10,000.00
	11,658.54	78.54	11,580.00
PROJECT 2A (221061)			
1000 Salaries & Allowances	13,000.00		13,000.00
1110 Travelling & Subsistence - Field Travel	650.00		650.00
1500 Stores	800.00		800.00
	14,450.00		14,450.00
PROJECT 2B (221062)			
1110 Travelling & Subsistence - Field Travel	500.00		500.00
1120 Travelling & Subsistence - Domestic Travel	500.00		500.00
	1,000.00		1,000.00

TABLE 4 cont'd

		Sum Allocated	Sum Commit.	Balance
PROJECT 2C (221063)				
1110	Travelling & Subsistence - Field Travel	490.92	90.92	400.00
1120	Travelling & Subsistence - Domestic Travel	600.00		600.00
1500	Stores	850.00		850.00
		1,940.92	90.92	1,850.00
PROJECT 2D (221064)				
		-		-
PROJECT 2E (221065)				
1110	Travelling & Subsistence - Field Travel	650.00		650.00
1120	Travelling & Subsistence - Domestic Travel	780.00		780.00
1500	Stores	575.00		575.00
		2,005.00		2,005.00
PROJECT 3A (221068)				
1000	Salaries & Allowances	72,511.00		72,511.00
1110	Travelling & Subsistence - Field Travel	1,100.00		1,100.00
1120	Travelling & Subsistence - Domestic Travel	1,800.00		1,800.00
1500	Stores	2,359.20	359.20	2,000.00
3000	Hire of Aircraft & Ships - Vessel Charter	20,000.00		20,000.00
		97,770.20	359.20	97,411.00
PROJECT 3B (221069)				
1110	Travelling & Subsistence - Field Travel	660.00		660.00
1500	Stores	700.00		700.00
		1,360.00		1,360.00

TABLE 4 cont'd

		Sum Allocated	Sum Commit.	Balance
PROJECT 4A (221070)				
		-		-
PROJECT 4B (221071)				
1110	Travelling & Subsistence - Field Travel	110.00		110.00
1500	Stores	300.00		300.00
3000	Hire of Aircraft & Ships - Vessel Charter	3,300.00		3,300.00
3656	Incidentals - Maps, Charts, etc	200.00		200.00
		3,910.00		3,910.00
PROJECT 4C (221076)				
3971	Collaborations - Fares & Travel Costs	1,000.00		1,000.00
3973	Collaborations - Salaries & on-costs	500.00		500.00
3981	Non-Consumable Equipment - Other Collaboration Costs	2,500.00		2,500.00
		4,000.00		4,000.00
PROJECT 4D (221072)				
1000	Salaries & Allowances	23,381.00		23,381.00
1500	Stores	5,000.00		5,000.00
3979	Non-consumable equipment - Computer	1,500.00		1,500.00
		29,881.00		29,881.00
PROJECT 4E (221073)				
3971	Collaborations - Fares & Travel Costs	1,500.00		1,500.00
		1,500.00		1,500.00

TABLE 4 cont'd

		Sum Allocated	Sum Commit.	Balance
PROJECT 4F (221074)				
1000	Salaries & Allowances	46,994.00		46,994.00
1120	Travelling & Subsistence - Domestic Travel	1,000.00		1,000.00
2200	Computer Services - Consumables	500.00		500.00
3979	Non-consumable equipment - Computer	4,000.00		4,000.00
		52,494.00		52,494.00
PROJECT 4G (221075)				
1500	Stores	3,600.00	2,100.00	1,500.00
		3,600.00	2,100.00	1,500.00
PROJECT 5A (221080)				
1000	Salaries & Allowances	44,551.00		44,551.00
1110	Travelling & Subsistence - Field Travel	5,000.00		5,000.00
1120	Travelling & Subsistence - Domestic Travel	5,000.00		5,000.00
1140	Travelling & Subsistence - Overseas Travel	3,000.00		3,000.00
1150	Travelling & Subsistence - Interview & Appointment expenses	2,122.00	122.00	2,000.00
1500	Stores	4,004.40	4.40	4,000.00
2000	Freight & Cartage - Field Trips	700.00		700.00
2200	Computer Services - Consumables	500.00		500.00
2400	Operational Costs Vehicles	5,000.00		5,000.00
3510	Incidentals - Advertising	500.00		500.00
3550	Incidentals - Diving Ops & Medicals	1,500.00		1,500.00

TABLE 4 cont'd

	Sum Allocated	Sum Commit.	Balance
PROJECT 5A (221080)			
3610 Incidentals - Equipment Hire	1,000.00		1,000.00
3972 Collaborations - Accommodation	2,288.40	788.40	1,500.00
3974 On-Costs (AIMS)	44,920.00		44,920.00
3979 Non-consumable Equipment Computer	960.00	960.00	0.00
	121,045.80	1,874.80	119,171.00
PROJECT 7A (221078)			
1110 Travelling & Subsistence - Field Travel	800.00		800.00
1500 Stores	200.00		200.00
3000 Hire of Aircraft & Ships - Vessel Charter	9,300.00		9,300.00
	10,300.00		10,300.00

TABLE 5

FINANCIAL STATEMENT AIMS PROGRAM: 30 JUNE 1986

Heading	Cost Code	Allocat 1985/86	Expenditure ($) Actual	Outstand. Commit.	Total	Funds Avail. ($)
SALARIES & ALLOWANCES:	1100	118000.00	96679.42	9814.36	106493.78	11506.22
TRAVELLING:						
Field	1110	1000.00	7250.28	119.92	7370.20	-6370.20
Domestic	1120	8000.00	3350.20	1075.15	4425.35	3574.65
Overseas	1140	3000.00	8243.07		8234.07	-5234.07
INTERVIEW & APPT EXP:	1150	10000.00	1073.25	910.40	1983.65	8016.35
STORES:	1500	24509.00	11290.03	1562.11	12852.14	11656.86
FREIGHT & CARTAGE:	2000	5000.00	448.00		448.00	4552.00
COMPUTER SERVICES:	2200	4000.00				4000.00
VEHICLE OPERATIONS:	2400	17000.00	16395.80		16395.80	604.20
VESSEL HIRE:	3000	26000.00				26000.00
INCIDENTALS:						
Advert.	3510	3000.00	1336.15		1336.15	1663.85
Diving	3550	1000.00	117.00		117.00	883.00
Equip.	3610	8000.00	357.08	75.00	432.08	7567.92
COLLABORATIONS:						
Travel	3971	9000.00	4918.95		4918.95	4081.05
Accom.	3972	1000.00				1000.00
On-costs	3973	28500.00	18894.20		18894.20	9605.80
- AIMS	3974	16000.00	16107.42		16107.42	-107.42

TABLE 5 cont'd

Heading	Cost Code	Allocat 1985/86	Expenditure ($) Actual	Outstand. Commit.	Total	Funds Avail. ($)
NON-CONSUMABLE EQUIPMENT:						
Buildings	3976	20000.00				20000.00
Vessels	3977	4500.00	4062.00		4062.00	438.00
Scient.	3978	9400.00	8205.60	3628.00	11833.60	-2433.60
Computer	3979	56000.00	54181.00	1090.00	55271.00	729.00
Field	3980	5246.00	6080.20		6080.20	-834.20
OTHER COSTS:	3981	16921.00	1500.00		1500.00	15421.00
EXTERNAL GRANTS:	3990	162924.00	162924.00		162924.00	
TOTAL		558000.00	423404.65	18274.94	441679.59	116320.41
FUNDS AVAILABLE: 1 JULY 1986						134595.35

PROPOSAL FOR COTSAC FUNDING OF CONTINUING RESEARCH PROJECT IN 1987

TO: AUSTRALIAN INSTITUTE OF MARINE SCIENCES

PROJECT TITLE: THE DYNAMICS OF PHYSIOLOGICAL PARAMETERS OF HIGH DENSITY CROWN-OF-THORNS POPULATIONS

INSTITUTION AND PRINCIPAL INVESTIGATOR: A/Prof. J.S. Lucas, Zoology Department, James Cook University.

OTHER PARTICIPANTS:

Mr. B. Kettle, Graduate Student.
Mr. R. Stump, Research Assistant.

OBJECTIVES:

To determine:

1. whether there are detectable physiological symptoms of ageing, nutritional status and unfavourable environmental conditions in high density Crown-of-Thorns populations and how these change during the course of population outbreaks;

2. whether growth is indeterminate or determinate;

3. an energy budget for Crown-of-Thorns starfish;

4. whether it is possible to age Crown-of-Thorns starfishes through: (a) cellular age pigments; (b) growth rings and layering in skeletal components; or (c) analyses of spine length/body diameter ratios.

Note that objective 4. is a new objective added for 1987. It has been included because, to date, no satisfactory method of determining the age of Crown-of-Thorns starfish is available. This has been a disadvantage for this study and for many other population studies of this starfish. It will continue to be a problem for successful modelling of Crown-of-Thorns' population dynamics, especially for reefs receiving repeated infestations. All present attempts to age Acanthaster have been based on size-frequency analyses, but age is only loosely related to size in asteroids (Crump and Emson, 1978). Several authors have noted that other factors significantly influence the size/age relationship. Chesher (1969) noted up to 10% shrinkage in Acanthaster planci starved for three months; Lucas (1984) observed 'senile' starfish shrinking to 69% of their original size; Yamaguchi (1974) found that handling specimens may cause them to reduce their diameter by up to 20%.

There are several possible methods of ageing these starfish that warrant further investigation and these are outlined in the proposed research for 1987.

Amended to $16,000
20/10/86

BUDGET FOR 1987:

1. **SALARIES**

Research Assistant (Grade 1.6 - Mr. R. Stump) basic salary	=	$14,429
Payroll tax, workers compensation, leave loading	=	866
CPI wage increases	=	918
		$16,213

Total Salaries = $16,213

2. **MAINTENANCE**

Chemicals	=	$1,500
Glassware and other materials	=	800
SEM and TEM user time	=	1,100
		$3,400

Total maintenance = $3,400

3. **TRAVEL**

Vehicle usage	$1,250

Total travel = $1,250

4. **EQUIPMENT**

Sonicator with microtip	$2,700
Corex centrifuge tubes	2,400
	$5,100

Total equipment = $5,100

Total budget = $25,963

JUSTIFICATION OF 1987 BUDGET ITEMS:

SALARIES

Research Assistant: The help of a Research Assistant will be required to work up the 200+ samples to be collected from Helix Reef next year, along with a carry-over of 100 samples from this year's sampling program (the December 1986 trip will not be analysed before the end of this year). Assistance will be required for large blocks of time in the field at Orpheus Island for the running of consumption and excretion experiments. The Research Assistant will also continue work on the three ageing aspects when not engaged in the above programs.

MAINTENANCE

Chemicals: Chloroform and methanol (spectroscopic grade) are required for the cell pigments extraction process; liquid nitrogen, Sephadex chromatography gel and other solvents (spectroscopic grade) for separations; nitric acid for cleaning glassware; quinine sulphate standards for calibration of the spectrofluorometer; stains for microscopy.

Glassware and other materials and EM user time: The cell pigments analysis involves round bottom flasks for the Roto-Evaporator, glass columns for chromatography gel, vacuum flasks for the separation procedure, conical flasks, disposable sealed tubes for extract transportation, disposable pipettes, quartz cuvettes for the spectrofluorometer, sealable tubes to prevent contamination. The skeletal analyses requires materials to prepare specimens for SEM and TEM studies and funding for SEM and TEM user time. Some floppy disks will be required for data storage.

TRAVEL

Vehicle usage: Travel to AIMS for quantitive analysis of starfish cell extracts using the AIMS' Spectrophotofluorometer on average one day per week.

EQUIPMENT

Sonicator with microtip: This apparatus will be used to disrupt the starfish cells so that all pigment can be extracted by the elution procedure. The sonicator in the JCU Botany Department, used in the preliminary studies this year, will not be available for the level of usage anticipated in 1987.

Corex centrifuge tubes: Special glass tubes are required for refrigerated centrifuging of the cell extracts. These tubes resist high speed centrifuging and do not interfere with the fluorescing compounds or eluents.

REPORT ON 1986 RESEARCH

Progress during this year has followed the original schedule with field trips to Keeper Reef and Helix Reef from February 28th to March 2nd, May 20th to 24th and August 12th to 15th. The fourth trip for the year is scheduled to take place from November 29th to December 6th.

During the February trip, insufficient starfish were found on Keeper Reef to achieve a sample size of 50. As a result, sampling of Keeper Reef for physiological studies was suspended for the May and August trips and will be undertaken at the end of 1986. This allowed extra time to be devoted to the Helix Reef collections, with the windfall of two days ship time which have been added to the November/December trip for a comprehensive assessment of the reproductive physiology of mature starfish on Helix Reef immediately prior to spawning.

Laboratory analysis of the samples is proceeding on schedule with the recently acquired electronic balance facilitating faster sample processing. Unaviodable delays in obtaining the semi-micro bomb calorimeter has caused inconvenience in the calorific analysis of winter reproductive material.

A field trip to the Capricornia Section was undertaken in March to measure the metabolic rates of the extraordinarily large starfish that had been reported at Lady Musgrove Island. These were smaller than the previous reports, but still yielded valuable information in the size range 50cm to 78cm diameter.

Analysis of the data from the Capricornia trip and the regular Helix Reef/Keeper Reef trips has shown interesting trends in the relationship between size versus specific metabolic rate and organ indices. A subset of these data, dealing with size dependent variables during the October 1985 sample period, was prepared for publication and presented at the session "RECENT FINDINGS IN ACANTHASTER BIOLOGY AND IMPLICATIONS FOR REEF MANAGEMENT" at the SECOND INTERNATIONAL SYMPOSIUM ON INDO-PACIFIC MARINE BIOLOGY at the University of Guam in July (Kettle and Lucas, MS). This paper is currently under review and is expected to be published in Bulletin of Marine Science with a number of other papers from the session.

Valuable data on metabolic patterns in Acanthaster have been gleaned from monitoring of juvenile and adult activity patterns, including preliminary work on estimating the relationship between distance covered and metabolic oxygen consumption.

Between now (beginning of October) and the end of the year the major impetus will be towards working up the now huge database of physiological and morphological parameters, with a view to establishing guidelines for the final year's research.

Helix Reef is still proving to be an ideal site for this study of the dynamics of an outbreak population of Acanthaster. Starfish numbers peaked in the summer of 1985, at which time the coral cover was declining rapidly. Starfish health, as measured by a suite of parameters, has declined noticeably since then, and it appears that starfish numbers are also beginning to wane. There is every reason to expect that these numbers will continue their decline so that by this time next year very few starfish will remain on Helix Reef. The population outbreak should have run its course within the 3 year time allocation of this project.

RESEARCH PROGRAM FOR 1987

It is anticipated that 1987 will be the final year of this study. Three aspects will be pursued and completed, if possible, during the year.

1. As the Helix Reef starfish population enters the final stages of the outbreak cycle, it is anticipated that starfish will be very stressed after their summer spawning effort, given that the coral cover on Helix Reef is very low. This should result in further symptoms of physiological stress and will provide data on the final fate of an aggregated population. Two or more samplings of the population will be made during the year. The

latter part of 1987 will be used to complete the laboratory and statistical analyses of the Helix Reef data.

2. A major part of the 1987 research will be to develop an energy budget of A. planci. This will be undertaken at Orpheus Island Research Station. Analyses will be made of coral consumption (calorific intake), particulate and dissolved feeding losses and excretion. When combined with the present data on energetic requirements of respiration, movement and reproduction, the calculation of a complete energy budget should be feasible. The research project of Mr John Keesing (Ph.D. student at AIMS) on the feeding ecology of these starfish meshes well with this study. Mr Keesing will consider the comparative nutritional values of a variety of corals while this study will concentrate on producing a comprehensive energy budget for feeding on one representative coral species.

3. Ageing methods. Three methods will be investigated:

a. Cellular age pigments. Biochemical ageing techniques have been used to demonstrate predictable relationships between the cellular age pigment (lipofuscin) density and physiological age for several invertebrate taxa. Klauss (1977) found that these fluorescing pigments increased with age on a weight and volumetric basis in the nematode Caenorhabditis elegans; Ettershank, MacDonnell and Croft (1983) demonstrated that the absolute measurement of lipofuscin offers a very convenient technique for estimating age of the fleshflies Sarcophaga bullata and Lucilia cuprina (Diptera : Calliphoridae); and Ettershank (1985) used this technique to determine year classes for Antarctic krill which revert to juvenile morphology as an overwintering strategy.

Preliminary results have shown that a fluorescing pigment like lipofuscin does occur in various tissues of A. planci. Quantitative comparison of this pigment from biopsies of similar tissues reveal that very large starfish possess significantly greater amounts of this pigment than juvenile starfish.

The approximate ages of adult starfish in populations on some reefs of Townsville are known from the times of the population outbreaks. There are also, currently, second year recruits on some reefs and these are readily distinguished by their small size. These different population modes provide an opportunity to test the lipofuscin aspect further. If the trend shown by the preliminary results holds, then some exceptionally large individuals will be tested as soon as one or more of these is located. This could solve the debate over whether these occasional "giants" are very old or very fast growers and thus whether a determinate or an indeterminate model of growth is applicable (Lucas, 1984)(see item 2 of the Objectives).

b. Growth rings or layering in skeletal components. Growth rings have been found in a North Sea echinoid Echinus esculentus. These growth rings are formed by the incorporation of spinochromes in the calcite of the

trabeculae of the echinoid test plates. Growth data from annual ring analysis enabled age to be measured in years and months (Sime and Cranmer, 1985).

Light microscopy and scanning electron microscopy will be used to examine the various skeletal components, oral ossicles, ambulacral groove ossicles, spines, etc., of Acanthaster planci to detect any periodic growth artefacts. There is expertise in the JCU School of Biological Sciences in the analysis of otoliths and statocysts which may be helpful here.

c. Spine length versus body diameter. Nash (1983) postulated that spine growth is less affected by environmental factors than body growth. Thus, the ratio of spine length verus body diameter may be a method of ageing Crown-of-Thorns starfish. Aboral arm spines increase in length with age and an estimated spine length to body diameter ratio of 1:10 has been observed for Crown-of-Thorns in their growth phase. This ratio changes as the growth phase diminishes and the animal matures. Subsequent ageing leads to an observed 'senile' phase where the ratio can increase to 1:5. Statistical analyses of the data may lead to a field technique for estimating age in these starfish.

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Signed:

10.10.88

A/Professor J.S. Lucas

APPENDIX 2

Replacement Project 1(d):

Tactile stimulation as a primary settlement cue for larvae of *Acanthaster planci*. (Chief Investigator: Dr R. Olson).

Introduction

A distinction can be made between primary and secondary settlement cues. A primary cue is one which induces a taxis in a larva, directing it towards its settlement substratum. An example of this is phototaxis. Some larvae descend in the water column when they detect an area of lower light intensity.

A secondary settlement cue is one that prompts a larva to select a specific surface. This cue is quite often chemical. For example, coralline algae have been shown to release chemicals which are very similar to neurotransmitters, and induce some mollusc larvae to settle on them.

The results of experiments conducted recently in Japan (see Progress of Projects: September, 1986 - Project 1(c)) lead to the hypothesis that tactile stimulation might be the primary settlement cue for *Acanthaster* larvae, inducing them to descend to the benthos. Brachiolaria larvae of *Acanthaster planci* are extremely sensitive to touch. When disturbed in this way they respond by contracting themselves, and stop swimming for a few seconds. Observations of brachiolaria larvae in 3 litre *in situ* culture chambers revealed that they spent all their time at the very top of the chambers. When the chambers were flushed, about 25% of the larvae ended up in contact with the mesh at the end of the chamber. These larvae invariably descended straight to the bottom of the chamber once the flushing had been completed. This brought many of them in contact with coralline algae placed at the bottom of the chamber; possibly much earlier than they would have contacted it in the field.

What if wave motion causes the same sort of tactile stimulation? This would mean that larvae drifting into the surf zone on a coral reef would be induced to drift down to the benthos. Certainly the largest populations of juveniles discovered to date have been on shallow reef flats (although it could be argued that most research has focused in these areas).

This hypothesis, that wave motion might induce larval descent, provides a possible yet interesting answer to the question of how larvae descend at the proper location on reefs and not into the deep water between reefs.

Research plan

To test the idea that increased water agitation might induce larval descent, the larvae of A. planci will be cultured in the laboratory under different levels of water motion. Larvae will be reared in 3 litre conical flasks, with a volume of 1.5 litres of seawater. At the late brachiolaria stage, the flasks will be placed on shaker tables at 3 different speeds. A fourth treatment of larvae in unshaken flasks will be maintained. After 48 hours of shaking, each culture will be poured into a 1.5 m tall, 10 cm diameter, clear perspex cylinder. The larvae will be left for 1 hour, then the contents of the cylinder will be drawn off from the bottom into 5 equal volumes. All larvae in each sample will be counted to determine whether increased water motion in the culture chambers has had the result of inducing larvae to descend to the bottom. If this effect is observed, then the larvae will be placed into bowls containing coralline algae to determine settlement success. This will test whether the lower vertical position of the larvae is a result of intentional vertical orientation or the result of form of impairment.

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