

WESTERN AUSTRALIA &
SEA TURTLES - TORRES STRAIT

GH BALAZS

Turtle farming: the farmers and turtles are missing out

By BRIAN TOOHEY

In one of its unhappiest aboriginal giveaways, by the end of July the Australian Government had pumped over \$492,000 into a turtle farming project in the Torres Strait Islands which as each day goes by appears more of a shambles.

The project was started by the previous Government with funds being channelled through an Australian National University ecologist, Dr Robert Bustard.

Dr Bustard subsequently left the university to become managing director of a private company, Applied Ecology Pty Ltd, which now administers the Torres Strait project from offices in the MLC tower block in Canberra's Wooden Valley.

Applied Ecology has asked for an extra \$1.5m for its activities in 1973-74.

And Senator Georges (Lab, Q'land) claimed in the Senate last week that a further \$100,000 had been advanced to a related company, Aboriginal and Islander Marketing Pty Limited, which was to buy the turtles.

Senator Georges was put in as chairman of Applied Ecology by the former Aboriginal Affairs Minister, Mr Gordon Bryant to try to sort out the enterprise.

The aim of the project is to help both the people and the turtles of Torres Strait. An analysis carried out by the accounting firm of Peat Marwick Mitchell found that to the end of July, 22 per cent of the \$490,000 had gone to the islanders and 19

In other evidence to the committee a former administrative manager with the project, Mr D. M. Edwards, estimated that a one-year-old turtle stuffed for the curio trade would have to sell for over \$52 to cover costs.

The Department of Aboriginal Affairs expected to sell stuffed turtles for between \$25 and \$35, although Mr Edwards said that they were available in overseas outlets for as little as \$10.

He said that on a visit to the turtle farms he found the majority of turtles with deformations "due to cannibalism."

"Some were malformed to the extent of back flippers being entirely eaten away."

Mr Edwards noted wryly: "The market potential of these would be lowered."

Projections based on overseas sales ignore the fact that the Customs Minister, Senator Murphy, in line with UN policies on endangered species, has banned any killing of turtles for export.

The farming project is based not on breeding in captivity but on taking eggs or hatchlings from the wild state.

No studies appear to have been undertaken on the market potential for the alternative enterprise of fattening turtles for their meat and oil.

During his visit to the Torres Strait, Mr Edwards said he found turtles "being kept in garbage tins, plastic bins and there were



Robert Bustard and turtle

"You know, we'll be among the very first tourists visiting China," I said, as

An analysis carried out by the accounting firm of Peat Marwick Mitchell found that to the end of July, 22 per cent of the 5490,000 had gone to the islanders and 19 per cent to the European employees.

Islanders get a training allowance

Over 1000 islanders are employed compared with less than 20 Europeans.

Senator Georges said that Dr Bustard was paid an annual salary by Applied Ecology of \$18,000 a year plus expenses.

The islanders are paid what is called a training allowance of just over \$30 a week to farm the turtles, for which sufficiently rewarding markets are supposedly available to remove the need for the allowance.

A document written by a former field officer with the project, Mr Mould, and given in evidence to the House of Representatives stated: "The work load on farmers with larger turtles is excessive.

"From a practical viewpoint it is no longer possible for some farmers to keep their stock above a standard where mortality is bound to increase.

"It is a physical impossibility.

"From a welfare viewpoint if a whole family has to work so one member of that family can earn what in real benefit turns out to be a very small wage the project in my estimation is not fulfilling its promise to the islanders.

"The real wage (cash of benefit to the farmer) is what is left after paying for equipment and items necessary to being a farmer, boat repayments, outboard fuel, pool construction material and even the purchase of stock."

According to Mr Mould, a two-year-old turtle eats a five-gallon drum of sardines a day!

On market prospects Mr Mould said: "For the curio trade the animal needs to be unblemished. As a result of inadequate methods of housing and possibly diet deficiency very few animals have been produced of the required standard.

"As for the meat and oil market, growth rates have been so slow that should the animals ever reach the required size it is not likely to be an economic proposition.

"At present the housing is such that I would have serious doubts as to the fitness of the animals for human consumption."

their meat and on.

During his visit to the Torres Strait, Mr Edwards said he found turtles "being kept in garbage tins, plastic bins and there were two turtles in one-gallon paint tins in some places.

"There were very few farms that had obviously had some money spent on them and concrete tanks put in."

The water in these tanks has to be changed each day which in most cases was being done with buckets, Mr Edwards said.

In other evidence the tanks were described as often choked with turtle excreta.

The whole project is now the subject of investigations by the Attorney-General's Department, the Auditor-General, and an independent ecologist.

The ecologist will find scant records of such things as hatching or mortality rates.

While Minister for Aboriginal Affairs, Mr Gordon Bryant, expressed concern about expanding the farming operations, the permanent head of the department, Mr Dexter, has given the project strong backing.

Mr Dexter, incidentally, wrote to the House of Representatives Environment Committee following questioning of the departmental evidence on the amount of money provided for the project in the following terms:

"In paragraph 9 of the department's submission to the standing committee I find that a figure of \$250,000 was given as the total of grants made available for the project during the financial year 1972-73.

"On looking through the accounts of the project, I find that two additional amounts of \$50,000 and \$130,000 were allocated to the project from savings, on 18th June and 22nd June respectively, to enable certain additional commitments to be met and to provide carry-on funds until the grant for 1973-74 becomes available.

"With the addition of these two amounts the total provision for the project during 1972-73 should read \$430,000 and the total grant provision since the project was commenced will be \$574,730.

"I apologise for the need to have to correct the figures in my submission.

Yours sincerely,
B. Dexter,
Secretary."

"You know, we'll be among the very first tourists visiting China," I said, as the plane circled over Peking airport.

"Where shall we go?" she asked.
"When we're not having to visit communes and things, that is."

"I personally am going to spend most of my time eating," I said, offering her a Benson and Hedges.

"You're thinking of all those banquets they give Nixon, I suppose."

"I certainly am. I wonder what they'd have given an Australian president?"

"Steak and thousand-year-old eggs, probably," she smiled.



Benson & Hedges.
When only the best will do.

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REPORT ON
AN ENQUIRY INTO
ORGANISATION, MANAGEMENT AND MARKET PROSPECTS
OF A TURTLE FARMING PROJECT
IN NORTHERN AUSTRALIA

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October, 1973.

Preamble I am pleased to report on my enquiry into the organisation and management structure of the turtle farming project in Northern Australia and to make recommendations for improvements. I also report on whether the administrative headquarters should be located in Canberra or elsewhere.

Report format in accordance with brief The terms of reference of the enquiry are detailed in Appendix (1) and my report proceeds in the order set out in the terms of reference.

Approach to enquiry My approach to this enquiry is summarized in Appendix (2). It should be noted that because the objectives of the turtle project have been stated only in general terms and emphasis has been placed on the conservation aspects I have found it necessary to write the business objectives and strategy to complete the format of this report. These objectives, the strategy, general description and chart of the proposed business and management of turtle farming are set out in Appendix (3).

Material Available The material available and other source information, data and acknowledgements are detailed in Appendix (4). It is appropriate, however, to express my thanks to Mr. P.J. Lawler, O.B.E. and his staff for their attention to my numerous requests. Also Dr. A.F. Carr and Professor A.R. Main have given me the benefit of their remarkable knowledge and ability in relating this business study to sound scientific ecological and conservation material. In fact, this report should be read in conjunction with the report dated October, 1973 prepared by Dr. Carr and Professor Main.

Basis of Opinion This report is based on the data listed in Appendix (4), my observation of the project and my commercial judgment. The financial information used has not been subject to audit. The report is an expression of my opinions of the various matters raised, which opinions are subject to the correctness of the data supplied to me.

To examine
the organ-
isation
and
management
structure

"1. TO EXAMINE THE ORGANISATION AND MANAGEMENT STRUCTURE OF THE COMPANIES WHICH HAVE BEEN SET UP IN THE CONTEXT OF THE TURTLE FARMING PROJECT IN NORTHERN AUSTRALIA AND TO CONSIDER WHETHER AND IN WHAT WAYS THEY MIGHT BE IMPROVED. IN PARTICULAR TO CONSIDER WHETHER THE ADMINISTRATIVE HEADQUARTERS SHOULD BE LOCATED IN CANBERRA OR ELSEWHERE"

Present
corporate
structure

The present structure comprises three companies:

- Applied Ecology Pty. Limited
- Aboriginal and Islander Products Pty. Limited
- Aboriginal and Islander Marketing Pty. Limited

with common management structure and interlocking directorates.

The organisation and management structures of these companies are no longer suitable for the turtle venture.

The principal reasons are:

Reasons for
changing
organisa-
tion and
management
structure

- (i) Applied Ecology Pty. Limited is designed to undertake research and development activity which is an entirely different function from an ongoing production venture. Accordingly Applied Ecology Pty. Limited should not control the management of the turtle venture.
- (ii) The marketing strategy discussed in section 4 is a co-ordinating function rather than a direct selling function. A co-ordinating marketing function calls for a different modus operandi from that presently proposed and must be kept separate from research and development in ownership, control and direction.
- (iii) The business objectives (as distinct from the scientific objectives) as set out in Appendix (3) would be best achieved by a structure which could cater for the turtle venture as an integrated unit but would keep areas of responsibility clearly defined through a corporate or legal status designed to suit the needs of each area of responsibility.

- (iv) The business as envisaged is dependent on the "turtle farmers" and as it is their work, their ability and their business they should have considerable involvement in the management of the turtle venture.

Accordingly I would recommend the following arrangements:

Applied Ecology - Research and Development

- (a) Applied Ecology Pty. Limited. This company should be a scientific applied research company. Its income should be solely from grants for specific research on projects involving Australian flora and fauna for the benefit of Aborigines and Islanders. The board should include (3) eminent scientists, (1) government representative, e.g. from the Council for Aboriginal Affairs, and (2) distinguished experienced businessmen. The board should be comprised of people who can attract grants for research, set sound parameters for research projects and organise and monitor the projects. The managing director should be a person who has administrative experience and should be based at head office. Applied Ecology Pty. Limited should act as the "technical advisor" to the turtle project but must not manage the project because of the probability that research and development if merged with the commercial turtle activities would result in a confused conglomerate. Such confusion creates breakdown in communications which are difficult under reasonable conditions and aggravated in this instance by geographical distances involved. Appendix (5) sets out suggested amended objectives and management chart of the operations of Applied Ecology Pty. Limited. The administration and management services structure of Applied Ecology Pty. Limited would be considerably reduced from the present level.

Cottage industry turtle farm co-operatives or similar corporate structure

- (b) "Cottage industry turtle farm co-operatives". In Appendix (3) there is reference to the "cottage industry turtle farms". This phrase identifies the business of growing turtles from hatchlings to approximately 15 lbs. weight in 2 years 8 months. At this stage the "farmer" would sell his 15 lb. turtle to a corporate body which would grow the turtles in sea crawls.

It is essential that the farmer manages this cottage farm part of the business. Dr. Carr and Professor Main, in their companion report, highlight the animal husbandry standards of the Torres Strait Islanders, their ingenuity and their obvious ability to handle turtles; these fundamental abilities must be used in the growing of young turtles. Furthermore, it is my opinion that the raising of young turtles would be in harmony with the Islanders traditional way of life.

The management structure envisaged within this section of the business would operate within the rules of 3 Co-operatives to be formed representing Eastern, Central and Western Island groups. The Co-operatives would each have a Board of Directors of 3 or 4 Island members plus the nominated representative of the Queensland Government Department of Aboriginal and Island Affairs. The co-operatives which could be co-operatives registered under a Companies Act would each employ an inspector and a recorder to facilitate the collection of management data. The co-operatives in consideration of permits, funding, etc. would contract to sell their produce to a company to be formed which would

- (i) grow the turtles to slaughter size
- (ii) arrange the processing and marketing of the produce.

Appendix (6) sets out suggested objectives and management chart of the operations of these Co-operatives.

Torres Strait Turtles - the operating company

- (c) Torres Strait Turtles Pty. Limited (so named for the purpose of the report) would carry out the erection of sea crawls, the growing of turtles from a minimum 15 lbs. to slaughter size, the organizing of the processing and selling of the turtle product.

The direction of the company should include Torres Strait Islanders and businessmen. I would recommend a structure of three Islanders (one from each co-operative), two businessmen (one marketing oriented), and two Government observers - one from Queensland Department of Aboriginal Affairs and one from the Australian Government. The objectives and strategy of this company are set out in Appendix (7).

Once again, I am of the opinion that the Islanders should play a prominent role in this company and via the co-operatives own a part of this company. The Australian Government could own fifty-one per cent of the share capital until the project had been fully re-constituted and was self-supporting and then sell part of their equity in equal proportions to the co-operatives.

Location of Administration The administrative headquarters of Applied Ecology Pty. Limited should be in Canberra but as mentioned previously should be considerably smaller than the present administration.

The administrative headquarters of the three co-operatives should be on the Islands.

The headquarters of Torres Strait Turtles Pty. Limited should be in Canberra with a branch office established on the Island nearest the principal "turtle sea crawl". However, the Canberra office would be a statutory office with planning, staffing and direction being handled as much as possible from the operational office. It is important that management is located close to the principal place of business to facilitate the control of the business.

Audit needs It would be advisable for the audit of these three groups to be completed either by the Auditor General's Department or, by an independent professional firm so appointed. In either case the same auditor should be appointed to audit the three groups.

To consider effectiveness of financial management "2. TO CONSIDER WHETHER FROM A COMMERCIAL VIEWPOINT THE FINANCIAL MANAGEMENT IS EFFECTIVE AND WHETHER THE MANAGEMENT CONTROL REPORTS AND ACCOUNTING PRACTICES THAT HAVE BEEN IMPLEMENTED ARE APPROPRIATE"

I have not conducted an audit of the internal control procedures adopted by Applied Ecology Pty. Limited or of the data presented to me for examination.

However, the information presented to me was not appropriate for an expanded operation. It is important that the financial statements presented to date be subject to audit to establish whether the accounts do show a true and fair view of the state of affairs of the companies.

In respect of the future it is not possible to set out a detailed accounting and reporting procedure as this task is a major exercise and is dependent on the eventual format of the whole organisation. I have scheduled the principal matters which I consider should be the subject of regular management and accounting reporting and this schedule is attached as Appendix (8).

To estimate production costs

"3. TO ESTIMATE PRODUCTION COSTS FOR THE PRODUCTS THE PROJECT WILL INITIALLY PRODUCE (PAYING PARTICULAR ATTENTION TO THE IMPORTANCE OF LABOUR COSTS) AND TO SET OUT THE ASSUMPTIONS ON WHICH THESE ESTIMATES ARE BASED"

Appendix (9) sets out the detailed workings of the estimated production costs. In summary:-

Sea crawl

(i) If a sea crawl can be constructed for \$600,000 or less and it has an effective life of at least 20 years, the project is economically feasible.

150 employees

(ii) The project has been constructed on the basis of 100 turtle farms. It is estimated that a total of 150 Islanders would be employed; 120 would be employed in farming and related activity and 30 employed attending the sea crawl and trawler fishing.

Integral part of Islanders life

(iii) The "farming methods" envisaged can be truly described as cottage industry in respect of growing turtles to 15 lbs. Growing turtles in sea crawls is, of course, more intensive farming but the bulk of the work entailed is trawler fishing to provide feed for the turtles. Fishing is an integral part of the Islanders' life.

To assess current demand

"4. TO ASSESS CURRENT DEMAND FOR THESE PRODUCTS AND EXPECTED GROWTH FOR THE NEXT FIVE YEARS"

Sales to be expected

I have obtained an overall picture of the marketing and movement of turtle products throughout the world. This data, which is of considerable strategic importance, has been made available to the Department of the Special Minister of State for distribution on a confidential basis. In summary, the sales levels that can be reasonably expected depend entirely on a marketing program designed to fill the objectives of the turtle project.

The major producer of turtle meat currently is Mariculture Limited of Grand Cayman Island. Its strategy appears to be similar to that of an intensive poultry breeding industry and they will be marketing their better quality meats through U.S.A. supermarkets, the shell to Japan and elsewhere, and oils and soup meats mainly to Germany and United Kingdom. They have also sold meat to Australia for soup making.

Mariculture Ltd. have estimated that within five years their gross sales should be five times present sales and in the region of \$17 million per annum. Their market is related primarily to the rapidly growing world market for high protein meat. Turtle steak has a protein content of about 23%, a fat content of about only 0.2% and 102 calories per 100 grams. These factors and the similarity of turtle meat to veal should ensure acceptance of turtle meat in the market place.

Demand for food product

As there is a known world growth market for high protein foods, particularly meat, it is now axiomatic that the demand growth will continue rapidly.

The industry can grow

Accordingly the answer to the question - Can the industry grow? - is simply yes. Provided the industry is based on the production and marketing of food, the demands for the product will grow.

Curios

It will be noted that there has been no reference in this report to the curio trade. I have not taken the curio trade into the economic calculations of the project as a curio trade is 'suicidal' long-term. The sale of turtles as curios is a peculiar marketing situation and one which must be controlled. I recommend that:

(a) If the appropriate laws are relaxed to enable turtles to be sold as curios they be relaxed to permit no more than the manufacture and sale of 10,000 stuffed turtles per annum.

(b) Stuffed turtles should be sold only from Great Barrier Reef souvenir shops as an article depicting the wonders of this area. Australia should not permit marketing of stuffed Australian turtles on overseas markets. It is my opinion that it would not be possible to produce the number of stuffed turtles required to satisfy the demand that would be created world wide.

(c) At the above level of sales the "Torres Strait Turtles Pty. Limited" could augment its income by \$20 per turtle or \$100,000 - \$200,000 per annum.

Tortoise
Shell

In respect of tortoise shell from Hawksbill turtles there is a steady demand for shell at substantial prices but it is not possible to determine a growth factor. It is reasonable to assume that the growth of demand in this area is limited.

Assessment
of
prices

"5. TO MAKE AN ASSESSMENT OF THE GENERAL LEVEL OF PRICES THAT WOULD BE OBTAINED FOR THE PROJECT'S PRODUCTS AND THE SALES LEVELS THAT COULD BE REASONABLY EXPECTED IN THE INITIAL YEARS OF OPERATIONS AND TO IDENTIFY MAJOR FACTORS WHICH COULD INFLUENCE THESE ESTIMATES"

Appendix 10 (1) sets out the sales levels that could be reasonably expected.

Appendix 10 (2) attached sets out the assessment of the general level of prices that would be obtained for the turtle products and it should be noted in particular that a 100 lb. live weight green sea turtle could be reasonably expected to produce sales amounting to \$100 F.O.B. Australian main port.

To
consider
marketing

"6. TO CONSIDER WHAT MARKETING ARRANGEMENTS WILL ENABLE THE PROJECT TO OBTAIN MAXIMUM ADVANTAGE FROM ITS MARKET OPPORTUNITIES BOTH IN AUSTRALIA AND OVERSEAS"

Using
marketing
agencies

It should be noted that the projected total sales should be approximately \$1 million per annum when the project is in full operation. To establish a traditional network of sales outlets on a turnover of only \$1 million is not economically possible because the margins for selling are comparatively small. Accordingly, I am strongly of the opinion that, in respect of turtle product sales (both in Australia and overseas), the operating company should enter into arrangements with existing organisations who have the marketing outlets in Australia and overseas and, therefore, the marketing intelligence to service those markets.

To assess investment level \$3.6 million

"7. TO ASSESS THE DESIRABLE LEVEL OF INVESTMENT IN THE PROJECT AND TO ESTIMATE THE RETURN ON FUNDS INVESTED"

I am of the opinion that the desirable level of investment in the project should be about \$3.6 million including research costs to date and the return on these funds invested should be approximately 6.5 per cent per annum (non-compound).

Appendix 11 sets out detail of the calculation and assumptions made in arriving at these figures.

To consider company structure

"8. TO CONSIDER WHETHER THE COMPANY STRUCTURE THAT HAS BEEN ADOPTED IS AN APPROPRIATE MODE OF ORGANISATION FOR THE INDUSTRY WITH PARTICULAR REFERENCE TO THE FOLLOWING QUESTIONS:

- A - THE EXTENT TO WHICH THE VARIOUS FACETS OF THE PROPOSED TURTLE INDUSTRY SHOULD BE SEPARATED OR INTEGRATED EITHER WITHIN THE SAME ORGANISATION OR IN SEVERAL ORGANISATIONS
- B - THE MOST APPROPRIATE MODE OF ORGANISATION FOR THE INDUSTRY AS A WHOLE AND ITS VARIOUS FACETS E.G. CO-OPERATIVES, ONE PROPRIETARY COMPANY."

Appendices 5, 6 and 7 set out the corporate structures which I envisage as being appropriate for the proposed industry. As previously stated I do not consider that the existing company structure is now appropriate.

General Recommendations

"9. GENERAL RECOMMENDATIONS AND SUMMARY".

To communicate the feeling and social environment of this project in a traditional feasibility study is difficult and I have therefore made these comments with the purpose of highlighting factors influencing the report.

Need for cash income

Firstly there is a real need for the Island people to earn a cash income. They want an income but there is little scope for industry other than that involving the sea. A modern fishing industry is difficult to envisage in this area because of remoteness and the resulting transport costs which destroy the small margins available in this industry. It would appear that the only workable basis would be a fishing industry on a huge scale which would probably destroy the Islanders cultural environment.

Provision
of
employment

Secondly, the young men of the Islands have migrated to the mainland in search of employment. There does appear to be an undercurrent of desire that the men will return to the Island if there is work. This project will provide work.

Scientific
studies

Thirdly, there is a series of scientific studies to be undertaken in this area and the local knowledge of the Islanders is such that they would be excellent field assistants in the collection of the mass of data required for these projects.

Development
of
Project

mid-1970 Oct 73

The project has grown from a research and development situation over a period of approximately 3 years to a stage where it has to either proceed as a research and development study or be converted into a business venture. Because the project is at the crossroads, and because there has been a lack of overall business objectives as distinct from scientific objectives, there is considerable confusion and inconsistency within the management of the turtle project simply because of the lack of understanding of these basic objectives. To move from this hiatus and confusing position into a business venture is not an easy task and much of the report to date states, in effect, what should happen eventually. However, to convert the present into something considerably more ideal several intermediate stages will be involved and so, I have scheduled a course of action (Appendix 12) to set the project in to a correct business environment bearing in mind that the ownership, management and organisation of the industry should be appropriate to the social environment of the people involved. It should be noted the project can have considerable scientific benefits provided that the scientific research undertaken is clearly defined, the objectives known, and the work entailed is in parallel with the business venture. I believe the relevant research and the commercial viability of the project can be co-ordinated.

Recommend-
ations

In summary my recommendations are:

- (1) The turtle farmers should be consulted for their comment on the implementation of the report in terms of their requirements.
- (2) The business of growing turtles for meat and shell should proceed as a commercial undertaking on the basis detailed in this report, including producers' co-operatives and a processing/marketing company.

- (3) The management structure should be re-organised to give the planning, direction and co-ordination that the project needs and deserves.
- (4) The constraints listed in Appendix 13 should be carefully studied and decisions taken dependent on the outcome of those studies.
- (5) The sale of stuffed turtles as curios, if permitted, should be subject to control.
- (6) The existing company Applied Ecology Pty. Limited should remain as research and development technical advisor.
- (7) The companies Aboriginal and Islander Products Pty. Limited and Aboriginal and Islander Marketing Pty. Limited should be liquidated.
- (8) In respect of turtle farming areas other than Torres Strait such as Mornington Island and Cape Leveque these farms can be brought into the business venture (if they so desire) as soon as they are numerically strong enough to own and operate their area co-operative.



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Turtles: Terms of reference of Enquiry into
Organisation Management and market prospects

1. To examine the organisation and management structure of the companies which have been set up in the context of the turtle farming project in Northern Australia and to consider whether and in what ways they might be improved. In particular to consider whether the administrative headquarters should be located in Canberra or elsewhere.
2. To consider whether from a commercial viewpoint the financial management is effective and whether the management control reports and accounting practices that have been implemented are appropriate.
3. To estimate production costs for the products the project will initially produce (paying particular attention to the importance of labour costs) and to set out the assumptions on which these estimates are based.
4. To assess current demand for these products and expected growth for the next five years.
5. To make an assessment of the general level of prices that would be obtained for the project's products and the sales levels that could reasonably be expected in the initial years of operations and to identify major factors which could influence these estimates.
6. To consider what marketing arrangements would enable the project to obtain maximum advantage from its market opportunities both in Australia and overseas.
7. To assess the desirable level of investment in the project and to estimate the return on funds invested.
8. To consider whether the company structure that has been adopted is an appropriate mode of organisation for the industry with particular reference to the following questions:-

- (a) the extent to which the various facets of the proposed turtle industry should be separated or integrated either within the same organisation or in several organisations
- (b) the most appropriate mode of organisation for the industry as a whole and its various facets (e.g. co-operatives, 1 proprietary company, statutory authority).

9. To report on the matters considered to the Special Minister of State by 1 November including recommendations on the organisation and management of the project and on the directions in which the project should develop its marketing resources and policies.

NOTE: In the course of this assignment the following considerations should be borne in mind -

- (a) It is desirable that ownership of the industry should be vested in the communities farming the turtles.
- (b) These communities should, to the greatest extent feasible, manage the industry.
- (c) The organisation of the industry must be appropriate to its commercial as well as its social environment and facilitate the best use of the resources employed.

OUTLINE OF APPROACH TO THIS ENQUIRY

1. Undertake background reading and briefing.
2. Draft an outline report for clarifying key factors and major issues pursuant to the items detailed in the terms of reference.
3. Undertake familiarization tour of turtle project area in conjunction with Dr. Carr and Professor Main with the objects of:
 - (a) gaining first hand knowledge of the project
 - (b) examining the problems (if any) of communication, lack of consistency and delegation of control
 - (c) relating the actual scene to the background data and financial data available from Canberra
 - (d) collecting data which may influence the analysis of the projectand, in particular, equating the problems affecting the ecology and social structure with the organisation management and market prospects.
4. Prepare a questionnaire and data collection list for information required ex Canberra.
5. Visit and study the operations of Applied Ecology Pty. Limited.
6. Consider the facts and findings and ensure that terms of reference are maintained.
7. Discuss key factors as determined with Department, Dr. Carr and Professor Main.
8. Prepare draft report.
9. Discuss draft report with Department of the Special Minister of State and others as instructed.
10. Present final report.

OBJECTIVES, STRATEGY AND GENERAL DESCRIPTION OF THE
PROPOSED DEVELOPMENT OF THE TURTLE PROJECT INTO A
REASONABLY VIABLE BUSINESS.

OBJECTIVES

1. To create meaningful employment for the Islanders in occupations which are in reasonable harmony with their traditional way of life.
2. To develop an infrastructure of meaningful activity for the Islanders which will assist in obtaining economic independence in the Islands.
3. To encourage migration of Islanders back to their homes by creation of employment.
4. To conserve the various species of turtle in Northern Australia.
5. To farm turtles, process, market primarily as a source of food and co-ordinate the business within reasonable economic lines in harmony with the way of life of the Islanders.

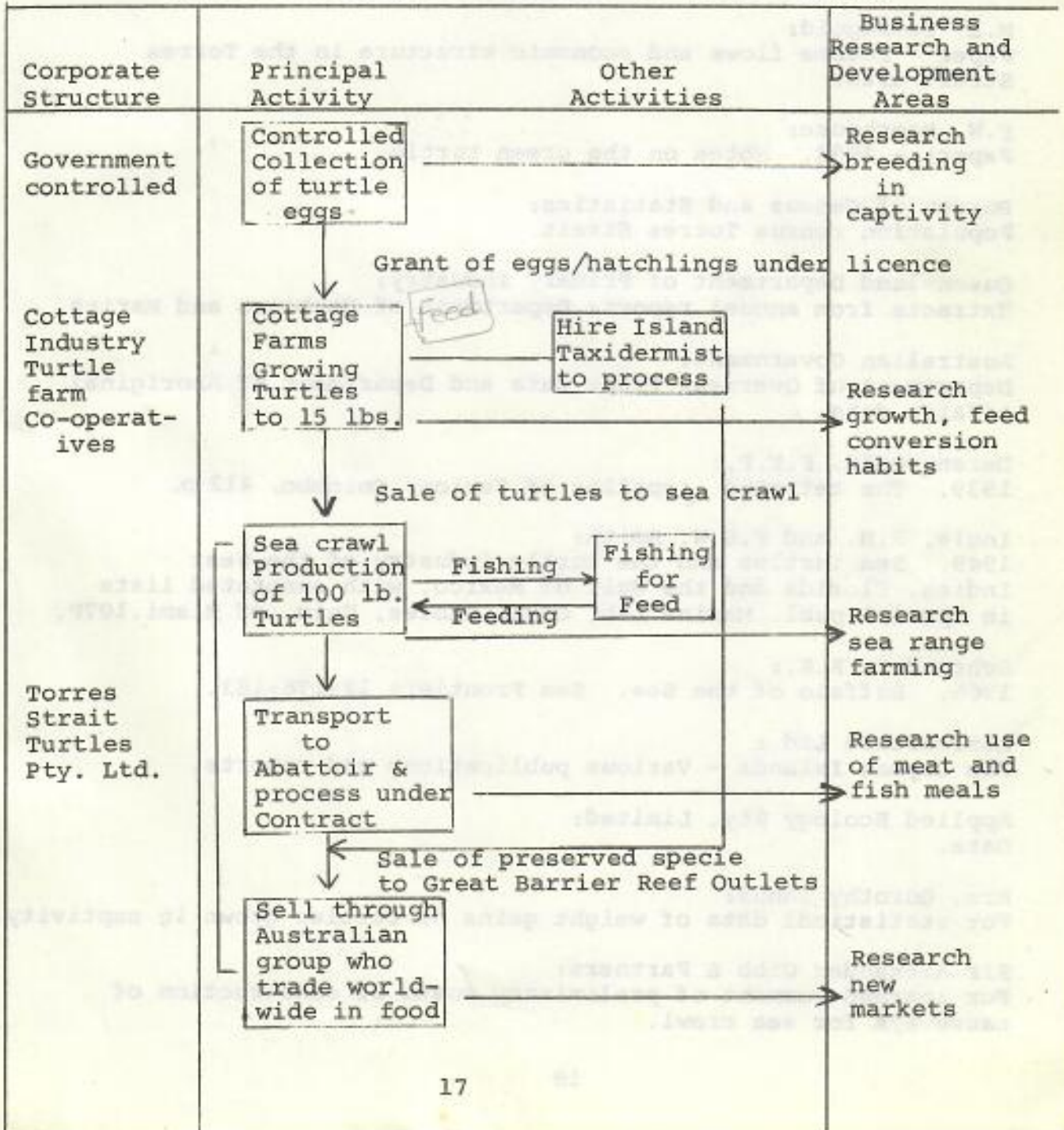
STRATEGY

1. Ownership and management of the project, as far as possible, should be in the hands of Islanders to ensure that the Islanders requirements are recognised.
2. Meaningful employment to be created through the cottage industry concept with the "intensive farming" set aside as a separate commercial venture to enable economical use of capital invested and technical expertise.
3. Research and development into turtles to be in parallel with but segregated from the business ventures.
4. Business strategy to be based on low capital involvement and inexpensive production costs to enable the cottage industry concept to compete on the open world markets with intensive farming high capital cost systems of operation.
5. Minimal overhead structure to assist in competing for sales on the open market.

GENERAL DESCRIPTION of the proposed turtle farm.

From a controlled collection of turtle eggs Islanders grow turtles in tanks about 10' x 10' x 1' located on the foreshore of their Islands. The Islanders feed the turtles from fish caught by them on the shallow reefs. It is proposed that the turtle, when it is 15 lb, would be 'sold' to a sea crawl being a paddock in the sea - where they would be cared for by bulk feeding of fish caught from trawlers. When the turtle reached 100 lb. weight it would be delivered to an abattoir - say Wyndham - for contract processing and selling. As a side-line a controlled number of turtles 5,000-10,000 per annum would be stuffed by trained Island taxidermists for sale ONLY to marine gift tourist shops located in the tourist resort areas on the Great Barrier Reef. The economics of this exercise have been calculated excluding any proceeds from a limited sale of stuffed turtles.

Chart of the proposed business of turtle farming



SOURCE OF INFORMATION AND ACKNOWLEDGEMENTS

- Queensland Government:
The Land Acts 1962 to 1968 and amendments.
- Dr. A. Carr:
So excellent a Fishe.
- Queensland Department of Aboriginal and Island Affairs:
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- H. Robert Bustard:
Kay's Turtles and Australian Sea Turtles.
- E.K.Fiske and Maree Tait:
Paper - Rights Duties and Policy in the Torres Strait.
- M.L. Treadgold:
Paper - Income flows and economic structure in the Torres Strait area.
- F.W. Moorhouse:
Papers - 1933. Notes on the green turtle.
- Bureau of Census and Statistics:
Population census Torres Strait.
- Queensland Department of Primary Industry:
Extracts from annual reports Department of Harbours and Marine.
- Australian Government:
Department of Overseas Trade data and Department of Aboriginal Affairs data.
- Deraniyagala, P.E.P.:
1939. The tetrapod reptiles of Ceylon, Colombo, 412 p.
- Ingle, R.M. and F.G.W. Smith:
1949. Sea turtles and the turtle industry of the West Indies, Florida and the Gulf of Mexico, with annotated lists in special publ. Marine Lab. Coral Gables, Univ. of Miami. 107P.
- Schroeder, R.E.:
1966. Buffalo of the Sea. Sea Frontiers 12:176:183.
- Mariculture Ltd.:
The Cayman Islands - Various publications and reports.
- Applied Ecology Pty. Limited:
Data.
- Mrs. Dorothy Tanus:
For statistical data of weight gains of turtles grown in captivity.
- Sir Alexander Gibb & Partners:
For learned comment of preliminary costs of construction of causeways for sea crawl.

APPLIED ECOLOGY PTY. LIMITEDObjectives (amended)

To initiate and carry out pure and applied scientific researches and investigations.

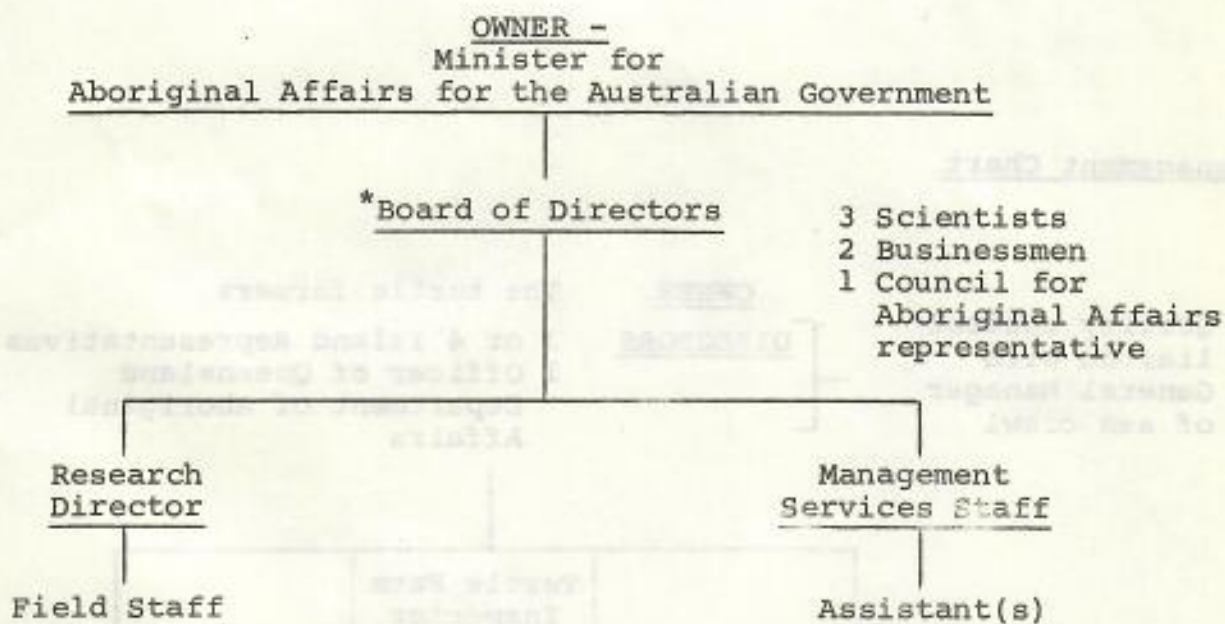
To undertake pilot studies, schemes, projects and activities to demonstrate the feasibility of research work and investigations.

To provide scientific research services, manpower and support to projects which they originally initiated and to others.

To collect and disseminate information.

To achieve a record of performances which will ensure the continuation of grants from the Australian Government and research institutions, and in particular,

To achieve the above objectives in respect of flora and fauna of Australia involving Australian Aborigines and/or Islanders.

Management Chart

- * The board of directors is appointed by the Australian Government via the Minister who would seek grants in the proper manner from the Department and also from research institutions.

COTTAGE INDUSTRY TURTLE FARM CO-OPERATIVES - EASTERN
 - CENTRAL
 - WESTERN

Objectives

To grow green sea turtles from hatchlings to a weight of 15 lbs. each in approximately 2 years 8 months.

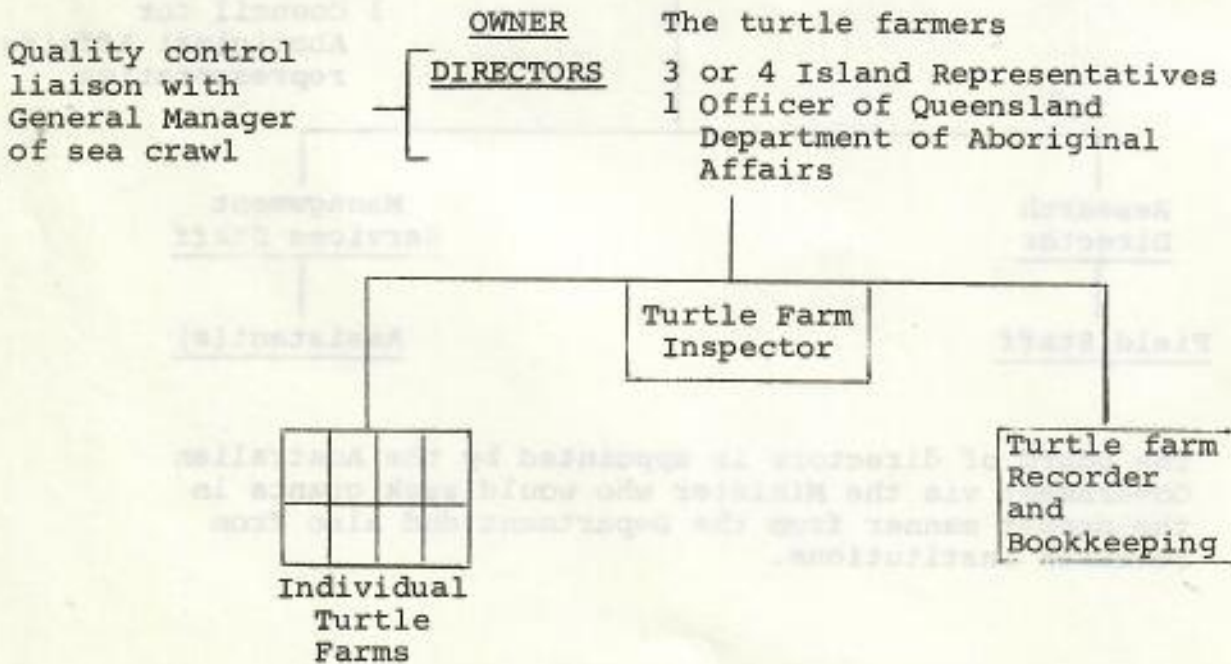
To grow turtles in a cottage farm environment.

To contract all the live turtles to "Torres Strait Turtles Pty. Limited".

To gain an adequate cash income for the turtle farmers without adversely affecting their way of life.

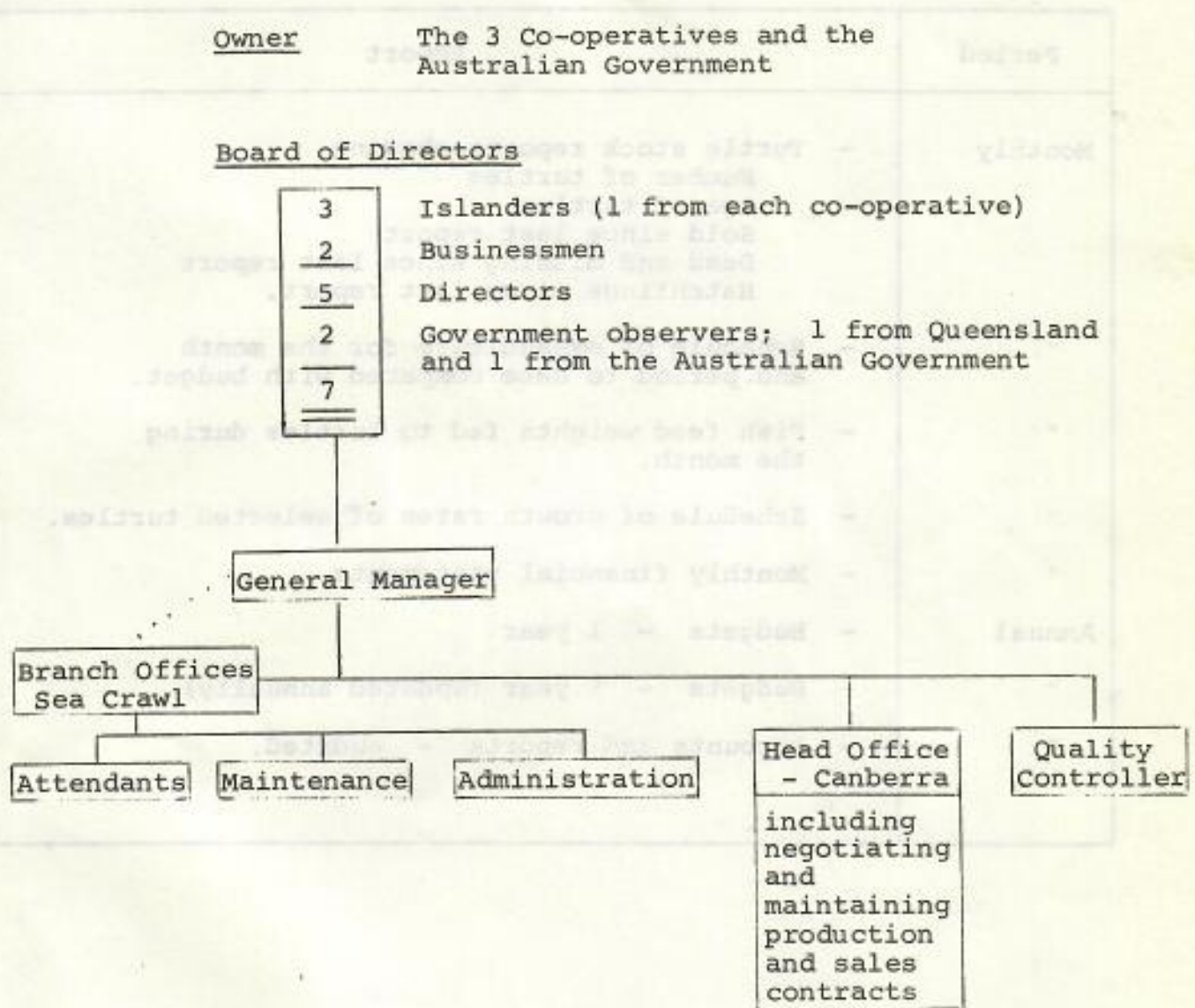
To operate the quality standard controls on a group or co-operative basis to minimize expense and to ensure consistent standards of product.

Management Chart



TORRES STRAIT TURTLES PTY. LIMITED

Management Chart



SCHEDULE OF SUGGESTED MANAGEMENT AND ACCOUNTING REPORTING

Period	Report
Monthly	<ul style="list-style-type: none"> - Turtle stock reports showing <ul style="list-style-type: none"> Number of turtles Age of turtles Sold since last report Dead and missing since last report Hatchlings since last report.
"	<ul style="list-style-type: none"> - Schedule of expenditure for the month and period to date compared with budget.
"	<ul style="list-style-type: none"> - Fish feed weights fed to turtles during the month.
"	<ul style="list-style-type: none"> - Schedule of growth rates of selected turtles.
"	<ul style="list-style-type: none"> - Monthly financial statements.
Annual	<ul style="list-style-type: none"> - Budgets - 1 year
"	<ul style="list-style-type: none"> - Budgets - 5 year (updated annually)
"	<ul style="list-style-type: none"> - Accounts and reports - audited.

PROJECTED ESTIMATES OF PRODUCTION COSTS

TURTLES FROM 15 LBS. GROWN TO 100 LBS. GROWN IN SEA CRAWLS

	Cumulative	1	2	3	4	5	6	7	8	9	10	15
Number of years												
Cost of turtles from cottage farms	\$ 4,125	-	-	165	330	330	330	330	330	330	330	330
Feeding costs												
Cost of collection of 50 ton of fish per day												
4 trawlers at an operating cost of \$30,000 each per annum	1,500	-	-	60	120	120	120	120	120	120	120	120
Production costs												
Amortization and maintenance of pens	* 600	-	-	30	30	30	30	30	30	30	30	30
Sea crawl attendants	325	-	-	25	25	25	25	25	25	25	25	25
Veterinary services	390	-	-	30	30	30	30	30	30	30	30	30
Administration												
Communications	260	-	-	20	20	20	20	20	20	20	20	20
Management Services	650	-	-	50	50	50	50	50	50	50	50	50
Freight and Cartage	920	-	-	-	-	80	80	80	80	80	80	80
	\$ 8,770	-	-	380	605	685	685	685	685	685	685	685

figures in round '000s

NOTE *

A preliminary cost of sea crawls and maintenance thereof has been estimated in conjunction with consulting engineers experienced in Island causeway constructing. A causeway 20 feet high and 1 mile long is estimated to cost \$600,000 and have a life span of at least 20 years. Although a sea crawl has not been designed based on data from Mariculture Ltd, it has been calculated that a 1 mile causeway would enclose an area more than adequate for the number of turtles to be housed.

PROJECTED ESTIMATES OF PRODUCTION COSTS

	1	2	3	4	5	6	7	8	9	10	15
Number of Years											
One average turtle farm direct costs											
Training allowance	\$ 1600	1600	1600	-	-	-	-	-	-	-	-
Internal Sales	-	-	1650	3300	3300	3300	3300	3300	3300	3300	3300
Operating Costs - as per Schedule (9(3))	50	50	50	50	50	50	50	50	50	50	50
Annual Total	\$ 1650	1650	3300	3350	3350	3350	3350	3350	3350	3350	3350
100 Turtle farm Group Production costs											
Material	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
Labour	40160	40160	40160	45160	45160	45160	45160	45160	45160	45160	45160
Expense	12600	12600	12600	12600	12600	12600	12600	12600	12600	12600	12600
Annual Total	\$64760	64760	64760	69760	69760	69760	69760	69760	69760	69760	69760
Proportion of group turtle farm production costs per ONE farm (say)	\$ 650	650	650	650	650	650	650	650	650	650	650
Summary of estimated total production costs to point of transfer of turtles to sea crawls @ 15 lbs - 3 years											
Direct Farm Costs	165000	165000	330000	330000	330000	330000	330000	330000	330000	330000	330000
Farm Group Costs	65000	65000	65000	70000	70000	70000	70000	70000	70000	70000	70000
Annual Total	\$230000	230000	395000	400000	400000	400000	400000	400000	400000	400000	400000
Cumulative Total	\$230000	460000	855000	1255000	1655000	2055000	2455000	2855000	3255000	3655000	5655000
Net Income to farmer before tax and before interest on turtles grown to 15 lbs.	\$ 900	900	2550	2600	2600	2600	2600	2600	2600	2600	2600

NOTE In all cost and sales calculations no provision has been made for inflation. Because the project is assessed as a basic commodity - foodstuffs - cost increases would tend to be offset by increased sale prices.

PROJECTED ESTIMATES OF OPERATING COSTS
FOR ONE 'AVERAGE' TURTLE FARM

Period of Activity	Activity	Estimated Capital Cost	Estimated Annual Operating Cost Excluding Labour	Labour Time
Development time	Construct farm tank	10		5 days
	" farm shelter	8		3 "
	" farm drainage	10		
	" work bench	5		
	Purchase mincer and knives	5		
	" buckets	5		
	" fishing gear	12		2 "
	" spring scales	5		
		<u>\$60</u>		<u>10 days</u>
Annual	Amortization		\$5	-
"	Collect eggs or hatchlings			-
Daily	Water turtles			See below
"	Drain water			1 hour
"	Clean farm			$\frac{1}{2}$ "
"	Water turtles			2 $\frac{1}{2}$ "
"	Feed turtles			$\frac{1}{2}$ "
"	Collect fish			2 $\frac{1}{2}$ "
"	Maintain equipment		\$20	$\frac{1}{2}$ "
"	Record fishing time)
"	Record weight of feed		\$1) $\frac{1}{2}$ "
"	Record dead or missing)
"	Record weight of turtles)
				<u>8 hours</u>
Monthly	Report monthly			N/A
	Medication		\$24	N/A
		\$60 per farm	\$50 p.a.	8 hours * per day

* With reticulation this time would reduce to 5-6 hours per day. Furthermore, the activity would be more appropriate, then, to the Islanders traditional way of life.

PROJECTED ESTIMATES OF TURTLE NUMBERS, WEIGHTS AND FEED
INDIVIDUAL FARM

Number of years		1	2	3	4	5	6	7	8	9	10	15
One Average Turtle Farm												
Age	- 1 yr	150	150	150	150	150	150	150	150	150	150	150
Number	- 2 yrs	-	122	122	122	122	122	122	122	122	122	122
	- 3 yrs	-	-	110	110	110	110	110	110	110	110	110
		150	272	382	382	382	382	382	382	382	382	382
Weights	1 lb. @ - 1 yr	150	150	150	150	150	150	150	150	150	150	150
	6 lbs @ - 2 yrs	-	732	732	732	732	732	732	732	732	732	732
	20 lbs @ - 3 yrs	-	-	2200	2200	2200	2200	2200	2200	2200	2200	2200
		150	882	3082	3082	3082	3082	3082	3082	3082	3082	3082
Feed	4 ozs - 1 yr	38	38	38	38	38	38	38	38	38	38	38
per	1 lb - 2 yrs	-	122	122	122	122	122	122	122	122	122	122
Day	2 lb - 3 yrs	-	-	220	220	220	220	220	220	220	220	220
		38	160	380	380	380	380	380	380	380	380	380
Above product from One 'Average' Turtle Farm transferred to a sea crawl												
Number	Age											
	- 4 yrs	-	-	-	99	99	99	99	99	99	99	99
	- 5 yrs	-	-	-	-	90	90	90	90	90	90	90
	- 6 yrs	-	-	-	-	-	80	80	80	80	80	80
		-	-	-	99	189	269	269	269	269	269	269
Weights	45 lbs - 4 yrs	-	-	-	4455	4455	4455	4455	4455	4455	4455	4455
	100 lbs - 5 yrs	-	-	-	-	9000	9000	9000	9000	9000	9000	9000
	120 lbs - 6 yrs	-	-	-	-	-	9600	9600	9600	9600	9600	9600
		-	-	-	4455	13455	23055	23055	23055	23055	23055	23055
Feed	3 lbs - 4 yrs	-	-	-	297	297	297	297	297	297	297	297
per	4 lbs - 5 yrs	-	-	-	-	360	360	360	360	360	360	360
Day	5 lbs - 6 yrs	-	-	-	-	-	400	400	400	400	400	400
		-	-	-	297	657	1057	1057	1057	1057	1057	1057

PROJECTED ESTIMATES OF TURTLES, NUMBERS, WEIGHTS AND FEED
 AGGREGATE OF 100 FARMS

Number of years	1	2	3	4	5	6	7	8	9	10	15
Age	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000
- 1 yr	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000
- 2 yrs	-	12200	12200	12200	12200	12200	12200	12200	12200	12200	12200
- 3 yrs	-	-	11100	11100	11100	11100	11100	11100	11100	11100	11100
- 4 yrs	-	-	-	9900	9900	9900	9900	9900	9900	9900	9900
- 5 yrs	-	-	-	-	9000	9000	9000	9000	9000	9000	9000
- 6 yrs	-	-	-	-	-	8000	8000	8000	8000	8000	8000
	15000	27200	38300	48200	57200	65200	65200	65200	65200	65200	65200
WEIGHTS											
1 lb @ - 1 yr	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
6 lbs @ - 2 yrs	-	73200	73200	73200	73200	73200	73200	73200	73200	73200	73200
20 lbs @ - 3 yrs	-	-	220000	220000	220000	220000	220000	220000	220000	220000	220000
45 lbs @ - 4 yrs	-	-	-	445500	445500	445500	445500	445500	445500	445500	445500
100 lbs @ - 5 yrs	-	-	-	-	900000	900000	900000	900000	900000	900000	900000
120 lbs @ - 6 yrs	-	-	-	-	-	960000	960000	960000	960000	960000	960000
	1500	74700	294700	740200	1640200	2600200	2600200	2600200	2600200	2600200	2600200
FEED											
4 ozs - 1 yr	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800	3800
1 lb - 2 yrs	-	12200	12200	12200	12200	12200	12200	12200	12200	12200	12200
2 lbs - 3 yrs	-	-	22000	22000	22000	22000	22000	22000	22000	22000	22000
3 lbs - 4 yrs	-	-	-	29700	29700	29700	29700	29700	29700	29700	29700
4 lbs - 5 yrs	-	-	-	-	36000	36000	36000	36000	36000	36000	36000
5 lbs - 6 yrs	-	-	-	-	-	40000	40000	40000	40000	40000	40000
	3800	16000	38000	67700	103700	143700	143700	143700	143700	143700	143700

PROJECTED ESTIMATES OF INCOME FROM SALE OF TURTLES

AGGREGATE OF 100 FARMS

	1	2	3	4	5	6	7	8	9	10	15
Number of Years											
External Sales											
Gross Sales excluding curios	\$ -	-	-	-	900000	900000	900000	900000	900000	900000	900000
Cumulative	\$ -	-	-	-	900000	1.60 m	2.70 m	3.60 m	4.50 m	5.40 m	9.90 m
Projected estimates of 'farmer' subsidy and 'internal' sale of 15 lb. weight turtles											
Annual payments to 100 farmers	\$160000	160000	325000	330000	330000	330000	330000	330000	330000	330000	330000
Cumulative	\$160000	320000	645000	975000	1305000	1635000	1965000	2295000	2625000	2955000	4605000
Projected estimates of gross values of turtles											
\$1.00 per inch of carapace	\$ 90000	90000	90000	90000	90000	90000	90000	90000	90000	90000	90000
\$2.00 per lb \$ 12 ea - 2 yrs	-	146400	145400	146400	146400	146400	146400	146400	146400	146400	146400
\$2.00 per lb \$ 40 ea - 3 yrs	-	-	444000	444000	444000	444000	444000	444000	444000	444000	444000
\$1.60 per lb \$ 72 ea - 4 yrs	-	-	-	712800	712800	712800	712800	712800	712800	712800	712800
\$1.20 per lb \$120 ea - 5 yrs	-	-	-	-	900000	900000	900000	900000	900000	900000	900000
\$1.33 per lb \$160 ea - 6 yrs	-	-	-	-	-	-	-	-	-	-	-
	\$ 90000	236400	680400	1393200	2293200	2293200	2293200	2293200	2293200	2293200	2293200

CALCULATIONS OF SELLING PRICES OF TURTLESGreen turtles - based on prices received from World markets

Weight 100 lbs.	Approx. weight* lbs.	Price F.O.B.	F.O.B. Price per lb
Steak meat	12	1.20 per lb	14.40
Industrial red meat	24	50 per lb	12.00
Breast plates and back plates	20	50 per lb	10.00
Gellatinous meat	6	1.05 per lb	6.30
Flippers	12	40 per lb	4.80
Liver, heart and kidney	4	25 per lb	1.00
Skins	5	2.00 per lb	10.00
Refined Oil	4	8.20 per lb	32.80
Shell as artifacts	5	5.10 per lb	25.50
Non-edible material	8	6 per lb	.48
	<u>100 lbs</u>		<u>\$117.28</u>

Live turtles - based on United States import statistics.

1971 \$2.10 Aust. per lb of live turtle

1972 \$2.60 per lb of live turtle

Based on the above quoted U.S. prices a 120 lb. live turtle C.I.F. U.S.A. is valued at

1971 \$252 per 120 lb turtle

1972 \$312 per 120 lb turtle.

Hawksbill turtles

The price of Hawksbill turtle shell is variable due to shell patterns, thickness and outlets. In Japan, for example, a large shell can sell at \$51 Australian per lb. giving a value of \$250-\$350 per turtle. However, a value of in excess of \$100 is considered realistic.

Assumption

From examination of the marketing data available and selling turtle products on a consistent annual basis a value of \$100 Aust. F.O.B. is, in my opinion, a realistic price for a 100 lb. turtle.

* The weight calculations have been calculated from data received from numerous sources. It would appear that additional quality meats can be extracted from the industrial red meat but for the purpose of the exercise I have erred towards conservatism.

NOTES ON MAJOR FACTORS AFFECTING SALES VALUES

1. Consistency of supply and quality should assist in the establishment of a stable market and price.
2. The major World supplier - Mariculture Limited - is likely to expand its operations. Accordingly, there could be temporary price declines, from time to time, as additional product is absorbed into the market.
3. As the demand for high protein meat is growing rapidly the farming activities should be concentrated on green sea turtles rather than hawksbill. The hawksbill shell markets, although apparently lucrative, do not have the apparent growth in demand as does the meat and oil market.

ESTIMATE OF LEVEL OF INVESTMENT IN THE PROJECTSchedule of Capital Works

Water reticulation on farms \$2,000 per farm x 100 farms	\$	200,000
Sea crawl - causeway		600,000
Cold storage units		150,000
Housing		100,000
Other out buildings		50,000
Trawlers		200,000
		<u>1,300,000</u>
Establishment costs - to date	Say	* 500,000
Additional 4 months @ \$55,000		* <u>220,000</u>
		2,020,000

Pre income operating costs

farmer allowances and costs	Year 1	see above	*
	Year 2	see above	*
	Year 3		350,000
	Year 4		575,000
	Year 5		<u>655,000</u>
			<u>\$ 3,600,000</u>

Return on total funds invested including training allowances
and research and development.

Year	Capital	Cumulative Profits before tax and before interest
1	\$ 500000	
2	2020000	<u>Calculation</u>
3	2370000	Sales \$ 9.900000
4	2945000	Stocks 2.293200
5	3600000	12.193200
6	3600000	Total
7	3600000	Expenses 8.770000
8	3600000	\$ <u>3.423200</u>
9	3600000	
10	3600000	Non-compound average annual return
To		= 6.5%
15	\$ <u>3600000</u>	(approx.)
		<u>\$3423200</u>

SCHEDULE OF ACTION

To proceed with the recommendations detailed herein and, after discussion with the Islanders, a General Manager (elect) should be appointed. His duties would be:

1. To arrange for an examination of the constraints.
2. To arrange for the continuing administration of the turtle project and the formation of the various Co-operatives.
3. To form Torres Strait Turtles Pty. Ltd. and to develop the project into the business as outlined in the report.

At the same time, the proposed Board of Directors should be formed into a committee to advise and assist the General Manager elect until the Torres Strait Turtles Pty. Ltd. company is incorporated. At that time they would be appointed as directors. Once the company has been structured the Directors and General Manager would continue to be responsible for the implementation of the project.

As a separate exercise, action should be taken to liquidate the two companies referred to in the report.

In respect of Applied Ecology Pty. Limited, direction as suggested in the report can be implemented simply by advising the Board of Directors of the company the requirements of the shareholder (The Australian Government).

Year	Capital	Operating Profit	Before Tax and	Before Interest
1	20000			
2	20000			
3	20000			
4	20000			
5	20000			
6	20000			
7	20000			
8	20000			
9	20000			
10	20000			
11	20000			
12	20000			
	<u>240000</u>			
		<u>32</u>		

CONSTRAINTS

The following items are key factors which have to be examined in relation to the turtle project.

1. Export of turtle products.
The laws applicable to endangered species should be considered and where appropriate provision made to permit farming of turtles and the export of turtle product.

2. Control of sale of turtles as curios.
A procedure to ensure adequate control of sale of turtles as curios has to be adopted and it would appear that the procedure involves both Queensland State Government and the Australian Government.

3. Sea crawls.
The proposed sea crawl has to be designed and firm costs estimated. The preliminary estimates to date are based on assumptions concerning location, estimated tidal movements and other matters which have yet to be determined. The preliminary cost estimates are subject to the results of a detailed study.

4. Anthropological.
The final location of the proposed sea crawl has to be agreed by the Islanders as there are anthropological reasons to be considered.

Turtle farm board senator dismissed

Dramatic move by minister



Senator Georges

CANBERRA, Tuesday. — The Minister for Aboriginal Affairs, Senator Cavanagh, has decided to dismiss a Labor backbencher, Senator George Georges, from the board of the company controlling the turtle farm venture in the Torres Strait.

Senator Georges, of Queensland, was appointed four months ago to the board on the venture.

Last night, Senator Georges announced that the board of directors of Applied Ecology Pty Ltd, the turtle-farming company, had dismissed its chief scientist, Dr Robert Bustard.

Senator Georges is the chairman of directors of Applied Ecology, and Dr Bustard is one of the company's five other directors.

The board of directors has power to hire or dismiss employees of Applied Ecology.

The Minister for Aboriginal Affairs is the sole shareholder in the company, and as such has

power to decide membership of the board.

In a dramatic turn-about in the Senate today, Senator Cavanagh said that Senator Georges and three other board members would be "dismissed" from the company.

Senator Cavanagh said that Dr Bustard had been dismissed as scientist in charge without proof of any wrongdoing.

"It was not with my approval," he said in reply to a question from the Opposition Leader in the Senate, Senator Withers.

"It was contrary to my direction of the previous day."

Senator Cavanagh said Dr Bustard would remain a member of a reconstituted board.

"Applied Ecology will continue as a scientific

and research organization," he said.

"Therefore, the present directors are unsuitable for that function."

Senator Georges was shocked and angry by

the announcement of his dismissal, but he refused to comment tonight.

Senator Cavanagh's decision to dismiss Senator Georges follows strong criticism of him by the Department of Aboriginal Affairs.

At his press conference tonight, Mr Whitlam supported Senator Cavanagh's decision.

In the Senate today, Senator Georges indicated that Applied Ecology would ask the Registrar of Companies to examine Dr Bustard's administration of the project in the Torres Strait.

Dr Bustard and the two departmental members abstained from voting at the board meeting last Thursday which decided on Dr Bustard's dismissal.

Senator Georges has refused to say why Dr Bustard was dismissed as chief scientist.

The present members of the board of Applied Ecology are Senator Georges, two senior officers of the Department of Aboriginal Affairs, Mr N. H. Jansz and Mr B. K. Thomas, a Canberra accountant, Mr J Neill, Mr R. Thorburn and Dr Bustard.

Pioneer beats radiation

LOS ANGELES, Tuesday. — America's Pioneer 10 spacecraft survived Jupiter's deadly radiation belt and swept close past the giant planet yesterday.

The 570lb spacecraft still faced dangers of burning up as it began its journey out through the lightning-torn Jupiter clouds.

Dragged in by a powerful force of Jupiter's radiation, it mapped a strange magnetic field around the planet, unlike anything known on Earth.

It gave the first confirmation that helium — which with hydrogen is the main component of the sun's gaseous atmos-

phere — existed around Jupiter.

Pioneer 10 turned its camera into the giant "red spot" of Jupiter's southern hemisphere.

It showed cloud details and shadows in the 15,000-mile wide spot, believed to be a roaring column of gas piercing up through freezing ammonia clouds.

• Report, P. 5.

5/12/73

LIBRARY OF GEORGE H. BALAZS

Down south is heard the voice of the turtle



Dr BUSTARD

ROBERT Bustard, the Scotsman in the middle of the case of the Torres Strait turtle farm, admits to having fallen in love with turtles.

He says he's "completely captivated" by them since he first watched them one night on Heron Island in the Barrier Reef in December 1964.

To Dr Bustard, turtles are akin to pet cats . . . "not responsive animals like dogs, but rather independently-minded creatures." They have endearing charm.

He hates crabs, "those cold, characterless automatons which are, alas for young turtles, extremely efficient hunters."

In fact, if it weren't for that sight of his first turtle, he would have left Australia forever nine years ago — returning home to Perthshire in Scotland after completing a post-graduate course at the Australian National University on the ecology of tiny gecko lizards "which had interested me since earliest childhood in China."

He had planned to study the giant tortoises in the Galapagos Islands off Ecuador and the land iguana, but "I watched fascinated as a turtle slowly emerged from the sea, this huge reptile . . . this relic from the age of dinosaurs," Dr Bustard wrote of his first turtle sighting.

His study soon led Dr Bustard to believe that his knowledge of the turtle and its habits could be put to practical use. He knew it was called the "island bullock" in the straits, particularly where dugongs were not plentiful, and provided the main meat at meals — steaks. So why not farm them?

The Commonwealth gave him money to set up pilot schemes on Torres Strait Islands. The aim was to build up turtle stocks of the area to full holding capacity and to cull a specified number each year.

"Not only will this ensure the survival of large turtle populations in the area but, most importantly, it will offer very considerable employment to the people of the Torres Strait on their own islands," says Dr Bustard in his book *Kay's Turtles*.

Dr Bustard believes Queensland holds the key to turtle conservation: "The 2000 kilometre-long Great Barrier

Reef is a turtles' paradise as are the islands of the Torres Strait."

Dr Bustard's scheme was founded on his observation of turtles' tremendous mortality rate in the first few weeks of life and the large numbers of baby turtles one mother can produce — up to 900 in a three-month egg-laying season, compared to one calf a year by a cow which doesn't weigh much more than a turtle.

Survival

"By keeping them in confinement for one year and then liberating them on the reefs their survival chances may be increased one hundred-fold over babies leaving the natural nest," Dr Bustard wrote.

He tells in his book how seagulls swoop on newly hatched turtles, how ghost crabs descend on the hatchlings and grab them by the neck with their powerful

claws, how eagles rip the newly born turtles from the water, and red-eyed crabs wait among the rocks for them to pass.

Their eggs are sought after by goannas, pigs, foxes and dogs who smell them out beneath the sand. And those hatchlings that reach the water face becoming "a meal for sharks or other predaceous reef fish within minutes of emerging from the nest."

Dr Bustard reasoned that, because turtles are remarkably productive, the seas would be teeming with turtles except for "this terrible juvenile predation." Experiments showed him that when baby turtles are fed with fish they increase in size very substantially — an increase of seven times their birth weight in the first six weeks.

Armed with this information Dr Bustard convinced the Federal Government his scheme could at once help the cause of conservation, create employment for people mostly out of work and create a viable industry. It wasn't difficult to convince Canberra, more than 3200 kilometres to the south, that this was worthwhile.

In 1969 Dr Bustard set up working residences on Darnley Island, near the Barrier Reef, 192 kilometres north-west of Cape York and 80 kilometres south of Papua New Guinea. Over the next three years he spread the project to 13 islands in the 25,900 square kilometre area.

Viable

But it has been an expensive beginning for distant returns.

But, despite reports reaching Brisbane from Thursday Island that the immense distances were making the project very difficult to administer, Dr Bustard continued to see it as a viable project.

He told in his book how one teenage island girl was raising several hundred "very rapidly growing" baby green turtles as part of the project. And in August, on a trip to Brisbane, Dr Bustard said there were now 30,000 turtles of all kinds being farmed on the islands. By the end of the decade it would be a \$12 million-a-year industry. "By 1980 we will be farming 150,000 green turtles alone and the current London price for a green turtle is \$80," he said.

LIBRARY OF
GEORGE W. BALAZS

He claimed that 1000 islanders were benefiting directly from the scheme but gave no details of how they were being paid or of any income being derived from the sale of turtles.

This week he should have left his beloved turtles to fly to Canberra following the row over Gordon Bryant's leaving Aboriginal Affairs and the famous confidential letter from Barry Dexter which suggested "discretion in what we say (to a Parliamentary committee) in particular in relation to those aspects where we may not yet have determined our own approach, such as marketing."

Marketing certainly seems to be the problem.

There's no doubt the turtle population can be increased dramatically using Dr Bustard's research. But how will they be farmed and marketed back off the reef? How many turtles can world markets stand? What return on capital can be expected . . . and when?

These are some of the questions Dr Bustard would have been asked if he'd arrived in Canberra today. At the last minute he decided not to make the trip just yet.

Meanwhile some of his problems may be gauged by the fact that it would have taken him a week to get from turtles down to Canberra.

LIBRARY OF
GEORGE H. DALAZSAN East London roofing
and building contractor's
name: Fidler and Leake.

Could it mean that a foreign banker is using its foreign backers' prestige to borrow Australian savings to finance foreign operations in Australia? Surely not.

New recruit

The Federal Government is losing one of its staunchest supporters in sharebroking. But it is gaining an employee.

Barry Capp, a non-member partner in the Melbourne firm of Simon Lidgett Collingwood and Co has resigned to join the AIDC. While a broker Barry was a key apologist for the Labor Party's policies in an industry which has been noted for its mounting antipathy towards Labor.

He was one of the first brokers to cheer for a Labor victory — even before the 1972 election. At the firm of Simon Lidgett and Co (before the merger with Collingwood) Barry was instrumental in the firm's publication of an investment circular which predicted good things for a sharemarket under Labor. The theme was picked up widely in the broking industry in the early months of Labor Government, as analysts saw the effects on profits of the Labor spending boom.

That was before inflation, credit squeezes and a few million words of business bashing.

Bear, Rex

In my "What will Rex do next?" competition, a Melbourne reader has suggested an even more vigorous attack on the stock market than on the mining companies.

The running dogs, blowflies, louts, roughnecks and bullies of the market will be so intimidated by Rex's prose that they'll ignore even the sage advice of Uncle Frank. Stock prices will plummet.

Then the AIDC will buy everything. Well, not exactly everything. Neither it nor Rex will want Bounty Oil.

The big league

We're all in the big league now — even Gollin Holdings Ltd. Last week it sent a letter to the financial press asking whether in future Gollin just might be considered to have joined the international set like all the other big boys.

It complained that a newspaper had recently described it as a "South Melbourne based raw materials importer and exporter."



Keith Gale

However, Gollin managing director Keith Gale was at pains to point out to the press in his letter last week that his company does lots more than this. Not only this, but Gollin is now Sydney based, having moved its head office north a couple of years ago.

In view of these facts, Keith thinks that his company should rather be described as an "Australian international trader and manufacturer."

Closed circuit

If commercial turtle breeding in the Torres Strait is a flop (for both turtles and their human masters) it hasn't deterred other investors with an eye to the exotic.

Australian and Japanese interests are planning a farm for crocodiles in Papua New Guinea. Australia's G. T. Crosbie Pty Ltd is to have 35 per cent interest in the venture, and Hayashikane Sangyo Co of Japan 65 per cent.

Their croc farm is to be set up on the Vanapa River near Port Moresby. Production aim is 50,000 crocs a year within 10 years — and at an average length of 11 metres this means output would be about 75 kilometres of croc annually.

The crocs would be killed and skinned at the farm, and the skins sent to markets in France and Japan. With productivity gains in mind, the meat, it seems, would probably be used as feed for . . . yes . . . for crocodiles.

Tobias Hatch

APPLIED ECOLOGY *pty. Ltd.*

P.O. Box 26, Woden, A.C.T. 2606 Australia

Telephone: 81 0722 Telex No.: 62488 Answer Back Code: AA62488 Telegrams/Cables "Ecology" Canberra.



Conservation through Research and Resource Management



7th April 1977

Please address all correspondence
to the Secretary

In reply please quote:

RDC:DM
102/30/OPS

Dr. G.H. Balazs,
Hawaii Institute of Marine Biology,
University of Hawaii at Manoa,
P.O. Box 1346,
Coconut Island,
Kaneohe, HAWAII 96744

Dear Dr. Balazs,

1. Dr. K. Radway Allen (Chief of Division of Fisheries & Oceanography, CSIRO) has sent us a copy of your letter of 21st March 1977 addressed to Dr. Allen on the subject of Mr. Teokotai Paiti's visit to our turtle farms in the Torres Strait.
2. In September 1976 the Australian Development Assistance Agency advised us that Mr. Paiti had been nominated by the United Nations Food and Agricultural Organisation to undertake two months training in turtle conservation management - it was then expected that Mr. Paiti would arrive in Australia in October 1976 and leave Australia in December 1976. We explained that while we were not really in a position to give Mr. Paiti "training in turtle conservation management" (and, regrettably, could not arrange a formal training programme) we were more than happy to show Mr. Paiti our turtle farms and turtle farming research work being conducted in the Torres Strait and to give Mr. Paiti every assistance in nesting and tagging programme observations.
3. We did not hear anything further until Mr. Paiti actually arrived at our office on Thursday Island on 28th January 1977. Since that time Mr. Paiti has visited all our turtle farms spread over 8 islands in the Torres Strait and our turtle farming research station on Yorke Island in the Torres Strait on a working attachment. We have shown Mr. Paiti all we are doing on turtle farming techniques and turtle research in the Torres Strait Area.

.../2

7th April 1977

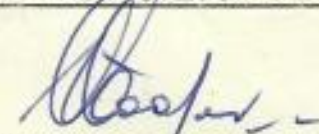
Unfortunately, Mr. Paiti missed the 1976/77 turtle nesting and tagging programme; however, Mr. Paiti has visited the nesting islands and been associated with post-nesting/tagging activities.

4. Mr. Paiti is a very young man (a little over 18 years of age) and it is understood came to the Torres Strait almost straight from high school. However, our Torres Strait staff report that Mr. Paiti has been very popular in the Torres Strait Area and has shown great keenness and interest in our turtle farming operations.

5. Mr. Paiti is currently on Murray Island and it is understood he will be returning to Thursday Island on Friday 8th April 1977. We do not know Mr. Paiti's movements after that date - however, as he will now have spent over two months in the Torres Strait Area, it is probable that he will be leaving the Torres Strait Area on or soon after 8th April 1977.

6. Please do not hesitate to make contact with us if you feel we can assist with any further information.

Yours sincerely,
APPLIED ECOLOGY PTY. LTD.



(R.D. Cooper)
SECRETARY

29 March 1977

Dr G. H. Balazs,
Hawaii Institute of Marine Biology,
University of Hawaii at Manoa,
P.O. Box 1346,
Coconut Island,
Kaneohe, HAWAII 96744

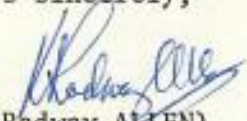
Dear Dr Balazs,

Thank you for your letter of 21st March in which you raise the question of the present whereabouts and activities of Mr Teokotai Paitai. I have spoken to Mr David Cooper, the Secretary of Applied Ecology Pty Ltd, the organization which is responsible for turtle work in Torres Strait. He assures me that Mr Paitai is in Torres Strait and seems to be very actively engaged in looking at the turtle work there. I am however sending a copy of your letter to Mr Cooper and I believe he will be replying to you direct with more details.

You will be interested to know that we have recently carried out a quite successful tagging operation on Bramble Cay. In two long visits 338 nesting females were tagged and we believe this is quite a high proportion of the total using this island this year. It appears also to be a substantial increase on the number nesting on Bramble Cay in 1975/76.

Thank you also for the copy of IUCN/SSC Marine Turtle Newsletter and for submitting my name for the permanent mailing list. I have not been getting this publication and I shall be very glad to have it.

Yours sincerely,


(K. Radway ALLEN)
Chief of Division

*answered
7/16/76*

DIVISION OF FISHERIES AND OCEANOGRAPHY

KRA:OMB

P.O. BOX 21, CRONULLA, N.S.W. 2230. TELEPHONE 523 6222. TELEGRAMS CORESEARCH CRONULLA. TELEX 24875

YOUR REF.

IN REPLY PLEASE QUOTE:

6 July 1976

Dr G.H. Balazs,
University of Hawaii at Manoa,
Hawaii Institute of Marine Biology,
P.O. Box 1346,
Coconut Island,
KANEEOHE, HAWAII 96744 USA

Dear Dr Balazs,

Thank you for your letter of May 21st, enquiring about the present status of the turtle farming project in Torres Strait. I am sorry that my reply has been delayed but I have been overseas for the last month.

Following the Carr-Main report on the original turtle farming project which was under the control of Dr Bustard, the operation was placed in the hands of a government-owned company, Applied Ecology Pty Ltd, of which I am one of the Directors. The function of this company is to carry out research and investigations on the possibility of developing improved use of the natural resources by the native peoples of Australia and Torres Strait, in ways which are consistent with their existing manner of life. The turtle project is one of several which we have under study at the present time. We have only been able to proceed slowly with this since a great deal of re-organization was necessary and we had to establish good means of working with the Torres Strait Islanders. We are however making useful progress, I believe, in two directions and have had a biologist, Dr J. Kowarsky, working on the project for about a year. He is unfortunately now leaving us and we are currently seeking a replacement.

Our two approaches are to develop farming techniques which are applicable to the particular social conditions existing in the islands, and to gain data on the state of the stocks of green turtles, so that we may be able to assess to what extent we can safely draw on these in establishing the farm stock.

Conditions in the islands require that at present we operate through a large number of very small farming units (100 yearlings or less), each operated by individual farmers. This of course involves major problems of adequate supervision and of communal requirements such as water supplies. We believe however that we have recently substantially overcome these, and we are hopeful for our future development in this respect. At present we have only reared turtles to three years but our intention is of course to be able ultimately to maintain our own breeding stock.

As regards the wild population, we have been able to accumulate further information on the location of some of the principal breeding areas and commenced surveys of the numbers coming ashore. We are rather concerned that last season the numbers nesting on Bramble Cay, to the north-east of Torres Strait, were considerably less than in recent years, although we have not been able to identify any probable causes of this. The same thing did not happen in other breeding islands round northern Australia, and we shall be watching with great interest what happens during the coming seasons.

Unfortunately we have at this stage no significant published reports on our work, but I trust that this will give you some indication of our progress.

Yours sincerely,



(K. Radway ALLEN)
Chief of Division

4 January 1977

Mr. George H. Balazs,
University of Hawaii at Manoa,
Hawaii Institute of Marine Biology,
P.O. Box 1346,
Coconut Island,
KANEHOE HAWAII 96744 USA

Dear Mr. Balazs,

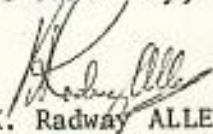
Thank you for your letter of 27th December announcing that you would like to visit our turtle farming operations in Torres Strait in connection with the study you are doing for the South Pacific Commission. We would be very pleased indeed to have a visit from you and I am sure that it would be to our mutual advantage. I have discussed the matter with Mr R.D. Cooper who is the Secretary and Executive Officer of Applied Ecology Pty Ltd, and he will be pleased to make all the necessary arrangements for you. I suggest that, as soon as your plans are rather more advanced, you write directly to him about them. It would be necessary for you to make your way to Thursday Island, which is quite well served by commercial airlines - I enclose a copy of the current timetable. The Company would be glad to look after your transportation and accommodation thereafter. The turtle farms are on a number of small islands scattered across Torres Strait and you should probably allow about four days to get an adequate idea of what is going on. From Thursday Island you will be able to fly by chartered plane, which we will provide, to Yorke Island, where we have our research establishment and our biologist, John Parmenter, is located. Travel to the other islands will be by the Company's boat.

If you have any time in Sydney on your way there or back, I should be very pleased to meet you and have a talk. This laboratory is only about 30 minutes by car from the airport, which is between us and the city. I would be glad to book accommodation for you, either in Cronulla or in the city, if this would be helpful.

It might also be worthwhile for you to meet Professor J.M. Thomson of the Zoology Department, University of Queensland, St. Lucia, Brisbane, Qld., who is the other biologist on the Board of Directors of Applied Ecology Pty. Ltd., and who is also very interested in the turtle project.

The turtle nesting season is only just beginning in Torres Strait but the preliminary reports we have had indicate that the number coming ashore this year are greatly in excess of last year and apparently back to normal. It seems that for some reason 1975/76 was an abnormally bad year in the north-west Australian region for turtle nesting. This looks an intriguing biological problem which at present we have no clues as to the answer.

Yours sincerely,


(K. Radway ALLEN)
Chief of Division

Encl.

Unfortunately we have at this stage no significant published reports on our work, but I trust that this will give you some indication of our progress.

Yours sincerely,



(K. Radway ALLEN)
Chief of Division

Company formed to market turtle farm produce

THE expenditure of \$100,000 from the Commonwealth Capital Fund for Aboriginal Enterprises to buy shares in a turtle produce marketing company was announced by the Minister for Aboriginal Affairs, Mr Gordon Bryant recently.

The company will handle produce from turtle and crocodile farms being developed in Northern Australia by aborigines and Torres Strait Islanders.

Mr Bryant said that a feasibility study of farming turtles and crocodiles commercially had been initiated as a research project in mid-1970 with the collaboration of the Australian National University under the direction of Dr H. R. Bustard (see *Australian Fisheries*, November 1972).

The farming of turtles and crocodiles had been successfully undertaken in other countries and it was thought that if it proved to be feasible in Australia it could provide a useful avenue of economic advancement for aborigines and Torres Strait Islanders who have a traditional association with these reptiles and with the sea.

It was also recognised that the farming of these reptiles would assist in conserving their population, believed to be dwindling as a result of indiscriminate hunting. Ten per cent of production will be returned to the sea.

The company, Aboriginal and Island Marketing Pty Ltd, will engage in the farming, mounting and marketing of between 4,000 and 5,000 green sea and hawksbill turtles which are now reaching a marketable stage.

Initially, the shareholding of the company will be held in the corporate name of the Capital Fund but arrangements will be made for ownership to be vested in aboriginal and Torres Strait Island incorporated bodies as soon as practicable.

Pilot farms have been established in selected areas and aborigines and islanders trained to conduct their farms on a commercial

basis.

The period of training involves the collection of baby turtles and crocodiles or the hatching of eggs and breeding of the reptiles to maturity in suitable pens, during which time the farmer has to provide food for them and see to the general wellbeing of his stock.

A taxidermist will visit the farms to conduct regular training 'schools' in the mounting of the turtles.

The project will provide employment for 65 aborigines and islanders and is expected to support between 300 and 400 persons this year.

Since the project was started, 60 turtle farms have been established in north Queensland and three in Western Australia. Two crocodile farms have also been established in north Queensland.

Move to high-speed planing hulls

HIGH-SPEED planing hulls are growing in popularity among South Australian rock lobster fishermen.

Port Lincoln boatbuilders P & H Kruger have built a number of high-speed rock lobster boats with marine plywood planing hulls and driven by powerful inboard diesel motors.

These boats have one big advantage — they get fishermen to the fishing grounds and back home again in about a third the time it takes the conventional rock lobster boat.

One of five recently-built planing boats is *Amethyst* owned by Tom Shannon who fitted a Cummins V8-185-M. He regularly gets 16 knots out of the 167 hp motor at 3,300 rpm.

Amethyst is a 35-footer with the engine amidships driving through a V-drive to an 18 in. x 13½ in. propeller.

With the prospect of a new fishery for sashimi tuna developing at Port Lincoln local tuna fishermen are considering building fast planing-hulled plywood and fibre glass boats.

Safcol opens new freezing plant at Port Lincoln

A NEW cold storage and freezing plant opened by the South Australian Fishermen's Co-operative Ltd at Port Lincoln has a holding capacity for 500 tons of fish.

Built in front of the co-operative's existing cannery it will enable a much larger quantity of tuna to be held for canning. If sufficient supplies of tuna are available the cannery will extend its operations by about three months a year.

Up until this year canning of tuna lasted for about five months from January to June. With other lines such as Australian 'salmon' and pet food it is now hoped to keep the cannery operating all year round.

Opening the new plant the South Australian Minister for Agriculture, Mr T. Casey, said it would give stability to the tuna industry and provide more employment at Port Lincoln.

Safcol's general manager, Mr R. Fowler, expressed concern at the opening ceremony at a possible loss of wages to process workers at the plant as a result of 1,500 tons of tuna being road freighted from Port Lincoln to Adelaide where it was frozen and exported to the United States.

The tuna was caught by a group of seven Port Lincoln fishermen and exported to Los Angeles by Ocean Foods Pty Ltd of Adelaide in the Swedish ship *Pacific Ocean*.

Fisheries officer for Wynyard

FULL time cover of the north west coast of Tasmania is now provided by the Sea Fisheries Inspection Service with the appointment of a permanent officer at Wynyard.

Mr Geoff Ley, began duties on the coast recently, operating from Agricultural Department offices at Wynyard.

He will carry out shore and sea patrol work and is available to advise commercial and other fishermen on all matters relating to sea fisheries, licences and regulations.

CSIRO

DIVISION OF FISHERIES AND OCEANOGRAPHY

P.O. BOX 21, CRONULLA, N.S.W. 2230. TELEPHONE 523 6222. TELEGRAMS CORESEARCH CRONULLA. TELEX 24875

KRA:OMB

YOUR REF.

IN REPLY PLEASE QUOTE:

4 January 1977

Mr. George H. Balazs,
University of Hawaii at Manoa,
Hawaii Institute of Marine Biology,
P.O. Box 1346,
Coconut Island,
KANEOHE HAWAII 96744 USA

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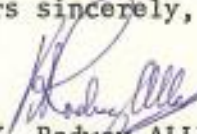
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It might also be worthwhile for you to meet Professor J.M. Thomson of the Zoology Department, University of Queensland, St. Lucia, Brisbane, Qld., who is the other biologist on the Board of Directors of Applied Ecology Pty. Ltd., and who is also very interested in the turtle project.

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Yours sincerely,


(K. Radway ALLEN)
Chief of Division

Encl.

QUEENSLAND SOUTH WESTERN AND CENTRAL

Flight No.	800	806	808	810	812	814	816	818	820	822	824	826	828
Frequency	Daily	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue
From	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane
To	Rockhampton	Blackwater	Cloncurry	Emerald	Alpha	Barkly	Longreach	Longreach	Longreach	Longreach	Longreach	Longreach	Longreach
Time	8:30	11:15	8:30	11:15	8:30	11:15	8:30	11:15	8:30	11:15	8:30	11:15	8:30

Flight No.	746	748
Frequency	Tue	Tue
From	Brisbane	Brisbane
To	St George	St George
Time	8:30	8:30

Flight No.	731	733	735	737	739	741	743	745	747	749	751	753
Frequency	Daily	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue	Tue
From	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane
To	Longreach	Barkly	Alpha	Cloncurry	Emerald	Blackwater	Rockhampton	Brisbane	Brisbane	Brisbane	Brisbane	Brisbane
Time	6:30	6:55	7:30	7:45	8:30	11:30	11:30	11:30	11:30	11:30	11:30	11:30

Flight No.	741	743
Frequency	Tue	Tue
From	Brisbane	Brisbane
To	St George	St George
Time	12:15	12:15

One Class fare only unless otherwise stated. * For QUEENSLAND. ** For CENTRAL. The above services are operated by Qantas Airways on behalf of Ansett Airways of Australia.

The above services are operated by Qantas Airways on behalf of Ansett Airways of Australia.

GAYDAH TO THANGOOL

Flight No.	883	885	887	889
Frequency	Daily	Tue	Tue	Mon
From	Brisbane	Brisbane	Brisbane	Brisbane
To	Gaydah	Monto	Thangool	Rockhampton
Time	6:00	11:30	12:35	3:45

Flight No.	889	891	893	895	897	899
Frequency	Daily	Tue	Tue	Tue	Tue	Tue
From	Rockhampton	Thangool	Monto	Gaydah	Brisbane	Brisbane
Time	10:00	10:40	11:15	12:00	10:15	10:15

The above services are operated by Qantas Airways and are one class only.

QANTAS AIRLINES OF AUSTRALIA

FOR FARES, FREIGHT AND EXCESS BAGGAGE RATES
NORTH QUEENSLAND HAMILTON — MT GAMBIE

CAIRNS — WEIPA — THURSDAY IS.

Flight No.	599	599	599	599	599	599	599	599	599	599	599	
Aircraft	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP
Frequency	MONDAY		TUESDAY		WEDNESDAY		THURSDAY		FRIDAY			
BRISBANE	Dep. 9.30	9.30	Dep. 9.30	9.30	Dep. 9.30	1.31	Dep. 9.30	1.31	Dep. 9.30	1.31	Dep. 9.30	1.31
TOWNSVILLE	Dep. 11.35	11.35	Dep. 11.35	11.35	Dep. 11.35	3.35	Dep. 11.35	3.35	Dep. 11.35	3.35	Dep. 11.35	3.35
CAIRNS	Dep. 12.15	12.15	Dep. 12.15	12.15	Dep. 12.15	4.15	Dep. 12.15	4.15	Dep. 12.15	4.15	Dep. 12.15	4.15
COOKTOWN	Dep. 1.00	1.00	Dep. 1.00	1.00	Dep. 1.00	4.45	Dep. 1.00	4.45	Dep. 1.00	4.45	Dep. 1.00	4.45
COEN	Dep. 8.30	8.30	Dep. 8.30	8.30	Dep. 8.30	8.30	Dep. 8.30	8.30	Dep. 8.30	8.30	Dep. 8.30	8.30
IRON RANGE	Dep. 8.45	8.45	Dep. 8.45	8.45	Dep. 8.45	8.45	Dep. 8.45	8.45	Dep. 8.45	8.45	Dep. 8.45	8.45
WEIPA	Dep. 9.45	9.45	Dep. 9.45	9.45	Dep. 9.45	9.45	Dep. 9.45	9.45	Dep. 9.45	9.45	Dep. 9.45	9.45
THURSDAY ISLAND (Horn Is.)	Dep. 3.50	3.50	Dep. 3.50	3.50	Dep. 3.50	3.50	Dep. 3.50	3.50	Dep. 3.50	3.50	Dep. 3.50	3.50

Flight No.	591	591	591	591	591	591	591	591	591	591	591
Aircraft	F/SHP	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP	FREIND SHIP	F/SHP
Frequency	MONDAY		TUESDAY		WEDNESDAY		THURSDAY		FRIDAY		
THURSDAY ISLAND (Horn Is.)	Dep. 4.20	4.20	Dep. 4.20	4.20	Dep. 4.20	4.20	Dep. 4.20	4.20	Dep. 4.20	4.20	Dep. 4.20
WEIPA	Dep. 9.15	9.15	Dep. 9.15	9.15	Dep. 10.10	10.10	Dep. 9.15	9.15	Dep. 9.15	9.15	Dep. 9.15
IRON RANGE	Dep. 10.35	10.35	Dep. 10.35	10.35	Dep. 10.35	10.35	Dep. 10.35	10.35	Dep. 10.35	10.35	Dep. 10.35
COEN	Dep. 10.50	10.50	Dep. 10.50	10.50	Dep. 10.50	10.50	Dep. 10.50	10.50	Dep. 10.50	10.50	Dep. 10.50
COOKTOWN	Dep. 11.25	11.25	Dep. 11.25	11.25	Dep. 11.25	11.25	Dep. 11.25	11.25	Dep. 11.25	11.25	Dep. 11.25
CAIRNS	Dep. 12.45	12.45	Dep. 12.45	12.45	Dep. 12.45	12.45	Dep. 12.45	12.45	Dep. 12.45	12.45	Dep. 12.45
TOWNSVILLE	Dep. 1.45	1.45	Dep. 1.45	1.45	Dep. 1.45	1.45	Dep. 1.45	1.45	Dep. 1.45	1.45	Dep. 1.45
BRISBANE	Dep. 3.20	3.20	Dep. 3.20	3.20	Dep. 3.20	3.20	Dep. 3.20	3.20	Dep. 3.20	3.20	Dep. 3.20

* - Aircraft lands HORN ISLAND. Transport to and from THURSDAY ISLAND is by Coach and Launch, fee 12.00.
 ☉ - One Class level only available these ports.

(Faint text containing flight numbers and dates)

Flight No.	541	542	541	542	541	542	541
Aircraft	ASA FREIND SHIP	ASA FREIND SHIP	ASA FREIND SHIP	ASA FREIND SHIP	ASA FREIND SHIP	ASA FREIND SHIP	ASA FREIND SHIP
Frequency	Wed. Thu.	Mon. Tue.	Tue. Wed.	Thu. Fri.	Sat. Sun.	Tue. Wed.	Thu. Fri.
MELBOURNE	Dep. 7.00	7.00	Dep. 7.00	7.00	Dep. 7.00	7.00	Dep. 7.00
HAMILTON	Dep. 7.55	7.55	Dep. 7.55	7.55	Dep. 7.55	7.55	Dep. 7.55
MOUNT GAMBIE (Mt Gambier)	Dep. 8.10	8.10	Dep. 8.10	8.10	Dep. 8.10	8.10	Dep. 8.10
ADLAIDE	Dep. 8.55	8.55	Dep. 8.55	8.55	Dep. 8.55	8.55	Dep. 8.55

Flight No.	701	540	703	542	544	705
Aircraft	FREIND SHIP	ASA FREIND SHIP	FREIND SHIP	ASA FREIND SHIP	ASA FREIND SHIP	ASA FREIND SHIP
Frequency	Wed. Thu. Fri. Sat.	Tue. Wed. Thu.	Mon. Tue. Wed.	Tue. Wed. Thu.	Tue. Wed. Thu.	Tue. Wed. Thu.
ADELAIDE	Dep. 7.10	7.10	Dep. 7.10	7.10	Dep. 7.10	7.10
MOUNT GAMBIE (Mt Gambier)	Dep. 7.00	7.00	Dep. 7.00	7.00	Dep. 7.00	7.00
HAMILTON	Dep. 8.00	8.00	Dep. 8.00	8.00	Dep. 8.00	8.00
MELBOURNE	Dep. 9.05	9.05	Dep. 9.05	9.05	Dep. 9.05	9.05

☉ - One Class level only available these ports.
 * - Car Service between MT GAMBIE and MELBOURNE fee 12.00

For explanation of Meal Legends see page 35. Schedule and Rates apply as shown at time of publication but are subject to alteration without notice.

April 25, 1977

Mr. R. D. Cooper
Secretary
Applied Ecology Pty. Ltd.
P. O. Box 26
Woden, A.C.T. 2606
Australia

Dear Mr. Cooper:

I would like to take this opportunity to thank you for your prompt letter of 7 April (102/30/OPS) in response to my enquiry about Mr. Teokotai Maitai of the Cook Islands. The information provided has been most useful in preparing my report for the South Pacific Commission.

I continue to have considerable interest in your resource assessment and farming research activities, and would appreciate receiving copies of publications or reports that may become available.

On a separate but related matter, I wonder if you can verify some observations that were recently passed on to me concerning Raine Island. Apparently in early December 1975 a Dr. Veron visited the island and observed what he estimated to be 13,000 nesting turtles on the beaches. Although I did not speak directly to Dr. Veron, the impression was given that this was a daytime occurrence. The species of turtle was not stated, but from such a description this certainly sounds like a mass nesting of olive ridleys. Any information that you can provide on the subject would be greatly appreciated.

Sincerely,

George H. Balazs
Jr. Marine Biologist

CHB:md

APPLIED ECOLOGY pty. ltd.

P.O. Box 26, Woden, A.C.T. 2606 Australia

Telephone: 81 0722 Telex No.: 62488 Answer Back Code: AA62488 Telegrams/Cables "Ecology" Canberra.



Conservation through Research
and Resource Management



2nd June 1977

Please address all correspondence
to the Secretary

In reply please quote:

102/15/OPS
JTVO:ML

Dr. G. Balazs,
University of Hawaii at Manoa,
Hawaii Institute of Marine Biology,
P.O. Box 1346,
Coconut Island,
Kaneohe,
HAWAII 96744

Dear Dr. Balazs,

1. Further to my letter of 11th May, I should like to advise that our biologist, Dr. J. Parmenter has confirmed that only green turtles (Chelonia mydas) were nesting on Raine Island last December and that nesting took place at night.

2. I have been unable to contact Mr. Colin Limpus, though he may be able to advise you further with regard to Olive Ridley turtles nesting, as he has been studying turtles along the Queensland coast for a number of years. Mr. Limpus' address is C/- Northern Regional Centre, Queensland National Parks & Wildlife Service, Pallarenda, Townsville, North Queensland, 4810, Australia.

3. I trust that this information will prove of use to you and your turtle studies.

Yours faithfully,
APPLIED ECOLOGY PTY. LTD.,

(J.T.V. Onions)
SCIENTIFIC INVESTIGATING OFFICER

APPLIED ECOLOGY pty. ltd.

P.O. Box 26, Woden, A.C.T. 2606 AUSTRALIA

Telephone: 81 0722 Telex No.: 62488 Answer Back Code: AA62488 Telegrams/Cables "Ecology" Canberra.



Conservation through Research
and Resource Management



11th May 1977.

Please address all correspondence
to the Secretary

In reply please quote:

JTVO:SQ

102/15/OPS

Dr. G. Balazs,
University of Hawaii at Manoa,
Hawaii Institute of Marine Biology,
P.O. Box 1346
Coconut Island
Kaneohe,
HAWAII 96744.

Dear Dr. Balazs,

1. Thankyou for your letter of 25th April to Mr. Cooper which has been passed to me for reply concerning turtle nesting on Raine Island.
2. As far as I am aware, the bulk of the turtles nesting on Raine Island were green turtles (Chelonia mydas) which nested at night. During the season some 1200 per night were coming ashore to nest.
3. If you can bear with me on this matter I shall make some enquiries from our turtle biologist in the Torres Strait area, Dr. J. Parmenter, and Mr. Colin Limpus of the Queensland National Parks and Wild Life Service, both of whom visited Raine Island last December, and shall advise you further in due course.
4. I regret that I cannot be more specific at this time.

Yours sincerely,
APPLIED ECOLOGY PTY. LTD.

Victoria Onions

(J.T.V. Onions)
SCIENTIFIC INVESTIGATING
OFFICER

Test farms for turtles started in Australia

RESEARCH WORK being carried out by the Australian National University, under a grant from the Federal Government, may lead to the establishment of turtle farming in the Torres Strait region of the far north-east coast.

The grant, of \$A27,730, has been made to Dr. Robert Bustard, Research Fellow in Environmental Biology in the Research School of Biological Sciences, for an ecological investigation of the green sea turtle. The research could lead to the establishment of farms run by Torres Strait islanders and aborigines to exploit the turtle commercially.

As part of the research, six pilot level turtle farms are being set up on Darnley and Murray Islands, Queensland.

Dr. Bustard (32) has been carrying out research into turtles for the past seven years. His research so far has centred on Heron Island, north of Brisbane where an experimental hatchery has been established. He is particularly interested in the practical application of his research to help the aborigines and Torres Strait islanders.

The green turtle population appears to have remained fairly static because of their high infant mortality rate. In a breeding year a female lays a clutch of about 110 eggs every 14 days—or 600 to 800 eggs during the breeding season. This large number is offset by a high predation rate. It is thought that of those turtles which survive the hatchling stage and run down



A research assistant checks data on a laying green turtle on the Great Barrier Reef.

the beach to the sea only three or four per 1000 live to adulthood.

The high mortality rate is caused by the extreme vulnerability of young turtles. As hatchlings they weigh only about three-quarters of an ounce and so are prey to even small fish and seagulls.

One of Dr. Bustard's plans is to keep hatchling turtles protected from predators in pens for a year. He believes that doing this will increase the survival rate of the turtles by between 50 and 100 times. The increase in turtle numbers could be exploited commercially, he says.

There is a good world market for turtle products. Most in demand is turtle oil which is used as a cosmetic base. At present, there is

also a strong demand for the very soft and durable turtle leather. Its popularity has been brought about by the scarcity of crocodile leather. There is a continuing demand for the calipee of the turtle, the cartilage under the shell that is dried in the sun and used as the basis of turtle soup. Japan has a high demand for high-protein meat-meal and turtle could contribute significantly there.

"The commercial demand for turtles is very strong," said Dr. Bustard. "It is so strong that British and American investors have spent \$A1,000,000 in setting up the world's first commercial turtle farm in the British West Indies, which has almost been denuded of its natural turtle population."

SOUTH PACIFIC COMMISSION

TENTH REGIONAL TECHNICAL MEETING ON FISHERIES
(Noumea, New Caledonia, 13 - 17 March 1978)

REPORT ON TURTLE CULTURE TRIALS IN TORRES STRAIT
FEBRUARY - JULY 1976

by

John Kowarsky
Department of Biology
Capricornia Institute of Advanced Education
M.S. 76, Rockhampton, Q. 4700, Australia

SUMMARY

A small turtle culture research station was set up on an island in Torres Strait, Northern Australia. Hatchling green turtles (*Chelonia mydas*) were kept for approximately five months under a variety of conditions during which time their survival and weight changes were documented. Culture conditions deliberately varied included stocking density, degree of physical crowding, and daily water turnover rates. Attempts were made to maintain food in excess at all times except overnight. There was evidence that poor water quality, rather than the degree of physical crowding, was the major adverse influence on the culture of these turtles over a wide range of stocking densities.

249/78

SOUTH PACIFIC COMMISSIONTENTH REGIONAL TECHNICAL MEETING ON FISHERIES
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John Kowarsky
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M.S. 76, Rockhampton, Q. 4700, Australia

INTRODUCTION:

Since the early part of this decade investigations have been carried out into the feasibility of setting up a turtle culture industry in the Torres Strait region by the Australian Government through its agency Applied Ecology Pty. Ltd. The aim of such development would be to provide much needed employment opportunities for people of the area. Alongside investigations into techniques of turtle culture have been studies of the wild turtle populations in order to properly assess the environmental impact of any future culture proposals.

In 1975 and 1976 I was employed by Applied Ecology Pty. Ltd. to study the feasibility of turtle culture in Torres Strait. To gain a realistic impression of the types of problems which could be encountered in the region the site for the experimental culture project was deliberately chosen to be Yorke Island ($9^{\circ}45'$ S, $143^{\circ}24'$ E), a small and remote coral cay. Several factors placed constraints upon the type of methods we used. Firstly, as the ultimate aim of the project was to provide employment opportunities the methods were designed to be as labour-intensive as possible without conflicting unduly with the life style to which local people employed on the project were accustomed. Secondly, due to the remoteness of the site, the level of technology used was limited. Delays and considerable expenses in supplying and servicing various pieces of equipment such as pumps and freezers were normal.

The culture trials were conducted between February and July 1976.

The work was aimed at obtaining baseline information regarding the relation of the growth and survival of young green turtles to environmental factors such as water turnover rates and stocking densities, and the food requirements of these turtles. Further details of these trials can be obtained from Kowarsky (1977).

METHODS:

Hatchling green turtles were obtained either from collection and artificial incubation of eggs or by collection of newly emerged hatchlings from a natural nesting site. Locally caught fish were skinned, filleted and diced into small cubes and stored in a freezer. This was the food fed to turtles throughout the trial period except for two days when the fish supply failed and canned dog food was used.

Experiment 1:

Turtles were mass reared from 5 to 164 days of age in a 3.1m diameter plastic lined pool. Water changes were effected by transferring turtles by scoop net from one such pool to another freshly filled pool. The number of water changes daily increased from approximately 2 at the start of the experiment to 6 by the end. After each water change except the final one for the day turtles were fed to excess. The amount of food ingested at each feed was estimated. During this experiment some of the turtles were kept in floating mesh enclosures within the pool to investigate the effects of crowding without, ideally, concomitant changes in water quality. At the start of the trial period the stocking density was approximately 32 cc/grm turtle; by the end of the period it was 47 cc/grm turtle. The available volume of water to turtles outside enclosures ranged from 119 to 76 cc/grm turtle; the comparable figures for turtles inside enclosures were 17 to 6 cc/grm turtle. The available surface area of pool for turtles outside enclosures ranged from 2 to 1.5 cm²/grm turtle, while inside enclosures the available surface area ranged from 0.7 to 0.4cm²/grm turtle.

Experiment 2:

This experiment consisted of keeping turtles in 40 litre plastic tanks at three different initial stocking densities with two different water change schedules (3 water changes daily vs 4 water changes daily). At the start of the 113 day trial stocking densities ranged from 455 to 18 cc/grm turtle; at the end of the period they ranged from 241 to 9 cc/grm turtle. Available surface area ranged from $40\text{cm}^2/\text{gram}$ turtle to $0.4\text{cm}^2/\text{gram}$ turtle. All turtles were fed to excess four times per day.

RESULTS:

Survival of turtles in Experiment 1 was approximately 70%. Turtles confined to enclosures survived equally well to those outside enclosures. Some mortality was associated with lesions which covered the eyes and skin. Many of the turtles which died without severe lesions were found to have foreign pieces of material such as Styrofoam, flakes of paint and strands of nylon rope apparently stuck in the gut or cloaca. At 5 months of age turtles kept outside enclosures were of average weight approximately 350 grms; the turtles in one of the enclosures achieved similar average weight, but those in other enclosures were of 312 gm average weight at 5 months of age. Estimates of conversion efficiency ranged from factors of 1.7 to 7.1 with a trend of increasing values with time. The factor calculated for the whole period during which monitoring of food ingested took place was 4.8.

In general terms the pattern of survival of turtles in Experiment 2 was similar to that of Experiment 1 turtles. It was apparent however, that at the two higher stocking densities the survival of turtles given four water changes daily was superior to those given three water changes daily. Maximum deterioration of water quality after the final meal of the day took place within 2 hours of that meal; this finding supported the idea that turtles exhibited a gastro-colic reflex.

Because turtles which died were on average lighter than the average live weight of turtles at the time, it was difficult to draw any conclusions about real growth under different treatments in this experiment.

CONCLUSIONS:

There was evidence that poor water quality, rather than the degree of physical crowding, was the major adverse influence on turtles. To improve the conditions of culture, strategies should be developed to maintain water quality at levels not exerting harmful effects (for example, in Experiment 2 at the lowest stocking density it would be reasonable to conclude that water quality deterioration was not a significant factor, as no difference in survival between those turtles given three water changes daily and those given four water changes daily was found, nor were the latter turtles on average heavier than those given three water changes daily). Within a given range of stocking densities a given volume of water could be better used by keeping turtles in crowded conditions and changing the water often than by keeping the turtles in relatively uncrowded conditions and changing the water infrequently.

Kowarsky, J. 1977. Culture trials of young green turtles, Chelonia mydas, in Torres Strait, Northern Australia. Aquaculture **11** : 197-215

Turtles and man is the subject of today's talk. Man's effect on turtles has been completely one-sided - to butcher them. The slaughter - for it is nothing less - has not been carried out by ignorant native people - they only kill what they need to eat and one turtle can feed a village - but by European commercial interests. While many seagoing natives catch turtles in the water using harpoons, taking a high proportion of males as a result, European man prefers to sit on beaches and turn female turtles as they come up to lay their eggs. Since turtles nest after spending several years feeding at sea, but can lay over one thousand eggs in a breeding season, this is an extremely foolish way to exploit them. Yet, despite legislation in various parts of the world, supposedly giving some protection, at least at the start of the breeding season, it still goes on.

Australia, with large populations of the green - I might say soup turtle - has forbidden any exploitation, and afforded full protection to all its turtles following my advice. This was not intended - by me at any rate - to prevent any utilisation, but to provide a break with the old methods and allow time to work out rational exploitation schemes. By rational exploitation I mean to exploit the population in such a way and at such a level of utilisation that one can go on indefinitely without the valuable resource being decimated or even exterminated. This is often referred to as sustained yield cropping. No sensible conservationist objects to it.

Apart from cropping wild turtle populations - which because of their ecological characteristics would permit only a low annual take of large turtles - there is another way to produce turtle products. This is by turtle farming. Game ranching, pioneered in South Africa, has a very bright future and can be applied to many animals including turtles. Properly carried out it could be extremely lucrative to the farmer, and if done on a large enough scale, would certainly reduce the pressure on wild populations. Commercial users of turtle products would much prefer a uniform farm product ordered in advance against known supply dates to having to get what they can from different regions of the world. At present there is one large turtle farm - Mariculture Ltd - farming the green turtle at Grand Cayman in the West Indies. Turtle farming is, however, an ideal cottage industry for tropical coastal peoples. Turtles occur naturally in the very areas where poverty and protein deprivation are most severe. I have already run a full field trial in the Torres Strait Islands between Australia and New Guinea. I can see and turtle farming as an inexpensive way in which any developed country, wishing to aid a poorer nation, can bring about a quick beneficial result affecting the lives of many coastal-dwelling people. It may not be as impressive as a manufacturing plant

but it will work, it will earn money, and offer employment at a cottage-industry level to many village people.

I repeat that it must be carried out in a proper way. By this I mean that the very best scientific advice must be obtained to advise on the setting up and subsequent running of the farm. No one would go into cattle raising without a sound background and expect to make money. Yet the information needed to plan a cattle ranch is well known. Turtle farming, a new industry only at the pioneering stage, has even more need of that sound background and management expertise. Yet, unfortunately many attempts have been made and are being made using only well intentioned young volunteers without expert back-up or under the aegis of over-worked fisheries officers who not unnaturally tend to consider turtle raising as a fringe activity. What is needed today is a ^{large-scale} scientifically-run farm in which money making is not allowed to prevent the adoption of the best scientific principles and turtle conservation.

I have talked at some length about turtle farming as I believe it offers the best positive approach to saving the world's sea turtles.

North West Cape Nov. 28th 79

Dear Linda, + George.

So sorry you've been concerned about our non arrival in Hawaii. I felt sure when you didn't write that you must have been away and not received our letter so I neglected to keep you up-to-date on all our adventures. Well this is what happened! Firstly our flight was a day late in taking off, then instead of going to Hikam after Richmond, NSW, it detoured to Christchurch (some detour!). That put us another day behind, but would still have been O.K, except they decided some airforce fellows there had priority over us so we were bumped - right at the last minute mind you. But if we had cause to be upset then, you should have seen us the next day when we were bumped again. Our last attempt, a day later again, we really thought we had it made, and were in fact half way to Pago Pago, but then they had trouble with the oxygen and had to return to Christchurch. After that it was grounded! So it seems we just weren't meant to get over to Hawaii and to see you.

Many, many thanks for the photo of little Christian - He is beautiful! We will be looking forward to seeing him in the flesh in July or August next year when we plan on taking our big trip back to see all Jim's folk in the States. He is going to retire in October and then we will build south of Perth 120 miles.

I'm having an Avon sale today to clear off my shelves a bit and am writing this between selling. We are all pretty fit, though Prodi and Shauna are both recovering from the chickenpox. It's the usual hot sunny weather and we have been beaching a lot to take advantage of it. We found one lovely camping spot (we needed to use our 4-wheel drive to get to it) and the turtles were all around. Jim + I crept up on one which was dozing in the sun right on the waterline + took some measurements in case you would be interested.

Carapace width ..	35"
Carapace length ..	36 $\frac{1}{2}$ "
Tail length ..	13"
Circumference ..	14 $\frac{5}{8}$ "

4 orbits.

There were another 8 or 9 turtles in the water of about the same size.

Jim says to tell you that the basking, even on this fairly remote beach, is taking place right at the water line and tends to indicate that people have moved them back into the water and basking is only seen on rare occasions. As you may remember from our photos, when we were here before in 1965-68 basking turtles could be found easily all along the beaches - this was before the base was built and the people came to the area. There are still a lot of turtles here though and right now they are starting to come up on the beaches for basking. Jim saw fresh tracks this morning. About a month ago they were observed in deep water, mating. If a paper is published on the Washington Conference Jim would appreciate a copy. We have noticed your name in print lately, one with the World Wildlife Quarterly Report and the picture published in National Wildlife.

We were disappointed not to be able to see you all this time - better luck next time!

Regards.

Elaine + Jim.

SPC-NMFS/Turtles/WP.10

5 December 1979

ORIGINAL : ENGLISH

SOUTH PACIFIC COMMISSION

LIBRARY OF
GEORGE H. BALAZS

JOINT SPC-NMFS WORKSHOP ON MARINE TURTLES
IN THE TROPICAL PACIFIC ISLANDS
(Nouméa, New Caledonia, 11 - 14 December 1979)

THE TURTLE FARMING PROJECT IN TORRES STRAIT -
NORTH QUEENSLAND

by

J.M. Thomson
University of Queensland, Brisbane

1645/79

SOUTH PACIFIC COMMISSION / NATIONAL MARINE FISHERIES SERVICE

WORKSHOP ON MARINE TURTLES

11 - 14 DECEMBER 1979

THE TURTLE FARMING PROJECT IN TORRES STRAIT -
NORTH QUEENSLAND

J.M. THOMSON

UNIVERSITY OF QUEENSLAND, BRISBANE

The Turtle Farming Project in Torres Strait, Queensland

by
J.M. Thomson

University of Queensland, and Director of Applied Ecology Pty Ltd

Introduction

In 1973 the Australian government set up Applied Ecology Pty Ltd, a wholly government owned company, to undertake research and development in industries compatible with the way of life of Aborigines and Torres Strait Islanders. Amongst the projects referred to the company was the turtle farming experiment which had been pioneered by Robert Bustard of the Applied Ecology Unit of the Australian National University.

In order to spread the possible benefits of turtle farming widely in the Torres Strait area rearing ponds were set up on various islands to create a cottage-industry type of enterprise. The original concept envisaged that after rearing for a year or two in these small farm ponds the larger turtles would be transferred to one or two centres with larger ponds where they could be held until they attained a size suitable for marketing. Conservation fervour was at its peak at this period. In order to assuage the fears of those who believed that any exploitation of the wild stocks would lead to their depletion the company further planned to erect a "sea-crawl" to hold selected adult turtles in an attempt to achieve breeding in captivity. This would have produced a self-sustaining industry which would be independent of wild stocks whether in the form of eggs, hatchlings or adults.

Because of the conservationist fears the company was also obliged to gather data for an environmental impact statement which was planned to include not only the effect of taking eggs from turtle rookeries, but also the effects of harvesting plants or animals for use as food in the farms.

The Farms

Over a two year period the company experimented with various types of enclosure, including portions of enclosed foreshore, floating cages and tanks or pools of various kinds, including locally constructed tanks made of cement. The standard farm ponds decided upon were fibre glass tanks of 300 cm diameter and 60 cm depth. Standard plastic baby baths were found to be ideal for newly hatched turtles and they could be kept in these for several weeks providing they were not over-crowded. Larger turtles (i.e. 2 years or older) were accommodated in a commercial-type surface swimming pool 1200 x 450 cm in size and 90 cm deep. It consisted of a fabric liner supported on a frame. Experience showed that the lining fabric had to be pulled taut, otherwise the turtles tended to nip creases or folds which led to a series of small leaks.

The details of the farm areas varied from island to island. On some each farmer had a separate tank area; on others several farmers combined to operate under a single large roof area. Roofing is necessary because shallow ponds exposed to the rays of the sun rapidly reach temperatures that are inimical to the turtles.

Originally farms were started on ten islands but after a short time these were reduced to eight where the Islanders exhibited the greatest interest and reliability. One of the handicaps under which Dr. Bustard's early work had suffered was the tendency of some of his farmers to neglect the farms in his absence. To counteract this tendency Applied Ecology established a monthly newsletter "Turtle Talk" which not only described research developments and advised on husbandry techniques but also reported on the survival rates and rates of growth on each farm, thus fostering pride in achievement and some mild degree of competition.

Petrol-powered pumps whose inlets were of 3.5 cm. cross-section were provided as a cheap and reliable means of replacing the water in the tanks. Tests indicated that a change of water four times a day provided the best conditions. However tidal conditions resulted in three changes a day being the norm for most farms. A second indispensable husbandry practice is to keep the tanks as clean as possible. Excreta and food remains can be removed by either siphon or by pump. Young turtles did not thrive where such organic wastes were not regularly removed. It became established practice not to feed after the last change of water of the day so that the young turtles might spend the overnight period in clean water.

Food

It is generally believed that hatchling green turtles are carnivorous, but that adult green turtles are entirely herbivorous. The latter has been confirmed by examination of the contents of a large number of turtle stomachs, but the belief about the food preferences of hatchling turtles is based on a relatively few underwater observations which suggest that the hatchlings are predators of planktonic organisms.

The standard diet offered to the hatchlings in the farms was originally the flesh of fish. At Murray Island the Murray Island sardine has been a reliable source of food. Elsewhere Spanish mackerel, mullet, rock fish and bluefish have been chopped to portions of a size suitable for the young turtles to handle. There were early indications however that a purely flesh diet did not result in optimum condition or maximum growth. The farmers have experimented with the addition of green feed, utilising either sea-grasses or various terrestrial plants growing on their islands. Members of the School of Veterinary Science of the James Cook University have been studying various formulations hoping to prescribe an optimum diet. It can be said however that an omnivorous diet produces better results than an entirely carnivorous one.

Weather conditions or fish movements may preclude a sufficient catch of fish from time to time. This necessitates either local freezer space to hold a reserve for such periods or holding stocks of pelletised food. Estimates of the food requirements of larger (over 2 years) turtles have suggested that maintenance of supplies of fish would be difficult for some islands and for these pelletised food seems the only reliable food source. To be acceptable to turtles the pellets must float, which rules out many commercial pellets. A formulation suitable for turtles required special orders which meant increased cost. When added to the high cost of freight to the Islands area the pellets became a costly food item.

Growth

There have been great discrepancies in the rate of growth of young turtles from the various farms. It is difficult to be certain whether

this is entirely the result of the amount or the nature of the food supplied. Neither temperature nor water quality can be precisely maintained in the farm ponds. There have also been problems with parasites and microbial disease organisms.

The rate of growth has been very variable both between farms and from year to year. The weight achieved at the end of the first year after hatching varied between 600 and 1200 gm. Two year-old turtles varied between 1700 and 3100 gm and three-year olds between 3000 and 8000 gm.

The growth rate of older turtles seems to be very slow judging by the small amount of data which Colin Limpus was able to give the Symposium at James Cook University. The increases for turtles larger than 40 cm curved carapace length were of the order of 0 to 3.25 cm per year.

Procurement of eggs

Although some eggs were procured from Raine Island in the early stages of the development of the Torres Strait farming system the more recent collections have been made from Bramble Cay. This is a small isolated coral cay in the north-east part of the Strait (9°9'S, 143°52'E). The site selected for nest construction is the outcome of several influences including sea conditions, the spot at which the turtle comes ashore, the moisture content of the sand (primarily derived from the rain) and the condition of the beach. The nature of the site selected will determine the depth to which the nest is dug. On average the nesting holes on Bramble Cay have been 72 cm deep, with the tope egg being about 50 cm below the surface of the sand.

It is believed that Applied Ecology's activities in collecting turtle eggs have had no effect on the wild stocks because all the eggs are taken from nests which are almost certainly doomed to fail. During the dry winter season the prevailing south-east winds generate seas whose action promotes the deposit of an extensive sand spit at the north-west end of the cay. During the wet summer the winds move to the north-west and the seas then gradually erode the sand spit. About 66% of the non-vegetated sand is lost from Bramble Cay each summer. Very few turtles venture into the vegetated part of the island for egg-laying, it is almost all done in the open sand. Although most nests are constructed in the higher sand at the base of the dunes about 40% of the nests constructed on Bramble Cay are in the sand spit. In the 1977/78 season 44% of the nests were washed out as the sand spit eroded; in 1978/79 about 42% of the nests were lost. In a normal season this would be equivalent to about 100,000 eggs, all of which are wasted and contribute nothing to the next generation. The few thousand eggs taken for the turtle farming project are only a small fraction of the potential loss.

The isolated nature of Bramble Cay makes it desirable to return the eggs to the farming islands for incubation. But incubation tests were also carried out on the cay to compare with the results from the farms. The early tests showed a much higher hatching rate at Bramble Cay than on the farms (92% on Bramble Cay; about 68% on the farms). Dr. Parmenter reasoned that this was most probably the result of the movement to which the eggs were submitted while in transit. He conducted some tests to determine the period of

sensitivity. The eggs showed no decrease in hatchability if they were handled only during the first six hours after being laid. But after six hours the sensitivity to handling increases markedly and handling of eggs two or three days after laying results in 100% mortality. The sensitivity then declines though hatching success was still only 72% with eggs handled 20 days after being laid. The results indicate that if the eggs cannot be moved within six hours of laying they should not be moved until at least twenty days later.

Presumably because of the somewhat different physical conditions in the styrofoam containers in which they were incubated the hatchery eggs hatched after 56 days compared with 54 in the natural nests.

Frequency of Nesting

Thanks to the tagging programmes of several workers it is now known that female green turtles emerge several times during the breeding season to construct nests and to lay eggs. At Bramble Cay the period between emergences varied between 9 and 17 days with an average of 11.9. An individual female came ashore between three and eight times during the season. The number of eggs produced varies between 300 and 800 per season.

It has always been assumed that female turtles must lay eggs several times during the life-span. The obvious failure of females to return to lay in consecutive years has been interpreted as an indication that there is a span of several years between nestings. However the span of years is growing longer along the Great Barrier Reef/Torres Strait region and none of the substantial number of females tagged after nesting has returned to nest again either on the original island or elsewhere. At the recent turtle symposium at James Cook University two of our most active research workers Colin Limpus of the Queensland National Parks and Wildlife Service and John Parmenter of Applied Ecology advanced the hypothesis that turtles may only lay eggs once in their life-time.

This may prove to be so but seems unlikely to me because of the great range in size of nesting females. On the other hand very little is known of the age or size or weight at which turtles mature and the small amount of data both from work in Queensland and from work in the Atlantic on the green turtles shows an amazingly divergent rate of growth of individuals. Possibly their age or size at maturity is equally as divergent. Estimates about the age at first maturity has ranged between eight and thirty years.

Turtle Health

In any form of animal husbandry there are always problems of health. Turtles are a novelty as far as being live-stock so that their particular health problems are largely unknown. In particular it has been difficult to be certain whether some manifestations of abnormalities have been the result of inadequate diet or of the effects of disease organisms. However Mr. Glazebrook of the School of Veterinary Science of James Cook University has been able to make tentative identifications of certain pathogens.

The Murray island sardine, although a useful food item, unfortunately transmits a nematode parasite (*Anisakis* sp.) which actively penetrates the stomach wall and may build up to high numbers in the pleuro-peritoneal cavity. A parasitic hepatitis is symptomatic in the infested turtles.

Heart flukes (*Learedius* sp. and others) are known from wild green turtles and may be transmissible to farm turtles.

Many of the farmed turtles suffer from skin lesions, especially on the edges of the flippers and on the upper neck. The lesions are believed to be due to a virus, similar to but not identical with the Herpes virus. Significantly fewer lesions appear in turtles fed with a vegetable fraction in their diet. It appears therefore that a lack of plant food results in a weakening of the defence mechanisms of the young turtles.

Stomatitis (inflammation of the mouth membrane) is fairly frequent amongst the small turtles. It becomes ulcerative and pneumonia may follow. It is probable that broad spectrum antibiotics would control this but a treatment regime has yet to be worked out. The stomatitis may be due to a deficiency in vitamin C or Vitamin A.

The Range of the Green Turtle

Several thousand green turtles have been tagged on the nesting islands, principally on Heron Island at the southern end of the Great Barrier Reef, on Raine Island which is well to the north of Cooktown and on Bramble Cay almost at the northern end of the Great Barrier Reef. The returns have been wide spread. Those tagged at Bramble Cay have been returned from hunters in the Gulf of Papua and from Aru Island in Indonesia and to the east from the Gilbert Islands. From Raine Island tagged turtles have moved into the Straits and to the New Guinea shore at both eastern and western ends of the Gulf of Papua; others have gone to Aru Island and to near Wessell Is. in the Northern Territory of Australia. Turtles tagged at Heron Island have been recovered near Port Moresby in New Guinea, in the Torres Straits and at several places between Heron Island and the Strait, and still others have moved south the Fraser Island and southern Queensland coasts, while at least five have been recaptured in New Caledonia.

The pattern of returns indicates a wide-ranging stock. Whether there are independently breeding stocks elsewhere in the range is unknown at present. The often mooted theory that turtles return to the island on which they themselves were hatched when they in turn mature has yet to be proved by tagging or any other means. Certainly the results indicate that turtles which are breeding on Australian islands are ranging elsewhere and are a food resource for people in at least the adjacent parts of Indonesia, in New Caledonia, in New Guinea and in the Gilbert Islands. Quite possibly turtle rookeries in the south-west Pacific are similarly contributing to the stocks on which Torres Strait Islanders of Aborigines depend.

The wild stocks then are an international resource, and international accord on management policies may be necessary in the future to maintain the numbers under increasing pressure as the human population using the resource continues to increase in number.

Applied Ecology's Decision

Applied Ecology's charter was to carry out research on the possibility of turtle farming as an economic proposition. After five years of research backed up by other evidence from such workers as Limpus and Bustard, the company has recommended to the Australian government that the turtle farming should not be proceeded with. The reason is simply that given the very slow rate of growth, the cost of food and the running costs of the farms, we believe that the system is uneconomic given the present prices for turtle products. The turtles simply have to be kept and fed for too long before they reach an acceptable size for slaughter.

Head-starting and Free-ranging

The turtle resource provides and estimated 35% of the animal protein consumed by Torres Strait Islanders and the people of the Gulf of Papua region. About 10,000 turtles a year are taken in this small part of the turtles' range. What might be the total taken over the whole of the green turtles' range is unknown. Fears of the possible effects of increasing hunting pressure on the turtle stocks has led Applied Ecology to apply for funds to carry out experiments on head starting and free-ranging. That is to say, hatching turtle eggs as has been done for the farming and then experimenting to find the optimum size at which to release the turtles into the sea where they would hopefully range normally. The major question to which an answer is still required is whether turtles which have been confined to farm ponds instead of entering the sea soon after hatching will behave normally when put into the sea at a later age. But the natural loss when hatchling turtles leave their nests is very great. It has been estimated that less than 10% even reach the water. It is hoped that head-starting the turtles would counteract this great loss. The release of the turtles would be similar to the activities of a fish hatchery. We believe that the possibility should be tested now rather than waiting for what we believe is inevitable the ultimate decline of the stocks.

Population size

In order to discharge Australia's obligations to study the marine resources within its economic zone Applied Ecology believes that the size of the existing stock of turtles must be estimated. We have recommended therefore that a large-scale tagging programme should be instituted in order to make a reasonable estimate of the population from the proportion of tags returned.

Conclusion

Because of the slow growth rate and the consequent cost of rearing captive turtles to acceptable slaughtering size, we have concluded that farming would not be economic. However as turtle meat is an important source of protein in the region, and because there are fears that the resource may decline under increasing hunting pressure we have recommended experimentation on a head-starting programme and in order to assess the success of such a programme we have also recommended that work should proceed to estimate the present population size of this international resource.

Acknowledgements

I wish to emphasise that this paper does not embody the results of work which I have carried out myself. I have simply reported the results of work sponsored by Applied Ecology together with relevant observations by others. In particular the reports rely on the work of Dr. John Parmenter and Dr. John Kowarsky. Inevitably some of the results of work performed by Mr. Colin Limpus have been included. I have also quoted from reports prepared by Mr. Vic Onions the senior scientist of Applied Ecology.

SOUTH PACIFIC COMMISSION / NATIONAL MARINE FISHERIES SERVICE

WORKSHOP ON MARINE TURTLES

11 - 14 DECEMBER 1979

THE TURTLE FARMING PROJECT IN TORRES STRAIT -
NORTH QUEENSLAND

J.M. THOMSON

UNIVERSITY OF QUEENSLAND, BRISBANE

by H.R. Bustard

Research School of Biological Sciences, Canberra

1. National (Regional) Situation Report(a) General

All but one of the world's seven species of sea turtle (Kemp's ridley is the exception) occur in Queensland waters and, apart from the leathery turtle, all have known nesting grounds in Queensland.

Populations of the green turtle (Chelonia mydas) are large as a result of active conservation over a period of 40 years. The species is widely distributed in Queensland, with the most important rookeries occurring in south-central Queensland (Capricorn and Bunker groups of coral cays, which form the southern limits of the Great Barrier Reef) and, in the north, in the Gulf of Carpentaria (Bountiful and associated islands) and around the northern limits of the Great Barrier Reef (Raine Island, Bramble Cay).

The flatback (Chelonia depressa) nests as far south as Bundaberg in south-east Queensland, with substantial rookeries further up the coast and on coastal islands as far south as Gladstone (south-central Queensland). Most important rookeries occur for the species on islands in the Gulf of Carpentaria (Crab, Bountiful). Since the latter are uninhabited Aboriginal Reserves, the flatback must be considered safe at the present time.

The loggerhead (Caretta caretta) nests extensively on certain islands in the Capricorn-Bunker Group at the south of the Reef, and on the adjacent mainland. An important rookery is under surveillance at Mon Repos beach near Bundaberg. Little nesting appears to occur in the north of the State.

The hawksbill (Eretmochelys imbricata) long remained an anomaly in that no Australian nesting grounds had been reported although adult and part-grown hawksbills were of fairly common occurrence in Queensland waters. Breeding grounds for the species have now been located on a number of Torres Strait islands (see Research).

The Pacific Ridley (Lepidochelys olivacea) is now known to nest fairly extensively on the mainland and islands in the Northern Territory part of the Gulf of Carpentaria and reports of nestings in the Queensland area of the Gulf have been received. These will be checked as soon as possible. This species certainly nests in the Wellesley Islands at the south of the Gulf of Carpentaria.

The leathery turtle (Dermochelys coriacea) has a well-marked migration pathway down the coast of south-east Queensland. However, no Australian nesting grounds are known. Individuals are accidentally caught in shark nets and released. Tagging of such individuals is now underway, it being anticipated that about 50 will be tagged each year.

(b) Exploitation

All sea turtles in Queensland enjoy total protection (see (c)), so that there is no legal exploitation. Poaching is considered insignificant. Aborigines and Torres Strait Islanders, who are not covered by wildlife legislation, are allowed to take turtle for their own use. However, their influence is now extremely slight as they are becoming settled and do little hunting. The only exception to this is in the extreme north where turtles are still actively hunted particularly in parts of Torres Strait.

(c) Conservation

Queensland has an unbroken record of conservation stretching back almost 40 years. This culminated in the 1968 legislation, gazetted following advice from me, which extended total protection for turtles and their eggs from the green turtle to all six species and extended the area covered by the legislation to the whole of the State of Queensland (this includes all islands of the Great Barrier Reef and virtually all islands between north Queensland and Papua).

A number of important sea turtle rookeries were already National Parks (Heron Island, Fairfax Islands, Hoskyn Islands and Lady Musgrave Island in the Capricorn-Bunker Groups of islands). However, it became clear that the ultimate in sea turtle conservation would only be achieved when the 1968 legislation was combined with adequate National Parks to safeguard the future of all species nesting in the State of Queensland. Unfortunately, information on sea turtles was fragmentary or non-existent outside of the Capricorns, where my research programme has operated for the last seven years. It was essential to locate and map all key rookeries (see Research).

(d) Education

We are continuing to foster wide public interest in sea turtles. Extensive public relations are conducted at our research headquarters at Heron Island and also at Mr. Limpus's tagging station near Bundaberg. The programme of newspaper articles and releases, semi-popular magazine articles and radio and T.V. talks is being continued and extended where possible.

(e) Research

In addition to my own large-scale sea turtle population ecology study based at Heron Island and adjacent islands of the Capricorn Group, I am pleased to be able to report that Mr. Colin Limpus has now been working on the loggerhead rookery at Mon Repos beach near Bundaberg for several years. This rookery includes a small number of nesting flatbacks which are also under surveillance. Furthermore, I have now extended my research efforts to the northern end of the Great Barrier Reef. During summer 1970-71, tagging operations were started at Campbell Island (a mixed hawksbill/green turtle rookery), near Darnley Island in eastern Torres Strait. It is hoped to tag other islands in the area including one near Murray Island on the Barrier and possibly also Bramble Cay. Certainly a couple of continuing long-term tagging operations are planned for the extreme north.

The most significant developments to report since the last Morges meeting have all stemmed from generous support given me by Mr. Herbert Mills and the United States National Appeal of the World Wildlife Fund. With the U.S. Appeal's support I was enabled to carry out exhaustive sea turtle natural resources surveys throughout the whole of Queensland. Hence the picture has changed dramatically since my report to the 1969 Morges meeting. Information exists for the whole of the State and follow-up ground work is well advanced as a result of initial aerial surveys. Now that we know the key areas for the various species, applications are being made to secure additional National Parks to safeguard very important nesting beaches.

Furthermore, the support of the U.S. Appeal allowed my knowledge of the Queensland situation to develop to a stage where the Government became actively interested. At the 1969 meeting I was an active proponent of turtle farming - at a pilot research level. The Commonwealth (Federal) Government

has now provided funds for research farms which are being sited in eastern Torres Strait. These will be operated at a research level under my overall control for a period of between 3 and 5 years. At the end of this time I will submit a full report on the work to both Federal and Queensland State Governments. This will enable Government to decide whether to allow commercial turtle farming subject, of course, to proper safeguards.

At the time of writing, 5 farms all based on the green turtle, are in operation and a small number of hawksbill turtles are being reared experimentally also. Dr. Harris, an ecologist with interests in energy flow through natural populations of animals, has been recruited to the project and will work both on the penned juvenile turtles as well as on the wild turtles utilizing the turtle grass beds. Productivity studies are long overdue and using this approach we are confident that much new information of both pure and applied interest can be gathered during the next few years.

Report presented to the Working Meeting of Marine Turtle Specialists,
International Union for Conservation of Nature and Natural Resources,
Morges, Switzerland March 1969

Torres Strait turtle study

A Commonwealth Government grant of \$27,730 made to a research worker at the Australian National University may lead to longterm benefits for the economy of the Torres Strait region. The grant has been given to Dr Robert Bustard, Research Fellow in Environmental Biology in the Research School of Biological Sciences at ANU, for an ecological investigation of the green sea turtle. The research could lead to the establishment of farms run by Torres Strait Islanders and Aborigines to exploit the turtles commercially.

The Commonwealth grant, which has been made through the Council for Aboriginal Affairs, is to support the first year of a three-year study of the population ecology of green sea turtles in the Torres Strait area. As part of the research six pilot level turtle farms will be set up on Darnley and Murray Islands this summer.

Dr Bustard, 32, has been carrying out research into turtles for the past seven years. His research so far has centred on Heron Island, north of Brisbane where an experimental hatchery has been established. He is particularly interested in the practical application of his research to help the Aborigines and Torres Strait Islanders.

'I am interested in the ecology and numbers of green turtles,' Dr Bustard said this week. 'In any animal population the numbers remain fairly constant in the long-term. I am interested in how animal populations stabilise their numbers. This research has its application in that when you know how animals stabilise their numbers you can manipulate the process to multiply their numbers.'

The green turtle population appears to have remained fairly static because of their high infant mortality rate. In a breeding year a female lays a clutch of about 110 eggs every fourteen days - or six to eight hundred eggs during the breeding season. This large number is offset by a high predation rate. It is thought that of those turtles which survive the hatchling stage and run down the beach to the sea only three or four per thousand live to adulthood.

The high mortality rate is caused by the extreme vulnerability of young turtles. As hatchlings they weigh only about three quarters of an ounce and so are pray to even small fish and sea-gulls.

The first-year of a turtle's existence is the most critical. Though they are so small as hatchlings their weight during their lifetime increases about 9,000 times to 400lb or more (by comparison the weight of a human at birth increases only about eighteen times during a lifetime). If a green turtle survives the first year it is relatively immune from attack by fish.

One of Dr Bustard's plans is to keep hatchling turtles protected from predators in pens for a year. He believes that doing this will increase the survival rate of the turtles by between fifty and 100 times. The increase in turtle numbers could be exploited commercially, he says.

There is a very good world market for turtle products. Most in demand is turtle oil which is used as a cosmetics base. At present there is also a strong demand for the very soft and durable turtle leather. Its popularity has been brought about by the scarcity of crocodile leather. There is a continuing demand for the calipee of the turtle - the cartilage under the shell that is dried in the sun and used as the basis of turtle soup. Japan has a high demand for high-protein meat-meal and turtle could contribute significantly here.

'The commercial demand for turtles is very strong,' says Dr Bustard. 'It is so strong that British and American investors have spent \$1 million in setting up the world's first commercial turtle farm in the British West Indies, which has almost been denuded of its natural turtle population.'

The north of Australia, as one of the last big refuges of turtles, has outstanding prospects for developing commercial exploitation of turtles, Dr Bustard says. Australia, because of its large turtle resources, also has the best facilities for research into the ecology of turtles, he says.

Dr Bustard's research will be centred on Darnley and Murray Islands in Torres Strait. On Darnley Island, as well as a study of the ecology of the natural turtle population, three of the six pilot turtle farms will be set up. These will be to explore the possibilities of 'battery rearing' techniques with hatchling turtles. Feeding methods similar to those which have revolutionised the poultry industry in the last ten years will be used in development experiments. Green sea turtles start life as carnivores but after a year they change and become predominantly vegetarian, eating sea grass and seaweed. At the Darnley Island pilot farms

the young turtles will be kept continually as carnivores, being fed almost entirely on fish.

On Murray Island Dr Bustard's research will be concentrated on reducing the high infant mortality rate of the wild turtles. Hatchlings will be reared in pens for periods varying from three to twelve months, then tagged and liberated. Their subsequent survival will then be compared with that of hatchlings marked and liberated as they emerged from the nest. This type of information has not been ascertained about any turtle population in the world.

Instead of taking students from ANU, Dr Bustard will be assisted in his Torres Strait work by islanders, whom he will train to tag and mark the young turtles and to record information about them when they are recaptured in future years. Because the turtle is fully protected Dr Bustard will report annually on the results of his work to the Queensland Government which has given permission for study to be carried out. He will also report to the Commonwealth Government.

Dr Bustard believes that if his research shows turtle farming can be carried out without threat to the conservation of the turtle population it could mean the establishment of an industry which the islanders and Aborigines could manage for themselves.

* * * * *

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University Information
28 October 1970

REPORT ON TURTLE CULTURE TRIALS IN

TORRES STRAIT

FEBRUARY - JULY 1976

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AUSTRALIA.

INTRODUCTION:

Since the early part of this decade investigations have been carried out into the feasibility of setting up a turtle culture industry in the Torres Strait region by the Australian Government through its agency Applied Ecology Pty. Ltd. The aim of such development would be to provide much needed employment opportunities for people of the area. Alongside investigations into techniques of turtle culture have been studies of the wild turtle populations in order to properly assess the environmental impact of any future culture proposals.

In 1975 and 1976 I was employed by Applied Ecology Pty. Ltd. to study the feasibility of turtle culture in Torres Strait. To gain a realistic impression of the types of problems which could be encountered in the region the site for the experimental culture project was deliberately chosen to be Yorke Island ($9^{\circ}45' S$, $143^{\circ}24' E$), a small and remote coral cay. Several factors placed constraints upon the type of methods we used. Firstly, as the ultimate aim of the project was to provide employment opportunities the methods were designed to be as labour-intensive as possible without conflicting unduly with the life style to which local people employed on the project were accustomed. Secondly, due to the remoteness of the site, the level of technology used was limited. Delays and considerable expenses in supplying and servicing various pieces of equipment such as pumps and freezers were normal.

The culture trials were conducted between February and July 1976. The work was aimed at obtaining baseline information regarding the relation of the growth and survival of young green turtles to environmental factors such as water turnover rates and stocking densities, and the food requirements of these turtles. Further details of these trials can be obtained from Kowarsky (1977).

METHODS:

Hatchling green turtles were obtained either from collection and artificial incubation of eggs or by collection of newly emerged hatchlings from a natural nesting site. Locally caught fish were skinned, filleted and diced into small cubes and stored in a freezer. This was the food fed to turtles throughout the trial period except for two days when the fish supply failed and canned dog food was used.

Experiment 1:

Turtles were mass reared from 5 to 164 days of age in a 3.1m diameter plastic lined pool. Water changes were effected by transferring turtles by scoop net from one such pool to another freshly filled pool. The number of water changes daily increased from approximately 2 at the start of the experiment to 6 by the end. After each water change except the final one for the day turtles were fed to excess. The amount of food ingested at each feed was estimated. During this experiment some of the turtles were kept in floating mesh enclosures within the pool to investigate the effects of crowding without, ideally, concomitant changes in water quality. At the start of the trial period the stocking density was approximately 32 cc/grm turtle; by the end of the period it was 47 cc/grm turtle. The available volume of water to turtles outside enclosures ranged from 119 to 76 cc/grm turtle; the comparable figures for turtles inside enclosures were 17 to 6 cc/grm turtle. The available surface area of pool for turtles outside enclosures ranged from 2 to 1.5 cm²/grm turtle, while inside enclosures the available surface area ranged from 0.7 to 0.4cm²/grm turtle.

Experiment 2:

This experiment consisted of keeping turtles in 40 litre plastic tanks at three different initial stocking densities with two different water change schedules (3 water changes daily vs 4 water changes daily). At the start of the 113 day trial stocking densities ranged from 455 to 18 cc/grm turtle; at the end of the period they ranged from 241 to 9 cc/grm turtle. Available surface area ranged from $40\text{cm}^2/\text{grm}$ turtle to $0.4\text{cm}^2/\text{grm}$ turtle. All turtles were fed to excess four times per day.

RESULTS:

Survival of turtles in Experiment 1 was approximately 70%. Turtles confined to enclosures survived equally well to those outside enclosures. Some mortality was associated with lesions which covered the eyes and skin. Many of the turtles which died without severe lesions were found to have foreign pieces of material such as Styrofoam, flakes of paint and strands of nylon rope apparently stuck in the gut or cloaca. At 5 months of age turtles kept outside enclosures were of average weight approximately 350 grms; the turtles in one of the enclosures achieved similar average weight, but those in other enclosures were of 312 grm average weight at 5 months of age. Estimates of conversion efficiency ranged from factors of 1.7 to 7.1 with a trend of increasing values with time. The factor calculated for the whole period during which monitoring of food ingested took place was 4.8.

In general terms the pattern of survival of turtles in Experiment 2 was similar to that of Experiment 1 turtles. It was apparent however, that at the two higher stocking densities the survival of turtles given four water changes daily was superior to those given three water changes daily. Maximum deterioration of water quality after the final meal of the day took place within 2 hours of that meal; this finding supported the idea that turtles exhibited a gastro-colic reflex.

Because turtles which died were on average lighter than the average live weight of turtles at the time, it was difficult to draw any conclusions about real growth under different treatments in this experiment.

CONCLUSIONS:

There was evidence that poor water quality, rather than the degree of physical crowding, was the major adverse influence on turtles. To improve the conditions of culture, strategies should be developed to maintain water quality at levels not exerting harmful effects (for example, in Experiment 2 at the lowest stocking density it would be reasonable to conclude that water quality deterioration was not a significant factor, as no difference in survival between those turtles given three water changes daily and those given four water changes daily was found, nor were the latter turtles on average heavier than those given three water changes daily). Within a given range of stocking densities a given volume of water could be better used by keeping turtles in crowded conditions and changing the water often than by keeping the turtles in relatively uncrowded conditions and changing the water infrequently.

Kowarsky, J. 1977. Culture trials of young green turtles, Chelonia mydas, in Torres Strait, Northern Australia. Aquaculture **11** : 197-215

Lavery *the City of Sydney* *Ballaranda* *George, F41*
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PRESS STATEMENT

by

THE HONOURABLE I.J. GIBBS, M.L.A.,
MINISTER FOR CULTURE, NATIONAL PARKS AND RECREATION

The State Government has moved to protect a unique species of marine life - the Flatback Turtle - by declaring one of its major rookeries a National Park.

State National Parks and Wildlife Minister, Mr. Ivan Gibbs, said today the new National Park would cover 207 hectares on tropical Wild Duck Island off the Central Queensland coast.

Mr. Gibbs said the Park had been declared specifically to safeguard a nesting area of the Flatback Turtle - the only one of the world's seven turtle species peculiar to Australia.

A tourist resort is being developed on part of the Island which is situated about 50 kilometres north-east of St. Lawrence.

Mr. Gibbs said "turtle watching" would be one of the attractions for visitors to the resort during the nesting season when mother turtles made their way up the beach to lay their eggs.

He said resort staff would co-operate with National Parks and Wildlife Service Officers in applying management techniques for the protection of the rookery.

28th February, 1980

Dropline feasibility project for WA, NT

A JOINT Australian-Japanese dropline feasibility fishing project has been approved to operate off Western Australia and the Northern Territory.

The Commonwealth Minister for Primary Industry, Mr Peter Nixon, the Western Australian Minister for Fisheries and Wildlife, Mr Gordon Masters and the Northern Territory Minister for Primary Production, Mr Roger Steele, announced the project in a joint statement last month.

The Ministers said Sumatil Pty Ltd, of New South Wales, and the Ishihara Fishing Co., of Japan would carry out the project.

They said Sumatil had already carried out a trawl fishing feasibility project off the north-west of Western Australia with another Japanese company.

In the droplining project one 300-gross-register-tons Japanese vessel would fish in areas currently approved for operations by foreign trawlers.

The emphasis of the project would be on droplining for 'reef fish', but gillnetting and pole fishing for pelagic (surface) fish would also be tested.

Darwin would be the port of entry and base for the joint venture. At least 10 per cent of the total catch would be landed at Australian ports and offered for sale to Australian processors.

The Ministers said it was hoped the project would provide valuable data on the commercial viability, extent and distribution of reef fish in these waters.

The project had the potential to develop into a joint commercial operation that could generate considerable flow-on benefits to Australia through onshore facilities, they said.

Commonwealth and State observers would study the fishing

operations. The results of the project would be made available to the Australian industry.

This was the eighth feasibility project approved to operate off Western Australia and the first to operate off the Northern Territory.

Deep water survey to begin off Queensland

A SURVEY of deepwater fishing grounds off central Queensland is scheduled to begin this month.

The survey is being conducted jointly by the Commonwealth Department of Primary Industry's Fisheries Division and the Queensland Fisheries Service in deep water from Breaksea Spit north, including areas outside the Swains Reefs. Depths to 600 m will be surveyed.

The Minister for Primary Industry, Mr Peter Nixon, recently approved finance from the Fisheries Development Trust Account to charter a suitable vessel.

Tenders were called and the charter awarded to Guillot Enterprises Pty Ltd for the 23-m trawler *Craigmin*.

The vessel is using fish, prawn and scallop trawls. It is equipped with sonar and is using satellite navigation to fix its position.

The survey is expected to continue till December. Progress will be reported each month in *Australian Fisheries*.

Qld search fails to find commercial scallop beds

A SEARCH for new scallop grounds off central Queensland has failed to find scallops in commercial quantities.

The search for new trawl and scallop grounds was carried out by the Queensland Fisheries Service research trawler *Bar-eamul* in the Swains Reefs region in June.

The Swains form the southern

end of the Great Barrier Reef and at their closest are 150 km from the mainland. The reef complex is about 150 km long and 100 km wide.

Queensland Fisheries Service biologist Mike Dredge said recently that the survey had concentrated on the south-western area from 21°40' to 22°20'S and 152° to 152°45'E. Navigation in the area had been difficult and great care had to be taken because of the large number of reefs and strong tides.

Suitable trawl grounds had been located by echosounder transects, and fishing had been carried out using standard scallop trawl gear. Much of the ground had been trawlable, particularly in the western half of the survey area.

Saucer scallops (*Amusium balloti*) had been found in small numbers throughout the area but at no time had catch rates reached commercial levels.

But saucer scallop populations fluctuated considerably from year to year and it was possible that in some years scallops could occur in commercial numbers around the Swains Reefs.

Low numbers of saucer scallops had also been found between reefs in the Innisfail-Princess Charlotte Bay region by a joint Commonwealth-Queensland Fisheries Service exploratory fishing venture in 1979.

He said that although scallop fishing was at present based largely on southern stocks between Bundaberg and Yeppoon, the surveys had shown that the species occurred over a much wider area.

Further exploratory fishing between Mackay and Cairns might help determine whether commercial stocks of saucer scallops occurred in the area.

A smaller species of saucer scallop, *Amusium pleuronectes*, occurred in large quantities off Townsville but because of its small size it was not a commercial proposition.

Sunday Travel

The Sunday Star-Bulletin & Advertiser

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Heron Island is one of the few islands directly on the Great Barrier Reef. The island's hotel complex occupies only a portion of its 37 acres and the remainder is forest and beach. Daily reef walks and boat excursions take guests out on the water.



Photos by Alan Seiden

Reef walks provide almost as interesting a chance to view the diversity of coral and animal life as deeper dives. Here a guide talks to a group of visitors about the abundant sea cucumbers that live in the reef waters that surround Heron Island.

Australia has its G

By Allan Seiden

Special to the Advertiser

If our planet were to be described by superlatives of scale and beauty, the Great Barrier Reef would rank with the Himalayas, the Sahara and the Grand Canyon.

Winding its way for 1,200 miles off Australia's northeast coast, the Great Barrier Reef is distinctive enough an Earth feature to be visible from space; a curving ribbon of translucent color 10 to 40 miles wide, paralleling subtropical Queensland's border with the South Pacific.

What may be a vibrant path of color from space proves overwhelming in detail, for the reef is one of the Earth's most fertile domains, surging with an incredible abundance of life. To hang suspended in the multi-colored waters that cover the reef anywhere from a few inches to a couple of hundred feet, is to marvel anew at life's boundless ability to adapt.

Very special conditions have allowed the Great Barrier Reef to evolve. Millions of years have passed while incredibly varied corals have lived and died in these warm, sunlit, often calm waters.

The soft corals have left

few traces as one generation has succeeded another, but the hard corals have left behind their calcium-rich outer shells, providing a base on which new coral could grow. Reaching toward the surface in huge, elliptical colonies these corals have created the largest living organism on earth, with complex communities covering many square miles.

Today thousands of unimaginable forms of life coexist in symbiotic harmony along the reef, filling niches in an ecosystem that includes plant and animal species and others that seem to defy inclusion in either category. The soft coral filaments that gently drift in ocean currents like delicate flowers, are in fact animals whose feathery fingers feed off of passing algae and plankton. The hard corals that grow in dense groves looking like a winter forest bereft of leaves, are animals too.

Inside their hard casings live countless thousands of tiny polyps, which emerge in colorful profusion to feed on the water's rich nutrients. Giant clams, fused to hard coral beds, reveal radiant lips as they filter the water and feed. And spiny stone fish, camouflaged to blend into their surroundings rest immobile, awaiting their prey

while neon schools of fish, like darting remnants of a thousand rainbows, swim through an aquamarine sea.

One need not be an experienced scuba diver to participate in the reef's varied wonders. Walks in reef shallows reveal nearly as great an abundance of sights as do deeper tank dives.

For the casual snorkeler it takes little more than to drift about on the surface to remain absorbed for hours as turtles, groupers and countless unknowns swim by in casual disregard of your presence. For those interested in scuba dives, equipment rentals and training are available at a number of locations along the reef.

Actually, there are few on-reef locations that provide accommodations. Most of the reef in fact is sub-surface, with only an occasional coral islet providing a pied-a-terre.

Heron Island, reached by helicopter from the coastal town of Gladstone, offers access to the southern end of the reef. Daily boat excursions to surrounding reefs supplement reef walks that start from Heron's coral sand beaches.

Accommodations are simple bungalow style, while meals are served in a comfortable communal dining room. A lounge, shop and an oversize

reat Barrier Reef

den complete the range of facilities.

There is nothing fancy about Heron but the casual approach seems in keeping with the setting, which also offers a chance to see rare green or loggerhead turtles as they crawl ashore to build nests and lay their eggs.

Numerous birds also flock to Heron's 37 acres to nest. The island is home to reef herons, from which it took its name, as well as mutton birds, silver gulls, doves, landrails and an abundance of terns whose mating and nesting are sights as memorable as the reef itself.

While Heron is considered the best on-reef location, Green and Lizard islands, some 600 miles to the north, also provide direct access to the reef. Both are easily accessible by boat or plane from Cairns, the reef's near-tropical northern gateway. Green Island is somewhat commercialized, and while it offers simple accommodations, it is best visited on a day trip by hydrofoil, boat or charter seaplane from Cairns. Lizard Island offers a more remote, luxurious setting at rates that cater to a clientele willing to pay for a top of the line vacation. No crowds here. More the quiet of an exclusive resort serviced by its own airstrip, with its own

boats offering guests reef excursions and other activity options.

Cairns also serves as a point of departure for the deluxe Coral ReefTel, an 82-foot catamaran hotel that is one of approximately 10 that cruise the reef-lined Queensland coast. Offering private two-berth cabins and comfortable, elegant public rooms, the Coral ReefTel serves as a mother ship to smaller craft that offer day trips to various parts of the reef for scuba, snorkeling and fishing.

In addition to being one of the most unusual ways to explore the reef, it is also one of the most expensive, with rates independent of day-to-day excursions in the \$100 per day, per person range.

Between Heron and Lizard islands is an aggregate of hundreds of individual reefs separated by deep, narrow channels and portions of open sea. To visit this stretch of the reef requires establishing a base at one of several coastal towns, or spending some time at one of the numerous coastal or island resorts that are quite popular with vacationing Australians.

Some of these resorts are quite large, catering to the family trade, while others are small, providing a setting for an intimate getaway. If you

are headed this way, it is best to choose a resort that offers what you are after.

The Whitsunday Islands, located about halfway between Gladstone and Cairns present the greatest concentration of reef-oriented resorts. Hotels in Airlie Beach and Shute Harbor look out to a turquoise sea afloat with gentle green islands, the summits of coastal mountains now separated from the Australian mainland.

Beautiful beaches, quiet coves and small inter-island reefs abound, providing opportunities to sunbathe, swim, snorkel, scuba dive, cruise or sail. Whitsunday Rent-A-Yacht is one of several companies that offer a wide variety of yacht rentals, with or without crew, allowing for extended sails between the islands, many of which are part of Australia's national park system. In addition, there are resort hotels on Brampton, Dent, Lindeman, Long, South Molle, Daydream and Hayman islands.

The Great Barrier Reef itself lies some 45 miles east of the Whitsundays. Cruise boats link the Whitsunday area resorts with the reef, allowing snorkeling and scuba day trips. But the am-

Continued on next page

Exploring the grea

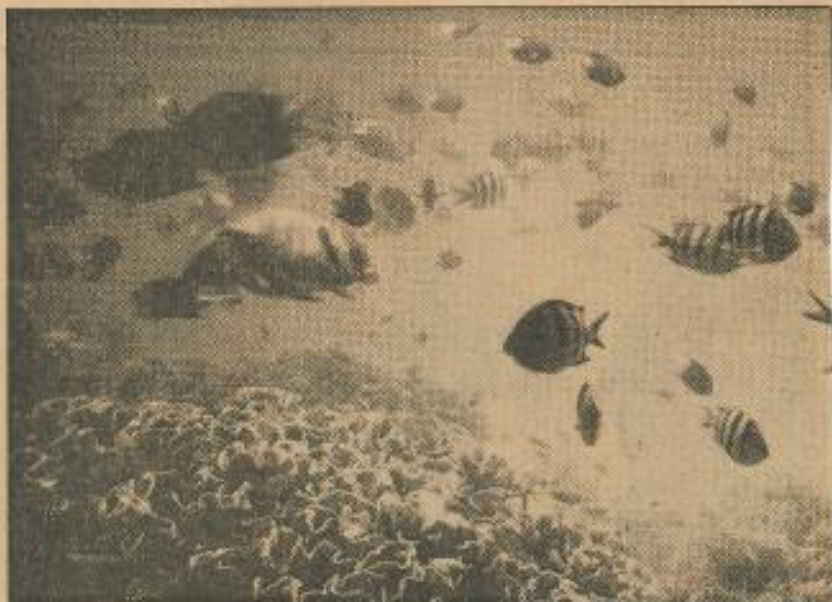
from page one

phibious flights provided by Air Whitsunday provide an even more spectacular access route, with aerial panoramas of the island-studded coast followed by the dramatic expanse of variegated reef. Once on the reef, a full range of activities are available.

Some 130 miles to the north of the Whitsundays, Townsville provides still more perspective on the reef area's appeal. Another attraction is Magnetic Island with its sheltered bays, beaches and extensive wilderness trails.

A shuttle links Magnetic Island's various attractions. The island, which is some 40 miles west of the Barrier Reef itself, offers a wide range of accommodations, from rustic cottages to comfortable motel-style units. For the adventurous, charter flights can be arranged from Magnetic Island or Townsville for a visit to the aboriginal settlements on the Palm Islands to the north, or to selected sites on the reef itself.

Whether it's a departure from Cairns, Townsville, the Whitsundays or Gladstone, the Great Barrier Reef provides entry to a world as remote and unique as any on earth. It's a world defined on its own terms, for it is the



Australia's Great Barrier Reef is alive with abundant corals and fish, easily accessible to scuba divers and snorklers.

definitive reef against which all others are measured.

For the scuba enthusiast or the vacationer interested in just a glimpse of one of our planet's natural treasures, the Great Barrier Reef awaits exploration. Few will be disappointed, for if magic does indeed exist, the Great Barrier Reef is one of its most obvious manifestations.

How to do it

The Great Barrier Reef can be enjoyed either as part

of a comprehensive visit down under, or as a destination well worth all the time and money you have got to spare.

Qantas provides the most direct route with a once-weekly flight direct to Townsville, where connecting flights to Cairns, Gladstone and the Whitsundays can be arranged on Ansett, Trans-Australia or BPA. Qantas also offers a wide range of tours that include the Great Barrier Reef.

For those interested in incorporating the reef into a

test of barrier reefs

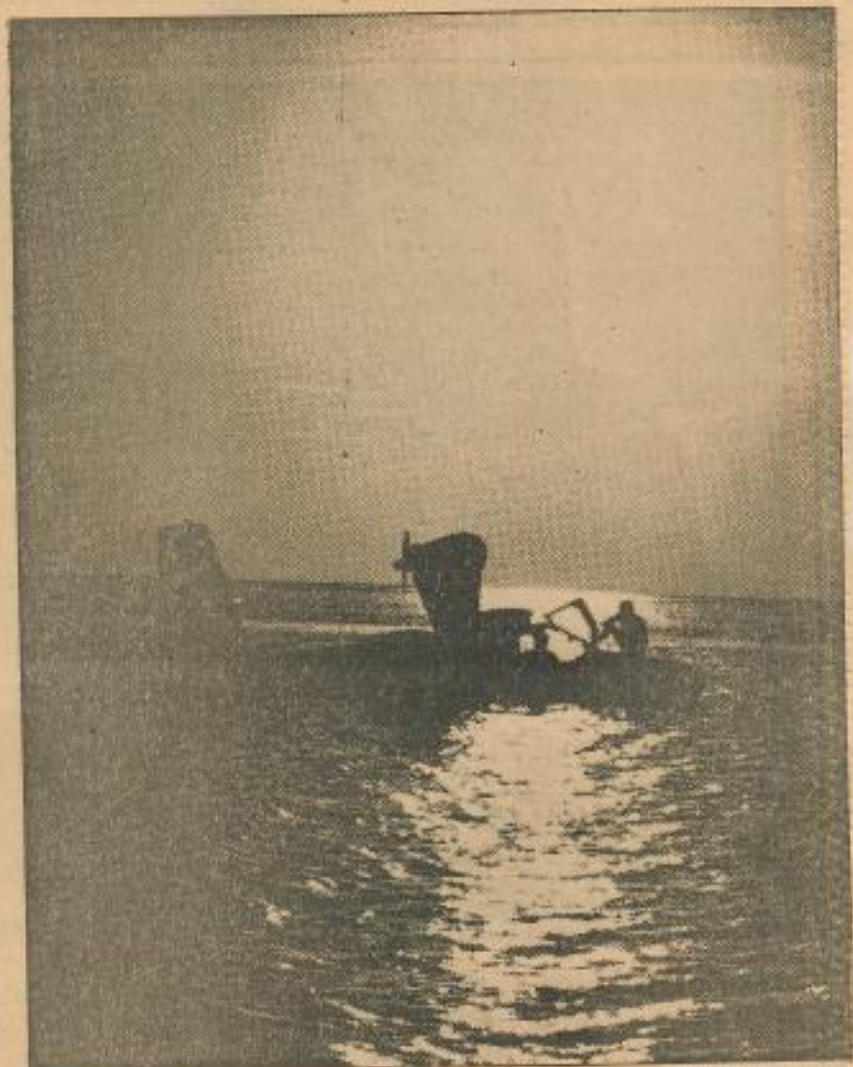
comprehensive tour of Australia, Pan American, Continental, Air New Zealand and Qantas provide links between Honolulu and Sydney or Melbourne. In addition, Qantas flies from Honolulu to Brisbane twice a week.

It is worth checking with the individual carriers to see if there are special fares or tours that might be of interest. Pan Am, for instance, has a fly/drive program that includes lodging that can be used to include location adjacent to the Great Barrier Reef. The current promotion requires travel start before Nov. 30.

With 1,200 miles of Queensland coast paralleling the reef, car rentals provide a demanding but worthwhile option for those with the time, providing an excellent way to take in not only the reef's various access points, but the countryside as well. Excursions by car are not recommended for stays shorter than two to three weeks. Motorcoach tours that include reef locations are also available.

For more information, contact your favorite travel agent, the airlines or the Queensland Tourist and Travel Corp., 307 Queen St., Brisbane 4000, Australia.

Allan Seiden is a free-lance writer and photographer who lives in Honolulu.



Photos by Allan Seiden

The setting sun silhouettes a seaplane and its passenger resting on waves above the Great Barrier Reef of the Whitsunday Islands.



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late March 83
- Review comments -
Articles

Dear George,

These are some ideas on turtles basking
in the Gulf of Carpentaria which we have submitted
to Copeia but which I thought would interest you.
The situation is different to yours in NWMI but
it would be interesting to know where yours do
rest between nesting attempts. I'd certainly be
interested in your comments.

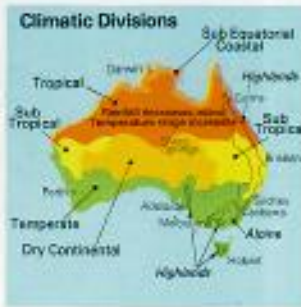
About hatchlings basking in Australia - I wonder
whether you are aware of the work of Moorehouse & Fox
(1933) Notes on the green turtle (*Chelonia mydas*)
Repts. Great Barrier Reef Comm. 4(1):1-22.
He tells of keeping hatchlings in captivity and
giving them little boards to climb up on. When
they have had enough they drop back into their
tanks. So I'd say it does occur in the
Australian population. Do they normally crawl on
top of seaweed or do they haul ashore in the
mangroves . . . ? I wonder what you think of
Stoneburgers tracking of turtles - or was it tracking
of turtle transmitters.

Cheers Stephen

- tile van
- shank?

Australia





Population: 14,113,800

Sydney	3,095,000
Melbourne	2,675,000
Brisbane	986,000
Adelaide	915,000
Perth	825,000
Canberra	205,000
Hobart	165,000
Darwin	47,000

Journey Time Comparisons

Sydney to:	Road km	Jet Time	Rail Time	Coach Time
Adelaide	1422	1.50	25.15	23.40
Alice Springs	2980	5.20	84.30	56.25
Brisbane	1027	1.10	15.30	17.45
Canberra	304	0.30	5.00	4.45
Darwin	4095	6.30	-	92.50
Hobart	1145	2.30	18.00	19.30
Melbourne	893	1.10	13.00	14.30
Perth	4135	5.20	85.45	72.15

Adelaide	Albany	Alice Springs	Ayers Rock	Brisbane	Broken Hill	Caithra	Canberra	Darwin	Hobart	Kununurra	Mackay	Melbourne	Mount Isa	Perth	Port Hedland	Southern Paradise	Sydney
2655																	
1693	3714																
1738	3758	468															
2127	4389	3064	3512														
510	2752	1790	1834	1617													
2945	6568	2435	2883	1826	1971												
1212	3887	2806	2949	1331	1108	3157											
3225	4690	1532	1980	3582	3322	2953	4239										
1007	3562	2700	2744	1927	1095	3753	903	4232									
3392	3816	1099	2147	3749	3489	3120	4400	875	4399								
2846	5033	2473	2921	1044	2335	786	2388	2891	2971	3158							
755	3410	2448	2492	1675	843	3501	651	3980	252	4147	2719						
2850	4915	1157	1805	1907	2164	1278	2724	1675	3070	1842	1318	2818					
2713	407	3772	3816	4427	2610	4727	3925	4283	3720	3408	5091	3468	4973				
4631	2225	3288	3737	5339	4628	4710	5743	2465	5338	1590	4748	5286	3432	1818			
1422	3922	2960	3004	1027	1170	2853	304	4095	1145	4095	3061	893	2420	4135	5953	947	

The black figure in the square where the horizontal and vertical columns meet is the road distance in kilometres between two places. The figure in red shows the distance by the most direct air-service (IATA kilometres). *Road distances to Hobart exclude the Melbourne-Devonport ferry journey.



THE TURTLE HUNTERS

By NORMAN W. CALDWELL

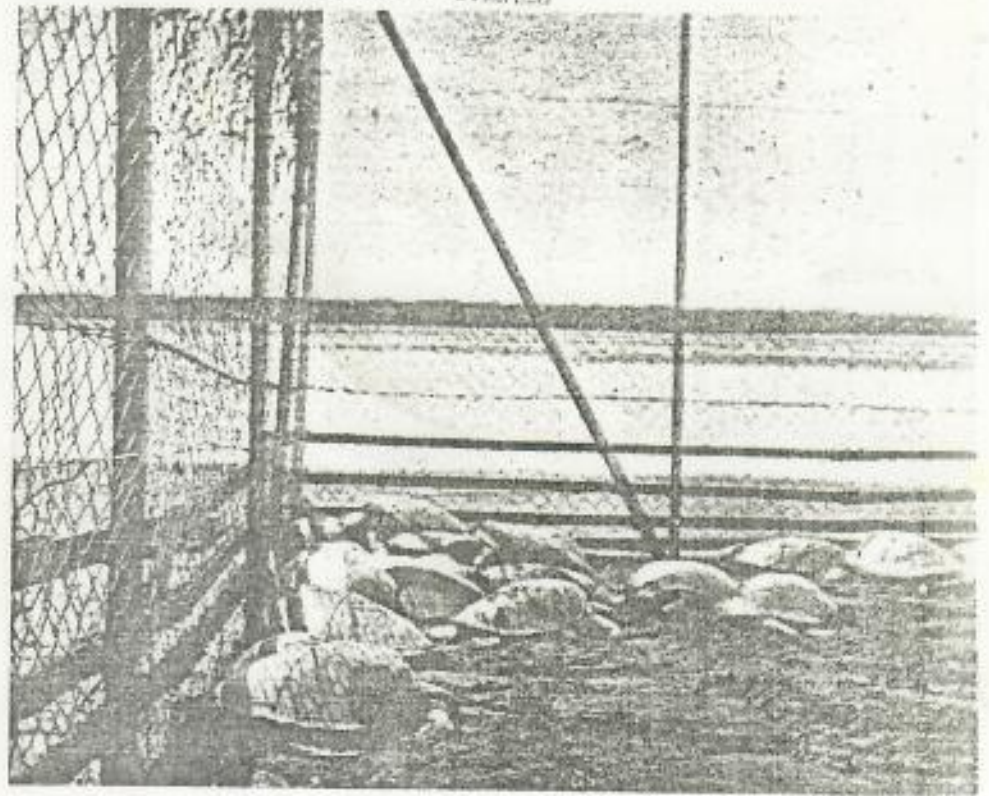
SEVERAL months ago I was invited by a Sydney syndicate to help form a company for canning turtle soup in Western Australia. After studying a rough draft prospectus I turned the offer down. I realized that with the rising cost of material, freight, labour, etc., there would be one outcome: the venture would not pay.

However, meeting these men reminded me of an adventure three of us had amongst turtles. Ever been Cossack way? It's a creek town of limited dimensions, and despite the savage willy-willies which have battered the coastline, it still hangs together as a distributing centre for wool and many other products.

I had seen turtle swimming up the Great Barrier Reef way, and had had an occasional feed from one, but the idea of making soup from the flesh was far from my thoughts, until I received a telegram from Captain Tommy Turner, chief of the Australian Canning Company, Cossack, Nor'-west Australia, offering me the factory manager's job. At the time I was busy catching sharks for their by-products, from an island base, yet not too busy to refuse an opportunity to see what the Golden West looked like at close quarters.

Anyway I left Bowen, North Queensland, early one Monday morning for the long overland journey to Perth. Tommy Turner met me at the city station. He was no stranger to me. I knew him of old. We'd worked together in charge of Marine Industries Ltd, N.S.W. A short square-shouldered bronze-faced man, his keen deep-set eyes seemed to absorb one at a glance. He began his career in Nor'-west Australia on a sheep station, then gold mining called, before the sea's spell got him.

I learned the story of his English-Australian company, whose turtle soup factory was at Cossack. I gathered that the waters of the Nor'-west were the home of green turtle, that the factory could



Turtles in pen at Cossack

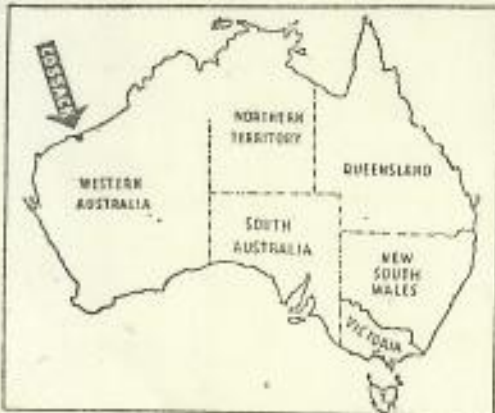
absorb double the number of turtle then being captured, that the soup was destined to become famous the world over. Yes, we also talked a lot regarding the working of the factory. He told me of a net he'd bought in London, built on shark-meshing lines, also the plan he'd formed for it to catch turtles. The set-up sounded good to me, and as I'd had a long experience of handling similar massive nets shark fishing in New South Wales waters, I reasoned that if we were successful the captured turtles would keep the cannery hands extremely busy. Several days later we shipped some cannery gear to Cossack by the T.S. Steamer *Kalinda*, then boarded the weekly plane to that port. However, I found that the landing strip at Roebourne was our aerial destination, a car taking us to Cossack. I "signed on" with Dave Stone of the Weld Hotel as guest. The hotel, a long rambling one-storied wooden structure, suited me well.

Cossack is built near the southern bank of a fairly wide creek which runs inland about one mile. The creek rises and falls eighteen feet. It is thickly populated by fish, a nice edible variety. Dense clumps of green-leaved mangrove trees fence the opposite banks of the creek. Near the stone-walled jetty (used mostly then by sea-going lighters which carried shell, turtle soup, baled wool and other goods to the occasional Perth-Singapore steamers anchored in the roadstead, was the turtle-holding pen, facing the factory. It was a large wired-in, mud-floored enclosure. In it turtles were held until required by the factory. It flooded with every tide, and on the ebb carried just sufficient water to give the shellbacks coolness from the

sunshine. Away on the mud-flats not often swept by very high tides and encrusted with salt, dozens of kangaroo played or hunted. Mirages were plentiful there, and several times I thought I had collected the ocean waves, but a walk towards them they disappeared and I found them behind me. Small creeks mangrove-fringed, toured through the sandhills topdressing the foreshore filled billabongs in which swam small large and small. Several miles inland heard, gold mines prospered, while nearest town was Roebourne.

THE cannery, I found, was situated on the creek and had solid walls of six concrete floors, massive sliding doors and heavy machinery. Its strength had been tested by some of the fiercest storms seen in from the Indian Ocean. Near the western end of the cannery was the old Cossack lock-up. I found the cells open and empty excepting for some enormous cockroaches which had forsaken their habitat, the yard wide underground water tank of cement.

Captain Turner introduced me to an engineer supervising the plant, Er Cooke. I liked him at sight, especially when I learned he was an ex-digger in World War 1. Slow-speaking, solid, wasted few words on trivialities. One thing he did not tell me was that he carried the legacy of his overseas experiences in a broad hairy chest, a piece of strap. Then I discovered Marko, a Greek who was one of the turtle "strippers." He stripped the shell and plastron of its green flesh, cut off and cleaned the flippers, and also saw that the thirteen thin plates of veneer adorning a green turtle's top



walkabout V17 N7 29-32
July 1 1951

shell were loosened by steam heat and pulled off. These, if cooked, give the soup a bitter flavour, although the solid shell itself adds value to the soup. But what attracted me to the lad was his swimming prowess. Each morning before dawn lightened the sky, Marko and brother Toni, if the pen was flooded, would search for and capture the turtles needed at the factory that day.



Taking turtles to pen.

I've a reason for mentioning Ernie Cooke and Marko because they feature in the story I have to tell. Fifty turtles per week was the input when I reached Cossack. The catchers received 10/- each for them. The catching location was the reefs surrounding the Flying Foam Islands, some thirty miles south. They were taken by hand. Watching from a small speedy launch, the men sought and selected a feeding turtle, then chased it to a standstill. When it lay exhausted on the reef, one of the men dived and secured the shellback. Later it became a member of the island's holding pen.

Turtles are inoffensive, likeable creatures, bent on enjoying life like the rest of us, and penning them for long periods did not appeal to me. However, there was no other way of keeping them alive, especially as the Indian Ocean, including the waters surrounding the islands, is alive with sharks, monsters of almost incredible length and weight. But the turtle catchers were alive also to the danger from the brutes and took the risks they ran as portion of the day's work. No harpoons were used. Catching the shellbacks meant taking them alive—just man and turtle. Generally the man won.

One Friday, it was the 13th of course, Ernie Cooke, the Greek lad Marko, and I sailed the lugger *Calarni* to the turtle islands, taking with us the great net. We had tested the latter in the Cossack roadstead waters and captured a number of sharks. Visiting the islands was a welcome project after the stifling heat of the cannery, and there was no forty-hour week then.

We reached our destination early the next day. Anchoring the *Calarni* in deep water, we took stock of our surroundings. Half a mile away we noticed some of the

crew of a Japanese lugger diving for shell. They were workers, those fellows. The islands were overloaded with ironstone rock, that and sand. What landing beaches we saw were yellow shell grit. West of the islands, so Cooke explained, acres upon acres of reef bared their fangs at low tide. There was no sign of the turtle men, so assuming they were chasing shellbacks elsewhere, we manned the twelve-foot-long dinghy and went in search of the two. What submerged reef coral we noticed was dead. No colouring like that which gave enchantment to the Barrier Reefs, just a drab hue.

Fish were plentiful. We saw turtle too, in incredible numbers. Marko rowed, Ernie Cooke sat in the stern, and I was in the bows with my camera. Cooke advised a thorough search of the reefs while the tide ebbed. Here and there we noticed huge boulders of water-worn rock whose bulk churned the water into a bedlam of conflicting currents. Several dugong swam leisurely away as we neared them. It was a day of glassy calm. We travelled swiftly.

SUDDENLY I noticed the water ahead was changing colour, a deep bluish green. I wondered why? "Row that way, Marko," I instructed, pointing to where I wanted him to go. His strong arm muscles carried the dinghy along. Suddenly a cone-shaped opening appeared in the reef beneath us, one about thirty feet wide. It shelved slowly into depth, its centre being almost black. Sea grass climbed the walls aplenty. Then with wild gyrations, and leaving a bubbly wake, a frightened turtle came surging upwards. Its sudden appearance from the unknown depths suggested something to me as to the possibilities of the place.

I told my companions. The idea appealed. Hurriedly we rowed to where the *Calarni* lay anchored and loaded the turtle net, anchors, etc., into the dinghy. An hour later we reached the mysterious hole again. There was still water covering the reef when we got busy with crowbars. A number of holes were driven into the cement-like sea floor. Into these we hammered long wooden stakes, the latter being part of the lugger's deck equipment for carrying turtles. This finished, over went the thousand-foot long net with its six-inch mesh. One end we fastened to a stake, and continued staking it until the reef opening was almost completely surrounded. From the air it would have looked like the figure 6 because the net continued across the reef until it came to an end. It was securely moored with double ropes to sixty-pound anchors. Tidal waters whirled over the reef again before our trap was finished.

I did not expect to capture anything until dusk, so we continued our exploration journey. Soon after, we saw the turtle men working. On the bows of the twenty-foot launch poised the diver, one hand pointing, while his mate nursed the

engine and steered. The chase was on, spray winged the bows of the boat. I did not see the turtle being pursued, by ever.

Near the island's north end the water deepened somewhat at a place where grass grew richly. It was several fathoms high, but now swayed with tidal flow. There seemed to be feeding turtles everywhere. They loved the fresh green fish and barely noticed our drifting dinghy.

Marko, his face wreathed in smiles, glanced my way hopefully. "Can I catch one?" he queried.

Cooke and I laughed. "Go ahead, lad," I told him. So, stripping, he waited for his chance and dived. His first victim was not large, being but eighty pounds weight. Taken by surprise it fought fitfully and soon lay on its back in the dinghy. Marko was happy now. "More soon," he grinned. Soon turtle two, a larger one, thrashed its flippers helplessly as it joined its companion. The Greek lad certainly could swim and really enjoyed his undersea tours.

I was at the oars when Cooke spotted an outsize in turtles. He guessed its weight at 500 pounds. However, it did not wait to meet Marko. Another turtle with beautiful black and yellow shell came swimming along. Cooke pointed it out to the Greek lad. "That cove's worth 10/- if you catch him," he said.

Marko rubbed his hands together. "I'll get him," he declared, before he dived. The turtle made no attempt to escape.



The "catcher" holds the turtle by its front flippers.

came swimming towards the lad as if he was glad to meet him. Then came a vivacious act of pantomime: The turtle whirled away like the wind, then turned, its mouth open like a mouth with a parrot-shaped beak, the ends had cruel sharpened ends. Suddenly it attacked, sailing at the swimmer like a whirling fury. The Greek sensed danger and became an eel in the water. We could sense his laughter as he sought an oppo-



Chasing a turtle, with the "catcher" poised ready to dive overboard.

tunity to secure a hold on the hawkbill's body. The latter collected a small fish in its stride, but swung viciously aside as the lad tried to make contact. The Greek boy was certainly quick. He beat the hawkbill to a possie, twisted his body and secured a hold on its front flippers.

A second later the turtle's top-shell lay pressed against the lad's stomach, as, with his captive, he rose to the surface. How we cheered the breathless winner. Cooke was ready with a looped rope and hauled the turtle on board. Later a Japanese bought it for its lovely shell, so Marko got more than 10/-.

Thoroughly wound up now, the Greek thirsted for further conquests. The next two turtles he chased escaped. They were too fast, but he secured a small sunburst, so named from Nature's design of a rising sun on the shell. I have seen many such in Barrier Reef surroundings.

WE were still drifting over the reef where grass food grew lush. Suddenly Marko pointed to where a turtle lay feeding. It was a large fellow, a male whose weight held the grass down. Large barnacles clung like warts to its shell, a shell scored and torn at the edges.

"That cove's an old stager," I told my companions, "too old for soup making."

However, Marko decided to capture it, but changed his mind as he stood at the bows and looked at the sea. I heard the gasp he gave, noticed the horrified expression which swept over his face. "See, see!" he cried, pointing suddenly before he leapt inboard again, as he restrained his youthful enthusiasm. We looked and saw swimming slowly a hammerhead shark. Actually its size was hard to guess, but it threatened death to any feeding shellback or fish in the vicinity. We saw old man shellback

feeding contentedly in his sheltered possie, but the smelling power of the shark was strong. Swiftly, yet quietly, Cooke let the anchor seek the reef; the curtain was rising on an undersea drama.

On came the shark, slowly at first as if gathering in the scent of the turtle, then charging with savage fury. The ungainly and awkward "ancient one" stood no chance; neither, I think, did it realize its foe's presence before the monster's great head went into action. Crash! Vainly the turtle sought to escape, to rise in the water, but we saw a hind flipper had been injured. Its world dissolved into chaos as the three remaining flippers half turned it before the monster's hammer clouted the shell again. The latter buckled, and one of its thirteen plates was forced away before the poor brute was tossed on its back, where it lay kicking helplessly. Then with the same violent hostility another head attack flooded the depths blood crimson, a narrow cloud which drifted away with the tidal flow.

The shark made frantic attempts to come to actual grips with its prey, but its small underslung jaw failed to bite off a flipper. As food would not come easily more headwork became necessary. The turtle rolled hither and thither with each violent assault. One such attack broke the old fellow's neck. The head swung limply with glazed eyes. The prolonged hammering literally tore the upper shell apart, and soon a bowel length protruded, a grey tube, inches thick. This the shark rapidly seized and swallowed, a nasty sight.

However, Nemesis avenged that murder, and brought the final act of the tragedy to an end. We gasped our horror. My pulse rate quickened. Our dinghy was small, its planking thin, and here came a tiger shark, bulky and fierce, to join the feast. It

looked enormous, an aquatic wand from the Indian Ocean, which the less turtle's blood had called in to avenge its death. Too late the hammerhead set its company. Its hunger madness fled away as it sought escape. But the tiger was quick. It had gained sufficient room for the attack. We saw its jaws strongly clamp over the hammerhead's tail. Then, when they opened again the hammerhead, now minus his propelling gear, sank helplessly to the sea floor, blood staining the water. The tiger shark did not attack a second time, but collected what remained of the mutilated turtle and disappeared.

Desperately our young diver mastered his fear. His face had whitened by the "Never I swim here again," he cried, voice high-pitched. Cooke and I agreed. Although we had witnessed this mauling in comparative safety, we were glad it was over.

AFTER collecting the anchor we went for and spent the rest of the day with the turtle catchers. In all, they captured 17. We visited a number of reefs during the aquatic round-up. We watched two turtles playing quietly in the deeper water. The turtle men told us some amusing stories and some desperate ones, all unfortunately too lengthy to repeat here. We visited a net before sundown but found it empty.

The following day began warm and lovely, yet noisy with diving seabirds. After a fish breakfast Marko rowed the dinghy across the reef. The turtle men had laughed our shark net to scorn, preferring their "hand-picking" method. Captain Turner's. A gentle swell crept glassily in from the Indian Ocean. Again we saw turtle feeding. In the distance the sea was blue with depth, and several floor cloud patches slowly crossed the heavens. We also noticed a school of fish, not in extent, leaping and splashing as they roamed the surface water.

The reef water was fairly shallow when we neared the net, or what we saw of it. It had collected drift weed by the ton, but how we shouted with excitement. Wet turtles, sharks and large fish were thrown together in the bunt. Several of the net holding stakes had snapped with the tidal strength and weight. The main net surrounding the reef, though weed-logged held four turtles of varying sizes, also an enormous eel, and two sharks, one with a five-foot-long saw. It certainly was a triumph.

Mooring the dinghy, we got busy in loading the net. It was a terrific task, for the weed clung tightly to the strand cotton mesh, a solid wall of green or brown. To leave the net in the water another day meant trouble, and the probable loss of net and gear. Rapidly we freed the turtles. They went into the dinghy, as did several nice trevally. Marko with instructions to hurry back, took them

to the *Calanni*, leaving Cooke and me clearing the net of its burden. One shark was alive, a whaler. We cut it free, watching it struggle away to deeper water. I don't think it realized its freedom. The other monsters were dead. These we left on the reef for fish to eat. The eel had squirmed its portion of the net and seaweed into a ball. It was an enormous fellow, and gladly we gave it freedom. We hacked at the weed with knives, for time and tide wait for no man, let alone us.

Marko was soon back, and gladly we welcomed his help. As each yard of net became empty, the lad hauled and stowed it into the dinghy, but he had a full-time job bailing water, for the wet net carried gallons on board. Two-thirds of the bunt was in the dinghy by the time the tide swirled back.

Our hardest task began then, for, once free of the holding stakes, which we had pulled up, it was lifted by water flow and

started moving away. We threw over another anchor to hold the dinghy. But how we hauled at the squirming net! I forgot to mention that the latter had lashed to its top line about 150 five-inch glass floats. Weed came too in that mad rush, and soon the small boat wallowed on the sea. How our muscles ached! Times came when we moored the net to a thwart, but the speeding water race rolled it into a massive rope. This had to be partially unravelled, to allow it to spread over the other bunt in the boat. How we growled at that task!

However, an hour later found us laughing at the experience, as Marko and I, sitting across the wet set, slowly urged the heavily weighted dinghy to the nearest island beach. Here we finished clearing the net of rubbish, finally spreading it over the sand to dry. We were thankful, however, that no hammerhead shark took a fancy to the over-burdened dinghy and "butted in."

A FOOT THROUGH FLINDERS CHASE KANGAROO ISLAND, SOUTH AUSTRALIA

By R. M. ARNOTT-ROGERS

THE western end of Kangaroo Island is bastioned by great limestone cliffs, rising to upwards of six hundred feet on the north-western section of the coast, with Cape Torrens, 725 feet, as its highest point. Torn and fretted by the wild storms which frequent this coast, they stand on a footing of ancient hard rock which forms long treacherous reefs: reefs which have been the wreckage of six known ships, and others suspected as having been lost hereabouts. This rugged seaboard is backed by a country so rough and densely scrub-covered that only those who go afoot or pass in small craft can hope to see the magnificent scenery of jagged rock and rolling breakers, of towering headlands and sand-duned bays.

Here lies Flinders Chase, the second largest Wild Life Sanctuary of South Australia, taking in nearly all of the western end of Kangaroo Island, and covering some 211½ square miles in extent. This mostly virgin piece of country was originally selected for conservation as early as 1888, not only because of its position as part of an island and thus easily fenced and controlled, but because Kangaroo Island is also unique in being free from the two pests, rabbits and foxes. It is said that rabbits were at one time introduced but that they were exterminated by the goannas eating the litters in the nesting burrows.

The first move to have this area conserved was a representation to the Government in 1906, but it was not until 1919, after seven such deputations, that "An Act to establish a Reserve in Kangaroo Island . . . etc." was passed and the Flora and Fauna Board set up. The enactment

was for 194 square miles, and with boundary changes from time to time since, has increased to its present extent. The original scheme was for the setting aside of 1,000 square miles, but it is doubtful that this will ever be achieved. What was then thought to be almost useless land, is to-day being brought into production through our present knowledge of soils, but that is a story to itself.

From 1923 onwards many different birds and animals have been liberated in different parts of the Chase. Among those which have settled down and increased may be mentioned the Cape Barren geese and the Koalas. It is the policy of the Board to introduce birds, animals and reptiles which are in danger of extermination, two examples being the Mallee Hen and the Scrub Turkey. Of the indigenous species, there is a rare red-tailed black Cockatoo, which is found nowhere else in the state. So tame is the wild life that kangaroos will stand and stare and have become almost a pet in the Apiary, where they raid tents for paper, and goannas come for hand-outs, at meal times.

When I first heard of Flinders Chase, I could find out very little about it, and that little information was so varied as to produce such a muddled mental picture that I was intrigued. Few people, even among the islanders, know anything of the Chase. So during the Christmas holiday period of 1947-48, with seven members of the—then newly-formed—Adelaide Bushwalkers, I had my first view of the Chase. We covered the whole of the West Coast Road, opened up in 1946, from Rocky River Station to Cape Borda, taking brief glances at the mouths of the

ivers. From the mouth of the Ravin-Casoars we followed the cliff edge to B lighthouse. We also saw the coos from Cape du Couedic to South-River.

What was seen on that first trip caught my interest that I planned to be equipped to photograph some of the un features. This object was fulfilled through the enthusiastic help of Ray Farran Tom Beesley. Farran, though unfamiliar with our Australian conditions, but with previous experience out of doors in India and England gave him quick adaptability, took over much of the leadership of the party. This left me free for photography work. The others who contributed to the success of the venture were John Marsh, Howard Kirkbright, Pauline McGowan. As not all could in the Chase for the whole of the projected stay, trips of different lengths were arranged to fit in with the comings and goings of the various members.

WE made our base at Rocky River Station, the headquarters of the Chase—the home of the Ranger, Mr. H. Han. This was the nucleus of the project forming the Wild Life Sanctuary, because it was on one of the two permanent rivers in the area, the other being Breadal River. This part of the Chase, an area 9,000 acres, was first owned by C. J. & and the cottage kindly lent for our use by the Board was the original home. A regular bus service comes here once a week, for Rocky River is now a Post Office and Telephone Exchange for lighthouses and will be for the south coast settlements when they are connected. The West Coast Road starts from 1 round the western end of the island at two to three miles back from the coast. Though so near, it is almost impossible to reach the sea, because of the thick scrub except by the foot tracks cut along the rivers.

About two miles from Rocky River Station and off from the West Coast Road in a wide valley between sandhills, is Government Queen Bee Breeding Station under the management of Mr J. F. Masman. These Ligurian Bees were brought here by the Chamber of Commerce in 1884. The apiary was planned and started by Mr A. E. Ophel in 1943 (or at 1944).

Just west of the apiary in a bend of Rocky River, where there is a stretch of Manna Gums (*Eucalyptus viminalis*), Pink Gums (*E. fasciculosa*) with patches of Water Gums (*E. ovata*). Here Kookaburras have been liberated and are on the increase. The first six were introduced in 1911 and a further group of six males and mothers with cubs in 1925. To our surprise we found them quite noisy animals with loud growls and squeals, particularly at night, as I found camping near them some days last December.

date: some time in 1981

name of science

Professor John Hendrickson devil that they four

SOMB university professors who are nearing retirement might occupy themselves with select tutorials, tapping out their pipe and planning a cabin in the hills.

Their idea of strenuous effort is a walk across the campus to the staff club.

Professor John Hendrickson and his wife Lupe (pronounced loopy) have spent the past five months living on remote beaches in the north of Australia during the west season, studying the flatback turtle.

He is professor of biology at the University of Arizona in Tucson, U.S.

Starting at Gladstone in Queensland, they have camped on sandfly-infested beaches to gain a full picture of a turtle that is unique to Australia, and about which little is known.

Was there anyone else in the world who knew more about the flatback turtle than they did?

"Not now," answered the sprightly professor with a tired smile.

He said that the flatback turtle not only chose to lay its eggs in remote areas, it also laid them at a time of year when few humans could move freely along tracks to see them.

Laying began in October, he said, peaking in about December but carrying on sporadically

Taxidermist Mr Ian Archibald with a death adder.

Pictures from JOHN EVANS in Port Hedland

for some months, right in the middle of the northern "wet" season.

A trip to remote Muddabullangana Beach was organised after the professor saw photographs taken by a party from *The West Australian* in November, showing

turtles laying eggs and inadvertently describing them as green turtles, which are better known.

One full-grown and two small green turtles were found on the latest trip, but flatbacks stayed away.

The professor had to be content with the discovery of a newly-laid nest of flatback eggs.

He and Mrs Hendrickson were accompanied on their trip by Mr Ian Archibald, a taxidermist-preparator from the Darwin Museum, who gave them a lift from Darwin in a four-wheel drive vehicle.

Mr Archibald collected enough reptiles to exhaust his sock collection (at one reptile per sock), using the socks to contain them for an air trip back to Darwin.

The highlight of the beach visit was the successful use of a 40cm remora, or sucker fish, on a string as a way of catching turtles for inspection and measuring.

With its suckers rubbed in sand, the fish's instinct was to "lock" on to the nearest big sea creature with the suckers to clean them.

Three small turtles found themselves being dragged shorewards by what seemed to be the strongest remora they had ever met.



Blue grenadier are caught spawning

SPAWNING blue grenadier have been caught off Cape Sorell in western Tasmania.

Tasmanian Fisheries Development Authority biologist Marc Wilson reported in a recent issue of the TFDA magazine *Fintas* that the fish had been caught in late August by the trawler *Margaret Philippa*. A 40-minute shot in 500 metres produced about five tonnes of grenadier. All the fish examined were either fully ripe or spent. The average size of the grenadier was considerably larger than the fish usually taken in the summer fishery.

Mr Wilson had predicted earlier in the year that blue grenadier could be spawning off Cape Sorell, based on his study of local catches of juvenile grenadier, the prevailing currents and estimated larval transport rates.

He said *Margaret Philippa* skipper Will Nichols followed up that prediction and caught ripe blue grenadier. Unfortunately the vessel suffered extensive gear damage because the slope grounds in that area were rough.

This was unlikely to be a commercially-viable trawl ground because of the rough bottom, but it was likely the spawning area could extend further north.

He said blue grenadier were likely to spawn over a three-month period, June to August, and during the earlier part of this period might be spawning over the trawlable ground west of Sandy Cape.

Safcol cannery

THE Safcol plant at Bitung in Indonesia is reported to have begun production of canned tuna late last month. It has been designed to produce 5 000 tonnes of canned tuna a year.

Tas. scallop catch

THE Tasmanian scallop catch for 1980-81 is 3 359 tonnes (shell weight), valued at \$1 740 000.

NZ sashimi price

SOUTHERN bluefin tuna shipped from New Zealand to Japan for the sashimi market has averaged about NZ\$8 a kg.

A total of 171 tonnes of frozen southern bluefin tuna, caught by South Island west coast troll and handline fishermen, was sent to Japan in late August on a chartered freezer vessel.

The highest price received was NZ\$17.64 a kg (for 7 per cent of the fish); 35 per cent of the fish brought \$10.96 a kg; and 54 per cent brought \$5.13 a kg. (The remaining 4 per cent was sold at various prices.)

Details of the development of the New Zealand west coast southern bluefin tuna fishery will be published in next month's *Australian Fisheries*.

Shark Bay net restrictions

NEW rules for fish-netting by amateurs in Shark Bay have been introduced by the Western Australian Government.

The State Minister for Fisheries and Wildlife, Mr Gordon Masters, said recently that the new rules included:

- a ban on using net stakes in the seabed;
- a ban on using nets between 90 minutes after sunrise and 90 minutes before the following sunset; and
- requirements that set nets be cleared every hour and be attended at all times.

Mr Masters said he had considered representations by amateur and commercial fishermen, and the need to conserve the rare and protected dugong which inhabited Shark Bay.

He had also considered the views of amateur line fishermen, who were travelling to Shark Bay in increasing numbers, and the long-term effects of continued netting on the tourism potential of the area.

The use of shark set nets in Shark Bay by commercial or

amateur fishermen was banned early last year because of the danger to dugong and turtles.

Mr Masters said inspection of nets used by amateurs would be given priority by fisheries inspectors. Unattended nets would be confiscated automatically and any apprehended offenders would be prosecuted.

Safcol's million-dollars ME sales

SAFCOL has sold more than \$1 million-worth of seafood products in the Middle East during the past year. The most recent sales were at a major food exhibition in Bahrain in January, at which Safcol sold three containers of frozen products.

Senior trading manager Mr Bob Bastian said demand for quality fish products from Australia was remarkable at the trade fair.

'Our sales were made on the strength of the exhibition and provided we can keep up the supply, we have a regular and growing market.'

Tas. seminar

A SEMINAR to examine Tasmania's scale-fish industry will be held next month. The seminar has been organised by the Tasmanian Fisheries Development Authority for April 28-29.

Further information: Mr Harry Rogers, TFDA; tel. (002) 30 6528.

Horrie Fairbanks dies

FORMER South Australian senior fisheries officer Mr Horace Fairbanks died last month, aged 62. Mr Fairbanks, widely known as 'Horrie', retired from the Department of Fisheries in 1979 because of ill health.

The director of fisheries, Mr Richard Stevens, said recently that Mr Fairbanks had had a deep interest in fishing in the State and would be missed in both government and industry circles.

Australian Fisheries, March, 1982

New packing plant for Eden

A NEW fish packing and processing plant is being built at Eden in southern New South Wales by the Eden Fish Packing Co. Pty Ltd.

Partners in the new venture are Mr Jack Miriklis, Mr Victor Rodahl and Mr David Barton.

Mr Barton said recently that the company combined Greek, Norwegian and Australian talent in a 'new' Aussie venture preparing and distributing fresh seafood.

'Our major aims are service, quality and the decentralisation of markets,' Mr Barton said.

'As well as servicing our boats as land agents, we are determined also to provide first-class fresh product to the southern half of New South Wales and central Victoria.

'Jack Miriklis' new \$600 000 processing plant at Maryborough in central Victoria is a cousin to our Eden business, and our obvious aim is to provide fresh product to new market areas.

'Apart from Sydney and Melbourne, most Australians do not have access to fresh product, and are forced to rely on imported frozen fish.

'Our only real weapon against this foreign frozen fish invasion is fresh, well-presented Australian fish, delivered as ordered, and ready for the cook. We have found in restaurants that once customers have tasted fresh, well-presented fish they come back for more. Our only frozen product will be bait.'

Mr Barton said the Eden Fish Packing Co. complex was almost completed and would allow the company to market trawler catches and process orders. Product would be distributed by chiller vehicles to the kitchens of motels, hotels, clubs and restaurants.

'Through our contacts in the industry we will also be marketing rock lobsters, oysters, prawns and scallops,' he said.

'If Eden boats don't catch it, some of our mates elsewhere will

supply us. We have friends catching prawns on the north coast and rock lobsters in Bass Strait.

'We hope our efforts will help both the fishermen and the catering trade, particularly in country areas.'

US to take part in Law of the Sea Conference

THE United States, following a review of its policies towards the Law of the Sea, has decided to resume participation in the Law of the Sea Conference, President Reagan announced recently.

Welcoming the announcement, the Minister for Foreign Affairs, Mr Tony Street, said the Conference was scheduled to begin what was intended to be its final negotiating session in New York in March-April this year.

Mr Street said the Conference was an attempt by the international community to bring order and certainty to an area covering seven-tenths of the earth's surface — an area where legal doubts and uncertainty currently existed.

After more than eight years of painstaking work the Conference had produced a draft convention containing over 350 articles on every aspect of the Law of the Sea.

Mr Street recalled that successive Australian Governments had taken the view that Australia's substantial interests in the Law of the Sea would best be protected by the early adoption of a comprehensive and widely accepted Convention.

Australia had on several occasions expressed the hope to the United States Government that the result of its review would be a decision to re-join with the rest of the international community in working for the successful conclusion of such a Convention. He said the House of Representatives had made the same point in the resolution on the Law of the Sea Conference

that it had adopted unanimously on September 17 last year.

Now that the United States' decision had been made, Mr Street emphasised that he hoped that the United States, and indeed all parties, would adopt a constructive attitude towards achieving a comprehensive and widely accepted Convention, and enable the Conference to conclude its work at the forthcoming Session.

New restrictions in Coral Sea Islands

SEARCHING for or taking various seabed dwelling animals from the continental shelf of the Coral Sea Islands Territory, east of the Great Barrier Reef, is to be regulated.

The Minister for Primary Industry, Mr Peter Nixon, said last month that a licence would be required to take a wide range of organisms, including corals, beche-de-mer, clams, trochus and triton shells.

Mr Nixon said that an increasing number of reports were being received of fishing activities in the Coral Sea. In some cases, fishermen may have been taking clams and there was a need to protect these and other sedentary species in this area and in adjacent sections of the Great Barrier Reef.

A notice giving effect to the new restrictions would be published in the near future, Mr Nixon said.

\$2 m fishing port for Yamba

DREDGING for a new \$2 million boat harbour at Yamba on the Clarence River in northern New South Wales has commenced.

The State Department of Public Works let a \$618 000 contract late last year for dredging and associated works in the first stage of the project.

At present about 90 vessels berth in the Clarence River, either at Iluka on the north shore or Yamba on the south.

Australian Fisheries, March, 1982

In this issue

A hard year

Many sectors of the Australian fishing industry had another hard year in 1981 as most of the economic and marketing problems faced in the previous year continued. An article beginning on page 2 explains what went wrong and looks at prospects for this year.

BAE fisheries role

Commonwealth responsibility for research into the economics of the fishing industry has been transferred from the Fisheries Division to the Bureau of Agricultural Economics. An article beginning on page 14 outlines what the move will mean for the fishing industry.

Problems in paradise

Fishing everywhere has been seriously affected by rising fuel prices, but the problems faced by Australia's small, undeveloped Pacific Island neighbours are particularly acute. University of the South Pacific scientist Dr Leon Zann examines those problems and the steps being taken to overcome them in an article beginning on page 26.

Trawling for profit

The Tober family of Portland in Victoria are proving that fish-trawling can be profitable — but they have developed a special formula for success. See pages 30-33.

Handling fish

A conference in the United States last year looked at the basics of fish handling and at advances in the technology of chilling, freezing, processing, storage and transport, both at sea and ashore. CSIRO food technologist Stephen Thrower, who attended the conference, describes some developments that may have an application in Australia in an article beginning on page 38.

Queensland oysters

At the turn of the century the oyster industry was southern Queensland's largest fishery but today it is one of the smallest. On pages 42-45 Glen Smith, a technician with the Queensland Department of Primary Industries' Fisheries Research Branch, examines the reasons for the industry's decline.

Front cover

Fisherman Dieter Shuelein cleaning a day's catch of snapper and bream at Seal Rocks (NSW). Photo by Jeremiah S. Sullivan.

Australian Fisheries

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GAINESVILLE, 32611



DEPARTMENT OF ZOOLOGY
223 BARTRAM HALL
904-392-1107

4 August 1983

The Director
World Wildlife Fund Indonesia
P. O. Box 133
Bogor, Indonesia

Dear Sir:

Reports of the high levels of exploitation of marine turtles in Indonesia have caused growing concern among the members of the IUCN Marine Turtle Specialist Group. At a recent meeting, I was asked by the membership of the Group to urge you to give proposals for monitoring the levels of exploitation of sea turtles in Indonesia your serious consideration.

Many of the sea turtles harvested in Indonesia are migrants from nesting beaches in western Australia. Although these populations are protected in Australia, the high rate of capture in Indonesian waters may well undermine the effects of the Australian conservation efforts. The turtle populations that both nest and feed in Indonesian waters are under an even greater pressure because they are harvested in both breeding and foraging habitats.

Any WWF money spent to assess levels of exploitation, either in cooperation with Australia or unilaterally, would be a wise and important investment of conservation funds. I hope that you will find it possible to take appropriate action toward furthering the conservation of this important resource.

Sincerely yours,

A handwritten signature in cursive script that reads "Archie Carr".

Archie Carr
Chairman, IUCN Marine Turtle
Specialist Group

CSIRO

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26th July 1983

Mr. G. Balazs,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
HONOLULU, HAWAII 96812,
U.S.A.

Dear George,

Here, at long last, is my turtle manuscript for your comments and criticisms. If your criticisms are minor, please fill in the enclosed form (CSIRO policy concerning internal reviews). If your criticisms are major, forget about the form and I'll go back to the drawing board on the MS.

Here, also is your sand sample data, about which one can make the following comments:

1. The East Isle data look very strange - they contained 20 or more times as much moisture as your other samples and my samples. Somewhere along the way there must have been a goof.
2. I don't know which of your Rose Atoll samples are nesting and which are non-nesting beach samples. I hope you kept records. If the results accorded with mine I'd guess that sample groups 3,4 and 5 came from nesting beaches.
3. The correlation between surface sand salt-content and the salinity of underlying sand moisture doesn't look good, but there are only five groups of samples to compare. I doubt if I would have found a relationship in my data with just five samples. (I used 20).

Let me know what conclusions you draw from the data. I couldn't analyze the data statistically because I didn't know which samples were from nesting beaches.

It looks as if I'll tackle the turtle report for NMFS. Unfortunately, the areas they want to know most about, Hawaii and Guam, I feel least able to do a good job on. Guam because there isn't much information. Hawaii because the ratio of information I possess to available information is low. After I write a rough draft of the Hawaii section I'd like to send it to you for your comments and suggestions concerning additional sources of information if I may. I can't wait until I finish the whole thing before doing so because they want it by Dec. 1 and I don't expect to finish it much before then.

2/...

26th July 1983

Hmm! I just found your letter describing the locations where the Rose Atoll samples were taken. It appears that my predictions as to which samples came from nesting beaches are almost exactly opposite to the truth. The non-nesting areas produced the sand with the lowest "bottom" salinities.

There is probably a lot more salt spray deposited under Messerschmidia than on open beaches because of the leaves trapping it and dropping it with rain. (Most of my samples were taken in areas of comparable plant cover, irrespective of whether they were nesting or non-nesting beaches). Also Messerschmidia would have a high transpiration rate and draw up a lot of water from the groundwater and leave the salt behind around its roots. But that really doesn't explain very much. The problem gets curiouser and curiouser.

See
Bustard-
nest into
vegetation

Cheers,



R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

P.S. Peggy Hodge in her Windward column says that female turtles have a refuge that males respect. This is an article in which she interviewed you. Is this correct? I've never heard of it before.

sent
FACT
SHEET

7-SEPTEMBER-83

7-9-83

JEFF DEALON
SEALIFE DIVEMASTER
LORD HOWE ISLAND
2898

LORD HOWE ISLAND

2898

Dear George.

Regret not having corresponded sooner but I have just returned to Lord Howe after being away for some time but am now here for a two year period so will endeavor to keep an accurate record of turtle sightings around the island.

Unfortunately the turtles have proved hard to approach so still don't have any good photos to send you but a ~~marine~~ biologist who has been here for the past two weeks has positively identified them as green sea turtles and also confirmed some areas of turtle grass around Neds beach and in the lagoon. Both these areas have resident turtles which we and other snorkelling tourists see quite often. There are a lot of areas where sea grasses ^{and algae} are abundant, particularly on the more sheltered western side and if I can pinpoint any areas where turtles are seen regularly by our divers I'll check for ~~at~~ turtle grass beds.

Without actually measuring some of the larger specimens I saw last season I would approximate their shell length to be just over one metre or almost 4 feet if you use that system. No, I nor any of our divers have never seen turtles copulating. It's very rare to see two together or even two or the one dive.

The turtles I have seen resting on the bottom have been of small to medium length, some have apparently been asleep as I have approached almost to touching distance before they have spooked. This always occurs when I don't have a camera. I have not yet seen turtles actually feeding. Unfortunately my knowledge of algae & sea grasses is limited as I've never had any interest in them but if we have any more marine biologists here I'll see what can be found out.

As far as I know nobody goes to the inaccessible blacks on the eastern side but as soon as we get some calm seas I'll go have a look so we know what's there. From a distance they seem very rocky, ~~as~~ mainly small boulders and stones.

The turtles I have ^{seen} ~~seen~~ ^{under the water} have all been in reasonably shallow water - up to 60 feet and most have been swimming just under the surface. The ones I have seen from the boat have been in waters close to the island ranging from 50 to 80 feet, ^{more common} or over shallower reefs.

The turtles were more common in summer last season from January to March, when the water is warmer and on some boat trips to dive sites 5 sightings during one outing was not unusual.

I have spoken to some of the older local people and discovered that they occasionally ate turtles in the old days (i.e. over 50 years ago) and also turtle eggs but couldn't recall when

the eggs were found. One old fisherman remembers seeing a baby turtle in the south passage of the lagoon many years ago and judging by the size he was of the opinion it had recently hatched but it was definitely alone.

I hope these answers to your questions are of some help and once again apologize for being so slack in answering but shall endeavor to do better over the next 24 months with an accurate record of turtle sightings. We have only been operating for the last two weeks and in that time have only been to sea 5 times due to bad weather. On those outings no turtles were seen underwater but one was sighted from the cliffs at Beach island and one just outside the lagoon at North lead.

Thanks for the interesting articles and the excellent material you forwarded last year.

Yours sincerely

Jeff Deacer

Sealife Dive Master.

June 17, 1985

F/SWC2:GHB

Mr. Jeff Deacon
Sealife Divemaster
Lord Howe Island
Australia 2898

Dear Jeff,

I am sure you will recall our correspondence 2 years ago concerning my interest in the sighting of sea turtles at Lord Howe Island. In your last letter to me on this subject, you mentioned that turtles were more common during the summer season, and that over a 24-month period you would try to compile an accurate record of sightings. Were you able to accomplish this ambitious, but potentially very important task? If so, I would greatly appreciate hearing about your results.

I hope that your time spent at Lord Howe Island has been enjoyable and rewarding, and that this letter reaches you at your present residence.

Sincerely,

George H. Balazs
Zoologist

cc: Balazs
HL

May 12, 1982

Mr. Jeff Deacon
Sealife Divemaster
Leanda Lei
Lord Howe Island
N.S.W. Australia

Dear Mr. Deacon:

Many thanks for your interesting and informative letter of April 24th concerning sea turtles at Lord Howe Island. I certainly appreciate this response, and look forward to receiving any other information you may come across.

Do the inaccessible beaches you mentioned ever get visited? If so, the tracks and diggings of turtles would be apparent, even several months after nesting takes place. What would the size be (approx. shell length) of the largest turtles you see around the island? Have you ever seen turtles copulating? What are the turtles doing when you see them underwater? Feeding? Sleeping on the bottom? If the turtles present are green sea turtles (Chelonia mydas), then they undoubtedly feed on seaweed (algae) or sea grasses. Do you have areas where this marine vegetation is abundant? Do you know what kinds are present? At what depth are most of the turtles seen? What is the greatest number you have seen at one time?

I realize that I've asked you many questions, and hopefully you won't view this as an inconvenience. I have a keen interest in the turtles at your island. Working together, we should be able to find out some interesting things about them. For your interest, I have enclosed several pieces of literature dealing with sea turtles. I look forward to hearing from you when your time permits.

Best regards,

GEORGE H. BALAZS
Assistant Marine Biologist

GHB:ec
Enclosures

REJ:jt

2nd June 1982

Mr. G. Balazs,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
HONOLULU, HAWAII 96812,
U.S.A.

Dear George,

To keep you up to date with my turtle work:

~~I have measured the salinity of the sand moisture in 15 nesting beaches and 15 non-nesting beaches that are visually indistinguishable from the former and interspersed with them on North West Cape. The salinity in the nesting beaches was half that in the non-nesting beaches. I'm going up in two weeks to do some more work.~~

The results appear to explain a number of unexplained phenomena in sea turtle biology, including the recent Georgia work on sand temperature differences that seem to relate to loggerhead nesting site choice. I'll be writing up a manuscript in July and I hope you'll be willing to serve as a pre-submission referee - which is CSIRO policy.

Do you know of any references to sea turtles other than Chelonia whose eggs require low salinity sand moisture? I saw an ASE abstract, 1978, Vol. 25, Part II, page 90, indicating that loggerhead eggs also need low salinity moisture, but I seem to have misplaced it. Do you have a copy? We don't carry this journal in Perth.

Thanks for the poster and the post cards.

May I have a copy of your Tokelau report?

Have you ever come across anything on the release of nitrogenous wastes by turtle eggs. Apparently the eggs lose nitrogen during development. I'm guessing that it would be lost as ammonia gas, but can't find any literature. (I'm trying to figure out why turtle eggs should require low salinity moisture, but haven't come up with anything yet).

I know about
all about storage
- but is there
a large fee?

With regard to your question of some time ago about whether very small islands could store freshwater: Not a lot of small islands have been examined in this regard. But there are a number of records. The smallest island with a freshwater lens that I've found in the literature so far measures 300 ft by 400 ft and is in a region of "only moderate" rainfall.

With regard to finding funds for more turtle work - to respond to a question you asked some months ago. Have you considered World Wildlife Fund? If you tried and succeeded in getting money to work in WA - where there are loads of sea turtles and no turtle workers unless you count me (Kowalski is working on crayfish nutrition) - I'm pretty sure I could find you some office space and secretarial assistance, either at this lab or in a University lab. Paul Anderson is out here for a year working on dugongs. You might ask him where he got his money. If you care to you can send him a letter care of me.

Cheers,



R.E. Johannes

TO OPEN SLIT HERE FIRST

BY AIR MAIL

PAR AVION

AEROGRAMME



Mr. G. Balazs,
 National Marine Fisheries Service,
 Southwest Fisheries Center,
 Honolulu Laboratory,
 HONOLULU, HAWAII 96812,
 U.S.A.

COUNTRY OF DESTINATION

SENDER'S NAME AND ADDRESS

R. E. JOHANNES
 CSIRO
 FISHERIES & OCEANOGRAPHY
 P.O. BOX 20,
 NORTH BEACH
 W.A. 6020

POSTCODE

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~~100
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24-4-82

JEFF DEACON
SEALIFE DIVERMASTER
LEANDA LEI

Dear Sir

As a seasonal scuba diving operator at Lord Howe Island I have had regular sightings of turtles both above and below the water. Our season here is from October through to May which coincides with the warmer weather and the warmest water. During this time our diving groups consistently see turtles but unfortunately I haven't taken enough time of any peak period or if they are of different species. To the best of my knowledge they are the common green sea turtle. There is reference material regarding turtles on hand here.

After extensive questioning among the local people I have found no evidence of the turtles ever coming ashore to lay eggs.

Col

However there are quite a few inaccessible beaches around the shores of Lord Howe where it would be possible. We have never seen any juvenile turtles in the water, the smallest would be about 13" long. ^{largest?}

I hope this letter is of some help to you in your research. I will forward your letter to my brother Kevin Deacon who is a well known underwater photographer and may be able to provide pictures of the local turtles as he has dived here extensively.

Yours sincerely
Jeff Deacon
Divermaster for Sealife Dive Co.
27 Alfreda Street
Geogee. N.S.W.
2034

J Deacon
Leanda Lei
Lord Howe Island 2098
Australia

REJ:jt

13th September 1982

Mr. G.H. Balazs,
National Marine Fisheries Service,
Honolulu Laboratory,
PO Box 3830,
HONOLULU, HAWAII 96812

Dear George,

Many thanks for the sand samples from French Frigate Shoals.

It may be a few weeks before I can get them analyzed. I'm travelling a lot these days, and in a rush to get ready for another trip tomorrow.

Am getting involved in an 18 month study of artisanal fisheries in the Torres Straits. Will undoubtedly be involved with turtles there to some extent since they are a major staple, along with dugong, of the islanders.

In Lampus's review of the status of sea turtles in Australia he refers to "isolated records" of flatback nesting in W.A.

A guy came in the other day with stories of what is apparently a fairly major flatback nesting site somewhere north of the Dampier archipelago. I haven't time to find my notes on this at the moment. In any event the presence of a flatback in a shark in WA does not appear to constitute a major range extension.

I see by my notes that Hendrickson located a flatback nesting colony at Cape Thoun near Port Hedland. Also, see enclosed newspaper article.

Gotta rush.

Cheers,

R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

P.S. When you get to Rose Atoll be sure to get some sand samples from non-nesting, as well as nesting beaches.

BY AIR MAIL

PAR AVION

AEROGRAMME



Mr. G.H. Balazs,
National Marine Fisheries Service,
Honolulu Laboratory,
PO Box 3830,
HONOLULU, HAWAII 96812
U.S.A.

COUNTRY OF DESTINATION

SENDER'S NAME AND ADDRESS

POSTCODE

FOLD FLAPS BEFORE MOISTENING GUM. FOR
MAXIMUM ADHESION, PRESS DOWN FOR A FEW SECONDS.
IF ANYTHING IS ENCLOSED OR ANY TAPE OR STICKER ATTACHED,
THIS FORM MUST BEAR POSTAGE AT THE RATE FOR AIR MAIL LETTERS.

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Urban wildlife

The Nature Conservancy Council (NCC), the Royal Society for Nature Conservation (RSNC), and CoEnCo have joined forces to produce a schools pack designed to encourage interest in urban wildlife. The pack consists of a teacher's guide, a colour poster and a broadsheet, and is available at £2.95 (including p & p) from RSNC, *The Green, Nettleham, Lincoln LN2*.

Shelduck moult

More and more shelduck (*Tadorna tadorna*) are staying in Britain to moult, rather than making the traditional 'moult migration' to the West German Knechtsand. According to a report in *Bird Study* (Vol 29 part 2), moulting flocks have been observed on the Humber, and it was suggested that estuaries other than those previously studied (Bridgewater Bay, Firth of Forth, and the Wash) may contain moulting birds. The reason for this could be linked to an increasing shelduck population, or it may be that the birds are now finding sufficiently undisturbed areas with adequate food supplies on British estuaries.

Falkland manoeuvres

Military training manoeuvres in the Falkland Islands will be carried out in a way that won't interfere with the wildlife of the area, claims Major John Charteris of the Royal Scots. Major Charteris, Forces Conservation Officer and Joint Forces Training Officer, says that conservation regions have been established to protect the huge colonies of penguins, petrels, and albatrosses. He is confident that these, and other Falklands wildlife, including kelp and upland geese, sea lions, and sea elephants, will be unharmed by the 4,000 soldiers who will be taking part in the exercises. Another reason for keeping the airforce and wildlife apart is that a collision between a bird and an aircraft could cause a serious accident. (*The Times*)

At the Museum

The following films and lectures will take place, free of charge, at 3pm in the Lecture Theatre of the Natural History Museum, *Cromwell Road, London SW7*: January 6, *Nature Detectives*; 13, *Animal Partnerships*; 18, *Silk Makers*; 20, *Small Mammals in Britain*; 22, *Birds in London*; 25, *Life in the Dark*; 27, *Trees in Winter*; 29, *Whales* (film).

US wilderness fight

An oil company began drilling in a Federal wilderness area in New Mexico in November, despite a Congressional ban on such drilling, and the refusal of the US Interior Department to grant a permit. The situation has been made difficult by the fact that the subsurface rights to minerals in the Federal wilderness are owned by the State of New Mexico, which had granted Yates Petroleum a permit to drill. The Interior Department's Fish and Wildlife Service has issued a trespassing citation, but the oil company is continuing to drill while the Interior Department decides if there is any other course of action it can take. Conservationists have warned that if the Government does not halt the drilling, a precedent could be set which would threaten other wilderness areas. (*New York Times*)

Barrier Reef battle

Australian Prime Minister Malcolm Fraser and Queensland Premier Bjelke Petersen have fallen out over the Great Barrier Reef. Despite the fact that an Act was passed in 1975 empowering the Australian Government to declare the reef a marine park, the Queensland Government has given park status to only 2.4 per cent of the reef. Malcolm Fraser recently overrode Queensland and declared the 550-kilometre Cairns Section a marine park. Premier Petersen replied by saying he did not want the reef to be a playground for conservationists and scientists.

Gunter Ziesler



Why elks have beards

Kaarlo Nygren, a Finnish scientist studying sparring contests between bull elks in the rutting season, believes that contestants are matched not by their body size but by the length of their beards. He concludes that the length and breadth of an elk's beard, the size of its antlers, determines an animal's status in the herd. (*Tier* 10/82)

Koala disease

The koala 'bear' is threatened with extinction in some parts of Australia where 90 per cent of female koalas are suffering from a mysterious disease which impairs their reproductive abilities. Between 1887 and 1889 and at the beginning of the 20th century, similar epidemics wiped out huge numbers of koalas. (*Tier* No 10)

1983 field courses

The Field Studies Council 1983 Programme of Field Courses is now available from the FSC, *Preston Montford, Montford Bridge, Shrewsbury SY4 1HW*; please include a 12½p stamp and a self-addressed label. Courses cover the whole range of natural history and are suitable for beginners and professionals. The FSC also runs field courses overseas.

Dinosaur Club

A new club designed to introduce children to the world of prehistoric reptiles has been launched. Called the Dinosaur Club, it is partly educational and partly social, and offers members a newsletter, field and museum trips, and information on the latest dinosaur discoveries. Further details from *The Dinosaur Club*, 29 Rydal Avenue, Tilehurst, Reading RG3 6XT.

Plants clean sewage

Australian scientists have discovered that sewage effluent can be effectively purified simply by passing it over native water weeds, which also remove the nitrogen and phosphorus that feed plants in rivers. *The Living Earth* (Vol 23, No 2 & 3) reports that the Sydney Water Board is interested in the idea.

Bracken spreads

Bracken, mainly a woodland plant, is gradually adapting to pasture conditions - all because we are losing so much of our woodland. The fern is spreading at the rate of 2 per cent per year, and already covers some 122,000 hectares of British countryside, of which two-thirds is in Scotland. (*Farmers Weekly* Vol 97, No 14)

Dear Camera Care Systems

"I have just returned from the USA where I walked the 2,600 mile Pacific Crest Trail... during the five and a half month walk the cases were magnificent and gave complete protection against rain, snow, wind, desert dust (particularly insidious that stuff!) and collisions with trees, rocks, ice etc. While descending from Glen Pass in the High Sierra... my rucksack burst open, one of my cameras tumbled about 1,000 feet across hard snow, bouncing off a couple of rocks on the way down. When I retrieved it, the camera was unmarked and worked perfectly. Whilst I wouldn't recommend doing this, it does show how good your cases are."

Chris Townsend, Manchester.


We think satisfied customers are our best advertisement.

Send 25p stamp for our new catalogue, and up to date information of our British-made product; range for camera protection in the outdoors. **Camera Care Systems**, 30 Alexandra Road, Clevedon, Avon BS21 7QH. Telephone (0272) 871791



SLR Pouch, Better Belt and Standard Lens Protector in use while carrying a 65 litre capacity rucksack

JANUARY 30, 1983

 World Environment Report

News and Information on International Resource Management

Great Barrier reef needs more protection

PERTH--Australia's Great Barrier Reef is the largest construction on Earth made by living creatures.

The reef begins some 50 kilometers from the mainland drawing closer in more northerly latitudes and then stretching eastward into the Pacific. Formed from the skeletons of countless coral polyps, the reef is based on an ancient mountain range that is slowly subsiding. As the mountains once rose in peaks and fell into canyons, so do the living coral structures. In all, the labyrinth of reefs and coral islands stretches 20,000 kilometers from north of Brisbane to the Papua New Guinea coastline.

The upward growth is limited by prolonged exposure to the atmosphere, and the reef tops tend to be stunted and close knit. It takes million of years for a reef to grow and millions more for an island to develop and become vegetated.

The Great Barrier Reef region covers 350,000 square kilometers. Of this, 12,000 square kilometers of the southern part have been zoned as the Capricornia section of the reef's marine park. This does not mean total protection, but it is a good start. A second part of the marine park is now being zoned. Located to the north, out from Cairns, it covers 36,000 square kilometers and is the largest marine park in the world.

Diver Valerie Taylor writes in the Australian publication, "The Bulletin," that "The reef would benefit greatly if three rules covered the whole length--to protect the reef against commercial mineral exploration, commercial spearfishing and spearfishing by people using scuba gear.

"By 1983 the Great Barrier Reef Marine Park Authority will control only 13 percent of the reef. So far, less than one-twentieth is protected totally against abuse of any kind and only one individual reef has national park status."

Taylor says the reef is "home of the richest varieties of marine animals on Earth. It has stood for centuries untouched. But progress has turned its destructive gaze upon this great reef. The dangers of drilling the reef for oil are apparent. Mining claims dot the more remote Coral Sea islands, and oil exploration is underway in the sea itself. Commercial dredging for shells, as well as prawn and scallop trawling, leave a path of dead bottom dwelling creatures in their wake. Overfishing by both commercial and sports fisherman has caused a tremendous decline in edible fish species. The Great Barrier Reef doesn't belong to any one person or group of persons. It belongs to all of us."

And although there are conflicting pressures on the reef, the government has begun the process of protecting it. ANNE BLOEMEN



JAMES COOK UNIVERSITY OF NORTH QUEENSLAND

POSTAL ADDRESS:
Post Office,
James Cook University, Q. 4811,
AUSTRALIA.

TELEPHONE:
Townsville (077) 814111

TELEX:
AA47009

Dear George,

This is just a quick note to thank you for your reports. Fascinating. At the moment I am in the throes of thesis writing so I shall write to you more fully when that is over. And will certainly send you a copy of the bathing note when it is ready. I'm sure there must be a summary of Australia which attaches somewhere - I'll get the library onto it as soon as possible.

I take your point about the communal nature of hatchlings although in the wild I don't think they could live at the density we had at the Torres Strait farms. In my thesis I have rather testily returned to Henderson's (1974) idea that at high densities dominance hierarchies could not develop. I know there is no evidence that dominance hierarchies occur in wild populations but then they never occur at comparable densities. In birds at feeding tables dominance hierarchies develop among species which are otherwise solitary.

Did I mention in my last letter Hansson's paper on hatchling basking. Tom Hansson (1955) Sarawak Mus. J. mentioned that his hatchlings enjoyed an area to haul out on on occasions - you probably know the article but I can get you a copy if you like. Interesting in the light of your own ~~and~~ observations

and those on the hatching transmitters drifting into traps.

Yes it is worrying that so many turtles are taken in the Torres Strait area although I do think 10000 is an overestimate. And it would create a lot of bitterness among a group of people who are already bureaucratically suppressed - the Torres Strait Islanders - if turtle hunting was ever made illegal. What is needed - both in Australia and New Guinea - is a public relations programme aimed at reducing the slaughter to ceremonial occasions while providing an alternative source of protein. The administration of the Torres Strait by the state of Queensland who rip off the islanders with high food prices only exacerbates the problem. I estimated that turtle meat made up about half the protein intake of the people at Badu when I lived for a year and the diet was still unbalanced towards carbohydrate. Any laws that tried to prevent turtle hunting would be unenforceable.

Anyway, thank you very much for the papers. I have some comments to make but I'd like to think about the first. - end first synthesis.

Kind regards
Stephen Garnett.

and those on the hatchling transmitters drifting into swamps.

Yes it is worrying that so many turtles are taken in the Torres Strait area although I do think 10000 is an overestimate. And it would create a lot of bitterness among a group of people who are already bureaucratically suppressed - the Torres Strait islanders - if turtle ~~hunting~~ was ever made illegal. What is needed - both in Australia and New Guinea - is a public relations programme aimed at reducing the slaughter ~~to~~ to ceremonial occasions while providing an alternative source of protein. The administration of the Torres Strait by the state of Queensland who rip off the islanders with high food prices only exacerbates the problem. I estimated that turtle meat made up about half the protein intake of the people at Badu when I lived for a year and the diet was still unbalanced towards carbohydrate. Any laws that tried to prevent turtle hunting would be unenforceable.

Anyway, thank you very much for the papers. I have some comments to make but I'd like to think about the first. - and finish my thesis.

Kind regards
Stephen Garnett.

CSIRO

Division of Fisheries and Oceanography

A Division of the Institute of Biological Sciences

Western Regional Laboratory
Leach Street, Marmion, Western Australia

P.O. Box 20, North Beach, Western Australia 6020
Telephone (08) 447 1388, 447 1375
Telex 83366

REJ/sm

31 December 1981.

Mr. G. Balazs,
U.S. Department of Commerce,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
P.O. Box 3830,
HONOLULU, HAWAII 96812.

Dear George,

Since you didn't say why you wanted photos of basking turtles I guessed (wrongly) that you were interested in their position and stance on the beach. In consequence I took most of the pictures from some distance, to enable me to get more of the beach, and sometimes several turtles in the picture. Most of the turtles were too far away for you to get much of a feel for shell morphology. I'm enclosing what appear to be the only useful photos for that purpose. I'll probably go up to Exmouth again in late February. If you want some more pictures, tell me more precisely what you need.

Although the powers that be here backed down in their efforts to stop me from working on turtles they are now sensitized to turtle research and have told one of our Queensland guys that he cannot even act as advisor to a graduate student who wants to work on turtle genetics. Moreover, they say, he cannot publish anything on turtles giving CSIRO as the source of support - and if he does the publication will not be counted towards promotion. Save us from little minds in big positions! The person who delivered this ultimatum said that she didn't really believe that turtles were of great international interest and significance. (She's a sheltered plant physiologist). So-what do you have in your files that might best be used to correct her impression that only a few misguided academics are interested in marine turtles?

Cheers,

R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

P.S. Several international organizations have recommended that the islands off Aleipata where the turtle hatchery eggs in Western Samoa

are collected, should be set aside as a national park. The UN guy who pushed through the existing parks is now gone and the local guy, who is head of parks and reserves, is pretty light-weight. If you have the time (I didn't) and the inclination while in Western Samoa, you might try to find out from people in the area just what hardships such a park might impose upon them and what might be done to make a park acceptable to them.

LORD HOWE ISLAND BOARD

Department of Lands

BRIDGE ST. SYDNEY



75-270

TELEGRAPHIC ADDRESS—LANDREP. SYDNEY.

ADDRESS ALL CORRESPONDENCE
TO SECRETARY, LORD HOWE ISLAND BOARD,
BOX 39 G.P.O. SYDNEY 2001

10 FEB 1982 19

Mr. G. H. Balazs,
Assistant Marine Biologist,
Hawaii Institute of Marine Biology,
University of Hawaii at Manoa,
P.O. Box, 1346, Coconut Island,
KANEOHE. HAWAII 96744

TELEPHONE 20579 Ext. 407

PLEASE QUOTE H080 A 298
JPC:RR

Dear Mr. Balazs,

Reference is made to your letter of 12th February, 1982, seeking information on the presence of sea turtles at Lord Howe Island.

Your letter has been referred to the Administrative Officer on Lord Howe Island who will make enquiries on the Island and reply direct to you.

Yours sincerely,

R. J. Morgan

R. J. MORGAN,
Secretary,
LORD HOWE ISLAND BOARD.

REJ:jt

18th November 1981

Mr. G. Balazs,
U.S. Department of Commerce,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
P.O. Box 3830,
HONOLULU, HAWAII 96812

Dear George,

Spent a week at North West Cape watching turtles mate, nest etc. For some reason the ghost crabs were not preying on the eggs as they did last year. I'm wondering if the explanation is that this predation is a lunar periodic phenomenon and doesn't occur during bright moonlit nights around full moon (which was when we were there). Not a very impressive hypothesis, but I can't think of a better one - they were doing it last year.

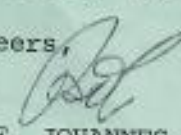
Saw lots of basking turtles. Took some photos, which haven't been sent off for development yet. Measured carapace length and width for 29 baskers, including three males. Most just rested in the swash zone. Often males hung around close by in the water and mounted the females when they moved back into the water as a consequence of our measuring activities. The females thwarted the male advances by ~~always~~ facing them head on. Only two of the 29 we measured had crawled a few feet up the beach from the swash zone. We saw baskers as early as 0630 in the daytime and also saw one basking from 1930 to 2300 and another for an hour or so during the same night-time period. Basking times and position in surf indicate heating up in the sun can't be the only reason. The basking of males indicates rape-escape can't be the only reason either. Average carapace dimensions ^{about} 90 cm by 100 cm with rather small range. Shell morphology, color and pattern quite variable - some highly domed, others not.

Let me know what use, if any, you can make of any of these observations and I'll provide more details. What, specifically, are you looking for in the photos of basking turtles? In other words what should I be looking for in choosing among the photos of which to send you copies. I discovered that, as occurs with some fishes, if you cover the eyes, the animal ceases to struggle. Once I figured this out measuring them was much easier; I just knelt in front and clapped the head gently between my legs. Might be dangerous with species that bite though!

The night-viewing device I used was superb for watching turtles crawl, nest, and even swim about in the middle of the night. As bright as daylight under full moon. Would probably work with only starlight. I think George Losey has one.

got your note
Hope the Tuamotu trip was profitable. I'll be spending a week in Western Samoa in the middle of December (working on fisheries, not turtles).

Cheers,


R.E. JOHANNES

TO OPEN SLIT HERE FIRST

BY AIR MAIL

PAR AVION

AEROGRAMME



Mr. G. Balazs,
 U.S. Department of Commerce,
 National Marine Fisheries Service,
 Southwest Fisheries Center,
 Honolulu Laboratory,
 P.O. Box 3830,
 HONOLULU, HAWAII 96812

COUNTRY OF DESTINATION

SENDER'S NAME AND ADDRESS

R. E. JOHANNES
 C S I R O
 FISHERIES & OCEANOGRAPHY
 P.O. BOX 20,
 NORTH BEACH
 W.A. 6020

POSTCODE

FOLD FLAPS BEFORE MOISTENING GUM. FOR
 MAXIMUM ADHESION, PRESS DOWN FOR A FEW SECONDS.
 IF ANYTHING IS ENCLOSED OR ANY TAPE OR STICKER ATTACHED,
 THIS FORM MUST BEAR POSTAGE AT THE RATE FOR AIR MAIL LETTERS.

SECOND FOLD HERE

FIRST FOLD HERE

Western Regional Laboratory
Leach Street, Marmion, Western Australia

P.O. Box 20, North Beach, Western Australia 6020
Telephone (09) 447 1388, 447 1375
Telex 93386

REJ:jt

1st October 1981

Mr. George Balazs,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
HONOLULU, HAWAII 96812,
U.S.A.

Dear George,

Thanks for your letter of September 22, and the useful enclosures.

To respond to the most important point first. I'm sorry to say that the job situation in Australia is no better than it is in the U.S. In addition the W.A. Fisheries and Wildlife people are very commercially oriented in their research and do not intend to spend any money on turtle work. (Turtles, however, are in their "jurisdiction" and I had to get permission from them to work on them). If you got your own money from IUCN or whatever, we could provide desk space and secretarial assistance for you, but that's about it. We're overcrowded and over our position ceiling and over our budget. (it's getting to be an old story isn't it).

As for groundwater cooling turtle eggs, I don't know. If the eggs were sitting in the groundwater the answer would be yes. But the eggs are above the water table sitting simply in moisture associated with the percolation of rain or the upward movement of groundwater by capillary action. I don't know how far down into the sand evaporation of this water would be significant enough to cool it, nor if the moisture would be sufficient because of its high specific heat to buffer diurnal temperature changes significantly at egg depths. There ought to be something relevant in the literature and I'll look out for it.

With regard to green turtles nesting at French Frigate Shoals in the low rainfall period. This is not inconsistent with groundwater influencing the nesting sand. Groundwater flows through the earth horizontally at very slow rates - of the order of meters or tens of meters per year. Sufficient seepage to keep the sand moisture near the beach at lower than seawater salinities can occur many months after the last rain as a consequence of the head created by the Ghyben-Herzberg lens - see accompanying sketch. Even at places like Bikar groundwater must occur throughout the year, otherwise you wouldn't have the plants you find there.

2/.....

Mr. George Balazs

-2-

1st October 1981

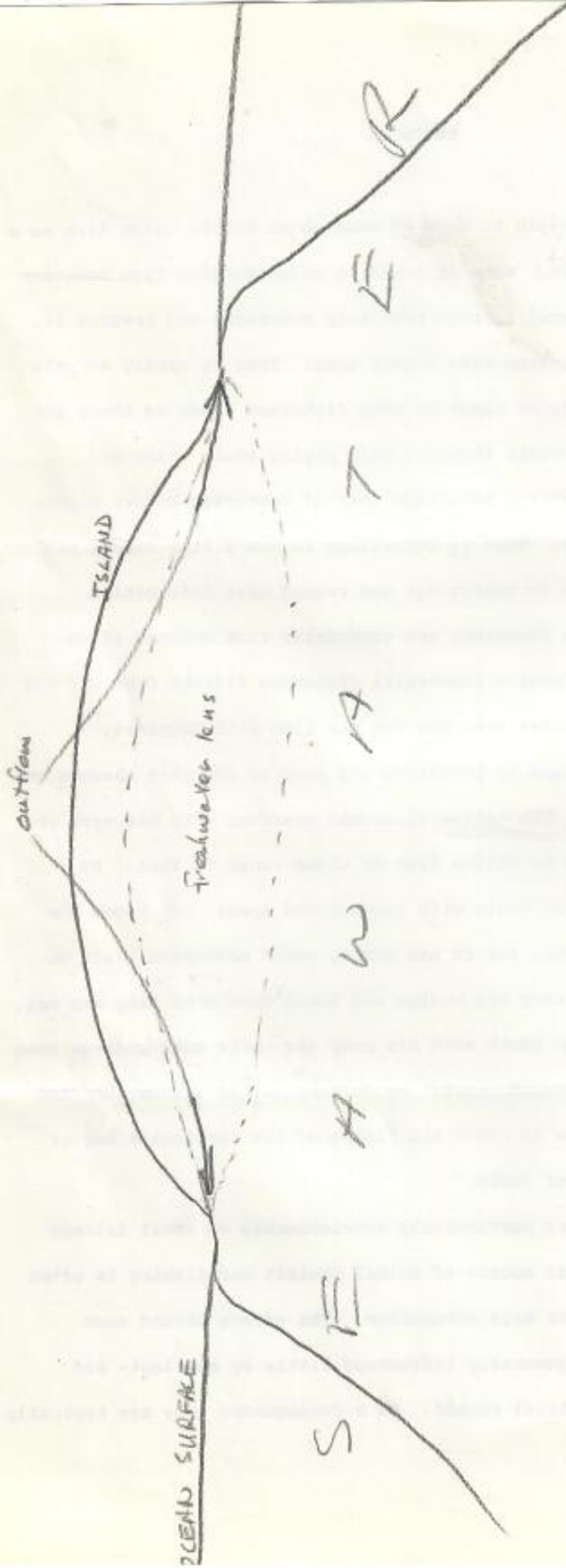
Kay's Turtles must be a rare book. I haven't been able to find it in W.A. or at AIMS or in the CSIRO main library in Sydney.

Cheers,



R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

P.S. Burbidge didn't publish anything on nesting site or anything else unfortunately.



5

PREFACE

Few people would claim to know as much about how to catch fish as a good full-time fisherman. When it comes to understanding fish behavior and the many environmental factors that help determine and predict it, marine biologists must often take a back seat. This is hardly surprising. There are hundreds of times as many fishermen today as there are marine biologists, and their forbears were plying their trade and passing on their accumulated knowledge tens of centuries before anyone heard of marine biology. What is surprising is how little effort has been made by scientists to search out and record this information.

Traditional native fishermen are especially rich sources of unrecorded knowledge. A modern commercial fisherman fifteen feet off the water in a rumbling trawler searches for his fish with machines. Isolated in his wheelhouse he perceives his prey as abstract shadows on an echo-sounder chart. The native fisherman searches with his eyes and ears. In shallow water he stalks fish at close range on foot. He pursues them in their own realm with goggles and spear. He knows the local currents intimately, for in his small, often motorless craft he must harness them when they are benign and avoid them when they are not. He is, in short, more in touch with his prey and their surroundings than his modern, mechanized counterpart. As Ommaney (1966) states, he "has forgotten more about how to catch the fishes of his particular bay or lagoon than we shall ever learn."

Native fishermen are particularly knowledgeable on small islands where seafood is the main source of animal protein and fishing is often the single most important male occupation. The waters around such islands, moreover, are generally influenced little by nutrient- and sediment-bearing terrestrial runoff. As a consequence they are typically

REJ:jt

23rd September 1981

Mr. G. Balazs,
U.S. Department of Commerce,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
P.O. Box 3830,
HONOLULU, HAWAII 96812

Dear George,

Thanks very much for the encouraging letter and the Applied Ecology publication.

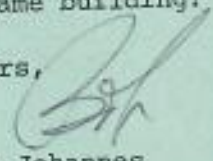
So far I have only spent a fraction of a day at the Exmouth turtle rookery - and at that time was not systematically looking at the turtles. I hope to go up for 2-3 weeks in November-December, during which time I'll check into basking for you. My recollection was that I saw a dozen or so turtles in a few inches of water near the shore - some mating but others resting singly with their shells half or two thirds out of the water. I don't recall seeing any actually on the beach.

As far as things you might do in the Tokelaus for me. I can only suggest that if you find my groundwater hypothesis interesting you might compare salinity of sand moisture in nesting areas with that of areas that are otherwise comparable but where turtles don't nest. If you were to do this for enough sites - and if there was a connection between low moisture salinity and rookeries, then you would be able to write a paper giving harder evidence than the circumstantial kind I have described in previous letters for the relationship between high water tables and nesting beaches. This is the kind of job that would take too long for me to ask you to do it for me. But if you are interested in doing it for yourself (since I don't have access to enough rookeries to get a good sample) I'd be delighted.

Otherwise, the only thing I can think of is that I'm always on the lookout for pockets of really good traditional island fishermen - so many island fishing cultures have been seriously degraded. So if you come across any really skilled traditional native fishermen or fishing villages, I'd like to hear about it.

If I were in Hawaii I'd love to go with you to your algal patches associated with underwater freshwater springs and measure nutrient levels and community responses to the outflow. Too bad none of these overlapping interests arose when we were in the same building!

Cheers,


R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

Western Regional Laboratory
Leach Street, Marmion, Western Australia

P.O. Box 20, North Beach, Western Australia 6020
Telephone (09) 447 1388, 447 1375
Telex 93366

REJ:jt

20th October 1981

Mr. George Balazs,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
HONOLULU, HAWAII 96812,
U.S.A.

Dear George,

You certainly are most helpful with all your comments and literature. I won't hold you to your offer to do salinities on Tuamotuan rookery sand because it can't easily be done in the field. But just in case you want to do it anyway, here's how. First, let me stress that you are measuring salinity of moisture adhering to sand - not the salinity of the groundwater beneath the nest. Therefore a refractometer in the field will be of no value. But you can use a refractometer once you get back to the lab and process the sample.

Gather a small test tube full of sand from the sand surrounding the eggs. Do so immediately after uncovering this sand so that no evaporation occurs. Seal the tube well so that no evaporation occurs in transit. Upon returning to the laboratory weigh the tube plus contents before and after drying in a drying oven. Then add 25 ml of water and let stand overnight. Give it a shake and then read salinity with refractometer. Since 1 gm of water is essentially equal to one ml you can then calculate the salinity of the sand moisture as follows:

$$\text{Salinity of sand moisture} = \text{Salinity of solution water} \times \frac{\text{volume of solution water (i.e. 25)}}{\text{volume of sand moisture}}$$

Example. If the wet weight of sand plus tube is 100 g and the dry weight of sand plus tube is 95 g, then the weight of the moisture is 5 g - which is equivalent to 5 ml. If the salinity of the solution water is 3‰ then the salinity of the moisture was

$$\frac{3 \times 25}{5} = 15‰ - \text{ or about half seawater strength.}$$

I shall send you a form letter for you to mail out to your friends after I return from Exmouth next month and have tried out the technique myself. While at Exmouth I'll try to get to photos of beached turtles for you.

2/...

I'm having trouble getting approval to do this work (see enclosed letters) - in fact I have been told that I may not submit a proposal to National Geographic Society for funds. But I'm going to ignore the idiots and go ahead with it, Geographic funds or not. (I've already got the Australian Survey Office committed to doing a \$12,000 aerial survey of the nesting beaches in the vicinity of Exmouth.)

The more I read about green and loggerhead nesting and about the influence of groundwater on sand moisture near the beach the more my hypothesis seems strengthened. I'll write a manuscript on the notion and send it to you in a month or two.

Cheers,



R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

CSIRO MARINE LABORATORIES

Division of Fisheries Research: A Division of the Inst. of Animal & Food Sciences
Division of Oceanography: A Division of the Inst. of Physical Sciences

BDS/MMcP

P.O. BOX 21, CRONULLA, N.S.W. 2230. TELEPHONE 523 6222. TELEGRAMS CORESEARCH CRONULLA. TELEX 24875

YOUR REF.

IN REPLY PLEASE QUOTE: XE7/2

9 October 1981

Dr R.E. Johannes
CSIRO Western Regional Laboratory,
PO Box 20,
NORTH BEACH WA 6020

Dear Bob,

Bernard Bowen has written to me to explain his views on the proposal that the CSIRO Division of Fisheries Research should become involved in research on turtles. Our image in the fishing industry and in some State Departments is not as bright as it should be and it will be tarnished further if the above proposal goes ahead. We would not be able to justify this work to our critics, who would want to know why the Division of Fisheries Research, in this era of dwindling resources, should choose to dissipate some of its research effort on a topic unrelated to the Australian fishing industry.

I value Bernard Bowen's views on this proposal and I think it would be imprudent to embark on a project that the Division would be hard-pressed to defend in terms of the accountability of scientific research. Bernard makes it clear to me that turtle research is by no means a forbidden topic in W.A. (indeed he would welcome work in this area) - he merely raises the query whether it is appropriate for us to divert some of your effort away from fisheries research (where there is a pressing need for your \$, skills & experience) and into turtle research where the need is not so apparent.

I do not believe that the proposal to work on turtles is in the best interest of the Division and therefore I am not able to give my support to the project.

Yours sincerely,



(B.D. STACY)
Acting Chief

for
Division of Fisheries Research



DEPARTMENT OF
FISHERIES AND WILDLIFE

Your Ref
Our Ref
Enquires

108 Adelaide Terrace, Perth,
Western Australia 6000
Telephone 325 5988

Telegraphic Address
Fishfaun, Perth

Telex: 93832

[Dr. B.D. Stacy,
Acting Chief,
CSIRO Marine Laboratories,
Division of Fisheries Research,
P.O. Box 21,
CRONULLA, N.S.W. 2230.]

October 1, 1981

Dear Dr. Stacy,

I have received a copy of a letter from Dr. Johannes to you on the subject of turtle research.

It is appropriate that I clarify my thoughts. In essence they are summed up in the last sentence of Bob's letter to you. At a time when the Division of Fisheries Research of CSIRO is under criticism by some segments of the fishing industry and some fisheries administrators it seems odd for a Principal Research Scientist to be undertaking turtle research. As Bob has put it "officially turtles aren't in our bailiwick".

Putting aside the above view of the appropriateness of a fisheries P.R.S. spending time on turtle research, I would, of course, welcome research on turtles in Western Australia. It was not the fact of research being done which was of concern to me, it was the use of a top fisheries scientist for such research.

Yours sincerely,

(B.K. Bowen)
DIRECTOR

Western Regional Laboratory
Leach Street, Marmion, Western Australia

P.O. Box 20, North Beach, Western Australia 6020
Telephone (09) 447 1388, 447 1375
Telex 93386

REJ:jt

17th September 1981

Mr. George Balazs,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
HONOLULU, HAWAII 96812,
U.S.A.

Dear George,

With regard to my notion about the possible relationship between groundwater seepage and green turtle rookeries (in case you've sent a reply it hasn't reached me yet):

I just discovered to my surprise that Hughes (1974) came up with a hypothesis to explain choice of nesting sites in loggerheads that dovetails with mine concerning greens. But whereas he feels that groundwater seepage simply provides a convenient cue for orientation, I feel that the existence of groundwater discharge indicates suitable interstitial salinities for incubation. I wonder if anyone working on turtle sensory physiology has demonstrated whether or not turtles can sense small changes in salinity.

I also wonder whether my notion isn't worth a note somewhere. What do you think? If you think the notion is a worthwhile one where would be a reasonable place to submit a note? Copeia?

Cheers,



R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

CSIRO

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PO Box 20, North Beach, W.A. 6020
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23rd September 1983.

Mr. George Balazs,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
HONOLULU, HAWAII 96812,
U.S.A.

Dear George,

It looks as if I'll be able to take two or three days holiday in Honolulu starting on November 15. Hope we can get together. I'll send a rough draft of the subsistence use of turtle MS to Nitta before then and the two of you can work it over and make suggestions for improvement by the time I get there. I haven't written the Hawaii section yet, but I know I'm not going to be happy with it. Not enough information.

With regard to your comments on the NW Cape turtle manuscript (which I am just getting around to responding to today after having been away in the Torres Strait for quite a while): I am not going to take some of your suggestions concerning added comments (re basking, nesting near vegetation) for the following reasons. The paper is too long - Perran Ross said this and I agree with him. I'm cutting about a page out of the manuscript. Already, before you saw it, I had cut out about two pages including mention of basking. It just didn't fit with the subject at hand. There were a number of other bits and pieces of information I cut out. I felt badly about it because so little has been recorded about WA sea turtles.

These odds and ends aren't quite sufficient to add up to a small note for a local museum journal or some other local outlet. But they just interfered with the flow of discussion of the main subject when included in the present manuscript.

As far as the basking observations go (and the shell measurements I sent you in the same letter) you are welcome to use them in a publication if the opportunity arises, simply citing Johannes (pers. comm.).

See you in six weeks I hope.

Cheers,



R.E. JOHANNES.
Principal Research Scientist.

P.S. Didn't you do some kind of manuscript on subsistence use of sea turtles in U.S. territories in Oceania? I don't think I have it.
Commonwealth Scientific and Industrial Research Organization, Australia

To Kelau - next issue
WWF letter

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22nd August 1983

Mr. G. Balazs,
U.S. Department of Commerce
National Oceanic and Atmospheric Administration,
National Marine Fisheries Service F/SWC2
P O Box 3830,
HONOLULU, HAWAII 96812.

Dear George,

Many thanks for your letter, your review of my manuscript and the assorted enclosures. It will be no problem to respond to your suggestions on the manuscript. John Kowarsky reviewed it, made some minor criticism - all of them easy to respond to by including additional snippets of information - and then suggested, with no further justification, that it should not be published. Can't figure out why. Haven't heard back from Col Limpus yet.

Rest assured that I will (and would anyway) acknowledge your help, both in this manuscript and, naturally, in the NMFS MS on subsistence use of turtles. I just hadn't got round to the acknowledgements. If there is anything else I can do to help support your campaign for permanency (I'm involved in the same kind of effort here) don't hesitate to let me know.

Re your comments about Messerschmidia, sex determination etc. I wonder if turtles don't have somewhat different reproductive strategies in different areas and that by looking for global generalities we are barking up the wrong tree, or at least I have been.

I've just about completed a rough draft of the Micronesia section for the NMFS manuscript. It will be longer than the Guam, Hawaii and Samoa sections put together, largely because the slower westernization of Micronesia enabled scientists to study traditional life before it all but disappeared. I keep hoping that some material will miraculously materialize in the mail from one of my contacts giving me a decent handle on Guam-Hawaii-Samoa. As it is those sections will be pretty thin.

Cheers,



R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST.

P.S. Parren Ross came by & gave an excellent overview seminar of sea turtle management problems a couple of days ago.

there should have been a reduction in the number of larger (older?) turtles which would not have been made up by new recruits by 1965. Thus younger turtles, i.e. new recruits, would have contributed more substantially to the population as a whole.

With the progressing seasons there has been an increasing remigration of older animals and presumably in the larger size groups these are reinforcing the new recruits and giving the modal size class the tendency to increase.

The 1968-69 season is unusual because of the fact that so few animals arrived in Tongaland, it was the poorest season in ten and showed a preponderance of larger females. It is possible that some years previously there had been an almost total failure of eggs or an unduly high mortality of hatchlings and the number of new recruits was thus reduced resulting in the emphasis being placed on larger turtles.

The fluctuations in annual nesting populations as shown in Figure 12 might be traced back to "good" seasons or "bad" seasons but this will become apparent only after future seasons of accurate monitoring.

It has been suggested in a previous section that loggerhead turtles mature at various sizes and it is suggested that from the figures in Table 17 for the 1972-73 season there is no particular emphasis on the smaller size classes which would suggest that these are the principal source of recruits. It seems likely that the modal size class in which loggerhead females reach maturity is in the 91-96cm curved carapace length class and thus new recruits to a population of loggerheads will be found in all size classes.

If remigrants to Tongaland continue to increase at the rate recorded in the past three seasons then within the near future, it should prove possible to allocate the percentage new recruits within each size class and the true variation in size of turtles at their first season of nesting will be ascertained.

Finally it is suggested that the annual recruitment rate will be found to be relatively high, between 20% and 30%. The reason for this suggestion is linked to the previous section in that many tagged turtles have not been recovered in Tongaland. Despite the large numbers of non-returning animals the overall population trends continue to move upwards and it is thus reasonable to assume that there must be many new recruits. This should be expected because of the total protection afforded the nesting colony since 1963. It will be of interest to see whether there is a sharp increase in total numbers within the next few years.

The success of the conservation programme will be judged on the recruitment of neophyte nesters and so far the results are promising.

LEATHERBACKS

As mentioned in a previous section there is a possibility that the leatherback population is drifting and not static; i.e. they do not adhere to a particular nesting zone unless it be a very wide zone. This reduces the chances of encounter and makes any assessment of recruitment extremely difficult.

Table 18 summarizes the size class composition of the seasonal measurement samples of leatherback females in Tongaland. The seasonal numbers are small and it is not possible to determine whether there has been any change in the size class composition since 1965.

Discussion

From the data presented above it is clear that the loggerhead turtle has a well developed direction finding ability which enables them to return periodically with great accuracy to the Tongaland beaches.

The guidance mechanism employed by these turtles would appear to be complex and it is pertinent to examine the most feasible theory on turtle orientation in the light of the data collected on the loggerhead.

CHEMORECEPTION

Koch, Carr and Ehrenfeld (1969: 167) postulated the possibility of green turtles finding Ascension Island by following an olfactory gradient of increasing strength between the feeding ground and the nesting ground. Carr (in press: 3) added to this and suggested that use may be made of sub-surface equatorial counter currents.

Considering that nearly all of the Tongaland loggerheads have been taken north and hence up-current, of the nesting grounds, it seems unlikely that chemoreception can be seriously considered as a long range guide because the possibility that counter currents and eddies could carry an olfactory cue for 3 600km is difficult to imagine.

Chemoreception might, however, play an important role in the final choice of a nesting site. Richard and Hughes (1972: 306) showed that green turtle nesting along the east coast of Costa Rica was clearly correlated with the outflow points of large rivers, being situated immediately down-current of each river mouth, the Tortuguero River being, apparently, particularly attractive to green turtles.

In Tongaland nesting is clearly associated with the Kosi Bay Estuary which has an outflow point immediately up-current of the main nesting areas. Figure 20 shows the nesting activity concentration points over eight seasons in Tongaland.

To suggest that this association is a direct result of outflow from the estuary mouth is, however, not necessarily justified.

Firstly, ~~outflow is limited to low tides, as during high tides sea water enters into the lake system thus the net outflow of possible olfactory cues is limited.~~ *not submarine outflow*

Secondly, the longshore drift is normally northward although it does change if a northerly wind blows steadily for more than two days. Thus, what little outflow there is would be carried northward and not southward where the turtles nest.

A third reason for the nesting orientation not being linked to outflow through the estuary mouth is the distinct break in nesting distribution along the favoured 24km of coast. It would be expected that if orientation was directly linked to outflow there would be an even distribution of nests over the area of most powerful olfactory cue. Variations in current directions should be evened out over eight seasons but in fact each season has emphasized the site selection.

Finally, it is perhaps noteworthy that during 1965 the estuary mouth was closed for five months (Breen and Hill, 1969: 285) so there was no outflow at all and this did not markedly affect the homing accuracy of the nesting turtles (Hughes, *et al.*, 1967: 14).

It was noted by Hughes (in press) that loggerheads in Tongaland showed site selection in that they always emerged near intertidal reefs and where there were no rocks nesting was either minimal or non-existent. It was suggested that inter-specific competition for nesting sites between the leatherback and loggerhead might have led to spatial separation and the preference by loggerheads for rocky areas. This may have some effect but the site selection exhibited by loggerheads does not justify this as the sole reason. The cumulative data in Figure 20 shows firstly the preference for rocky areas and then the greater concentration in the northern section of the protected area, and herein may lie the link between site selection and olfactory cues.

If there is a link between the Kosi Bay Lake system and the orientation of nesting sea turtles, and the link is not directly associated with outflow through the estuary mouth, then it must be an underground link.

Tinley (1971: Appendix 6) discusses at length the presence of impermeable hardpan layers which act as highly efficient aquifers in the Tongaland region, and cites, as a good example of such an aquifer, dune rock along the coastal zone. Evidence of freshwater seepage may be adduced from the dune rock itself which is formed through the cementing of sand under the influence of fresh water and a strong calcareous component. Therefore there is a possibility that there is drainage from the Kosi Bay Lake system via hardpan horizons to the shore line. If the hardpan continues out onto the beach, a relatively stronger flow would be present at that

where the water takes its course usually close to the surface

point as compared to a section of beach where the hardpan layer either dips or has been eroded away resulting in the water flow diffusing through a thick layer of sand and being further diffused by wave action as it enters the sea.

One could assume that the water draining over hardpan layers might itself provide the olfactory cue towards which turtles home if it had distinct properties.

For example, in Figure 20 there are two modal points in the peak nesting areas in the north of the protected area. Immediately south of each point there is a dramatic drop in nesting activity, whereas north of the modal points there is a very much less drastic fall in activity. In other words the nesting distribution is skewed to the north.

It has been mentioned above that coastal longshore drift is predominantly northward and this would carry the olfactory cue in a northerly direction away from the point of entry into the sea. The skewed distribution shown in Figure 20 would lend support to this suggestion. Figure 21 illustrates the relationship between the Kosi lakes and the main turtle nesting areas and shows the possible sources of the cue medium.

It is possible, however, that the association between the lakes and the nesting beaches may be less direct and may involve the turtles providing their own olfactory cue. Loggerhead nests have a distinct smell which would appear to be a strong disadvantage in areas with large numbers of terrestrial predators. In Tongaland feral dogs find turtle nests from which all surface traces have long been obliterated by wind action. On the Hutchinson Island rookery in Florida, raccoons cause extensive damage by digging up loggerhead nests (see Gallagher, Hollinger, Ingle and Futch, 1972: 6; Routa, 1967: 291). It would seem that the selective disadvantage of having a powerful odour attached to the eggs must be outweighed by a selective advantage or the colony would have been wiped out. It would appear feasible that the advantage derived from having large numbers of turtles nesting in one area, would be by producing more eggs than could be dealt with by the predators and thus reduce, to a tolerable level, the harmful effects of predation.

These predators can find the nest when it is freshly laid which would suggest that the smell is associated with the mucus exuded by the female in the process of laying but this might be later reinforced by the breakdown of unhatched eggs which, as is well known by workers dealing with turtles, has an extremely pungent odour.

Therefore if the turtles leave an olfactory cue in the sand it is logical to assume that the more turtles utilizing an area the stronger the olfactory cue and in turn the more attractive will be the area to nesting turtles.

As it is unlikely that the cue will be carried by winds it must be carried by dissolving in interstitial water and draining down towards the sea by gravity. If one considers the rainfall regime in Tongaland, one finds that in September or October there is always a period of rain preceding the beginning of the turtle nesting season (see Tinley, 1958: Fig. 2). This could be sufficient to initiate the percolation of olfactory cues down to the water table, or more simply, there is possibly a continuous leaching downwards to the water table.

The link with the lakes might be as a result of their maintaining a high water table which would flow, albeit slowly, even in times of drought which may have a marked effect on seepage points further south.

Further the drainage lines on the hardpan layer (dune rock) may cause the olfactory cues to be channeled to a particular outlet where it would enter the sea in relatively high concentration, being distributed by the longshore drift as was mentioned above.

Thus longshore drift, local winds and variations in wave patterns would shift or dilute the cue medium over limited areas before mixture with the sea rendered it untraceable. Further if the cue was gradually seeping over the rock layer it would tend to concentrate in rock pools and the lower beach during low tide periods and be at its strongest at the turn of the tide.

If the cue was either direct seepage from the Kosi lakes or the turtle-originating cue carried in this seepage, two separate outlets situated some 10km apart would explain the apparent zone target postulated above, rather than a specific point target, for the Tongaland loggerhead.

Similarities in the properties of the two cue sources either as a result of their being from the same original source (the Lakes), or from their being simply a "loggerhead" cue, would explain the periodic shifts by nesting turtles from the northern concentration to the southern and vice versa. Variations in sensitivity on the part of individual turtles would easily explain the ability of some turtles to orientate with remarkable accuracy whilst others are less precise.

Boteler Point is a good example, situated between two high nesting density areas, to show that the presence of rocks alone is not the attraction. It probably lacks a seepage point or a nesting density sufficiently high to create a cue.

The presence of nesting turtles in the southern part of the protected area is a little enigmatic. Either there are smaller seepage areas with a unique character making them attractive to turtles and into which is channelled turtle-cue, or these seepage outlets are not perennial because of the lack of a major water course inland and in times of drought they stop, lose their guidance role, and hence their nesting turtles, and have to be built up again. There is no other obvious reason why these southerly beaches are not more heavily utilized by the nesting turtles. If cues were weak or even non-existent in some seasons new recruits would probably nest in the strong cue areas further north and further reinforce these zones.

Thus the presence of a water table containing either identifiable water or acting as a carrier appears to be of value to loggerhead rookeries. In Madagascar the most important stretch of loggerhead nesting beach is separated from a long string of brackish and fresh water lakes by a set of high dunes.

In the United States there are three documented loggerhead rookeries on the east coast separated by large areas of apparently suitable beach (Caldwell, Carr and Ogren, 1959: 296). Baldwin and Lofton (1959: 320) show that the Cape Romain nesting beaches are backed by hectares of salt marsh which would maintain a high water table.

In Georgia, Jekyll Island and Little Cumberland are closely associated with mainland marsh areas whilst Hutchinson Island in Florida is backed completely by the Indian River Lagoon (see Caldwell, Carr and Ogren, 1959: 298; Rount, 1967: 288; and Gallagher, Hollinger, Ingle and Futch, 1972: 3).

Gallagher, *et al.* (*op. cit.*: 7) note a series of interesting intervals recorded from tagged loggerheads and the Hutchinson Island turtles seem somewhat less accurate than Tongaland turtles and this would be expected with such a wide area (22 miles, 35.2km) having an identical lagoon backing.

It will be of interest to see if future work in these areas shows a nest distribution that can be correlated with particular sites and longshore current direction.

From this hypothesis several other behavioural traits of the loggerhead are brought to mind.

Firstly the sand-smelling behaviour observed not only in Tongaland loggerheads but in other species as well (see for example Carr, 1967: 21). With the Tongaland loggerhead sand-smelling occurs immediately after stranding when the beak is thrust into the wet sand. Some females walk up the beach thrusting the beak in front of them like a ploughshare.

This behaviour, previously thought of as tactile testing of sand consistency, might now be described as it was originally named, i.e. "sand-smelling". If the cue is seeping to the shore line in drainage lines and then being carried northwards along the immediate shoreline the sand from the high tide mark down should be impregnated with the cue medium. The turtle stranding after low tide has a broad guide path which it can follow up the beach.

The strength of the cue distributed over the beach between high and low tide mark might also inform the female when she is above the high tide mark. There is possibly a sharp drop in the cue strength when the female passes the high tide mark which would trigger a new set of responses resulting in the turtle being susceptible to external stimuli. The presence of a bank, log or vegetation is then sufficient to trigger nest building behaviour.

It has been noted in Tongaland that the presence of a large log or bank below the high water mark does not generally stimulate nesting behaviour. On the contrary females take vigorous avoidance actions and if unsuccessful in bypassing or climbing the obstacle will return to the

this is the area where groundwater seepage is greatest.

Higher up the beach a relatively minor bank or patch of vegetation will immediately prompt nesting. *Higher water table here?*

If no obstacle is encountered some turtles in Tongaland have been observed to walk for hundreds of metres before laying.

Baldwin and Lofton (*op. cit.*: 322) were the first to note that loggerheads execute exploratory crawls. These "half-moon" tracks, often observed in Tongaland, might be explained as the tracks left by an emerging turtle which not having found the correct cue, has immediately returned to the water.

Finally, the presence of a distinct smell in the egg chamber must be the first sense imprint experienced by the hatchling loggerhead. It hatches within an enclosed chamber permeated with the smell and ascends for three or four days in company with its identically tainted siblings and only thereafter is it exposed to foreign stimuli through vision and surface odours. It is suggested that visual stimuli are dominated, during the night emergence, by the seaward orientation drive based on a single light source.

In conclusion it is suggested that chemoreception of a water-borne guidance cue, either as a property of the water itself, or in traces left by heavy nesting of the species in previous seasons, is of importance in the within season and remigration finding of a specific nesting site. A chemoreceptive agent and its distribution along and coast agrees with the data collected and explains various, as yet poorly understood, aspects of nesting behaviour in the Tongaland loggerhead. Nordeng (1971: 412) and Solomon (1973: 232) have provided convincing evidence that char and salmon utilize a chemical cue or pheromone, derived from their own relatives or group, as a guide to their home stream rather than the cue being provided by the stream water itself. In other words the pheromone is species specific or even group specific. A similar pheromone-guidance mechanism may be employed by sea turtles.

It is not suggested that chemoreception is acceptable as a long range navigation system because all migrations should require a reversible mechanism if the turtle is going to return to a favoured feeding ground or sleeping rock. Further a chemical trace carried by a surface current would be uni-directional and could not apply to turtles coming from both north and south of the nesting area.

Not having undertaken any specific work on long range navigation it is not intended to enter into a detailed review of navigational possibilities to explain how loggerheads get to Tongaland, but it is felt that Hirth (1971: 3: 23) is right in suggesting the answer may lie in non-visual theories.

In concluding one can only acknowledge that the Tongaland loggerhead, and Europa and Tromelin green turtles, are fine navigators but it seems likely that human understanding of their feats may never be realized.

The reproductive behaviour and potential of sea turtle populations in south-east Africa with especial reference to the Tongaland loggerhead *Caretta caretta*, the Tongaland leatherback *Dermochelys coriacea* and the green turtle *Chelonia mydas*

Introduction

The following section deals with the activity and behaviour associated with the nesting season excluding orientation and site selection which has been dealt with.

In Tongaland, it is unfortunate that patrol methods are not as efficient as desired. The records

are seldom sufficiently complete and recourse must be made to interpretive treatment of data that could be perfectly straight forward if every turtle was handled. Observations on green turtles on Europa and Tromelin Islands are even more scantily recorded and details are reported below for completeness and in the full knowledge that the data are drawn from minimal samples.

The problem of too short a working time must be faced once more with regards to the reproductive lifetime of the loggerhead turtle and the conclusions contained within some of the subsections must be accepted as tentative. Definite, conclusive results can only be forthcoming from long term tagging studies.

Methods

Many of the data contained below have resulted from direct observation or are derived from the recovery of tagged females.

Fertility and hatching success in turtle clutches are based on nests excavated after the departure of the hatchlings. On Europa and Tromelin Islands nests were inspected as found and the results are therefore fortuitous. In Tongaland natural nests were marked immediately after laying and excavated after the hatchlings had gone but were not interfered with in any way which could have affected the hatching success. The eggshells, hatchlings and eggs remaining in the nest were then counted. The fertility of unhatched eggs was adjudged on the presence or absence of blood spots. If the embryo was microscopic then the egg would be regarded as infertile. Bustard (1972: 99) discusses the possibility of numerous microscopic embryos being killed during laying and indeed, this is thought to be possible. Development of the embryo must commence immediately after fertilization and before the shell is laid down. If a turtle is disturbed by bad weather or research workers and laying is delayed for some days the embryos would be well advanced when the eggs are eventually laid and be susceptible to damage from the fall into the nest. It is felt, however, that any errors contained in the fertile-infertile data is of limited importance when compared to the emergence success.

Although small pilot hatcheries, into which have been moved clutches of loggerhead and leatherback eggs, are operated annually in Tongaland, few of the data collected therefrom are included in this section. Details concerning the hatchery programme are to be found in the Lammergeyer reports (see for example Hughes, 1972: 15-16). It is sufficient to say that barring natural disasters, the mean hatching success has been as high as 68.7%.

All egg measurements have been taken with Vernier Calipers and the mass recorded on an Ohaus triple-beam balance.

Results

FACTORS INFLUENCING THE NESTING SEASON

During 1971, three turtle nesting grounds in the south-western Indian Ocean viz. Europa Island, Tromelin Island and St. Brandon, were found to have a lower nesting activity than expected during November. This phenomenon was also observed in Tongaland where all loggerhead activities were markedly lower during November than those recorded during the two previous seasons (Hughes and Brent, 1972: 44).

Table 19 summarizes loggerhead and leatherback nesting and tagging records, expressed as a monthly percentage of the season's totals, and sea surface temperatures for the months of November, December and January during the 1969-70, 1970-71, 1971-72 and 1972-73 seasons.

Figure 22 illustrates the sea surface temperatures for the four seasons and compares them with the loggerhead nest records. It can be seen that during the 1971-72 season the sea temperature was lower in October and November and appeared to result in the season having a slower start. As it was a record season, with January nest records abnormally high it is assumed that the lower temperatures off Tongaland did not result in loggerheads nesting in Mozambique where warmer temperatures must have prevailed. Thus the lower temperatures retarded the start of the season but did not restrict eventual nesting intensity. A χ^2 test between the four seasons showed no significant difference between three of them but between the 1970-71 and

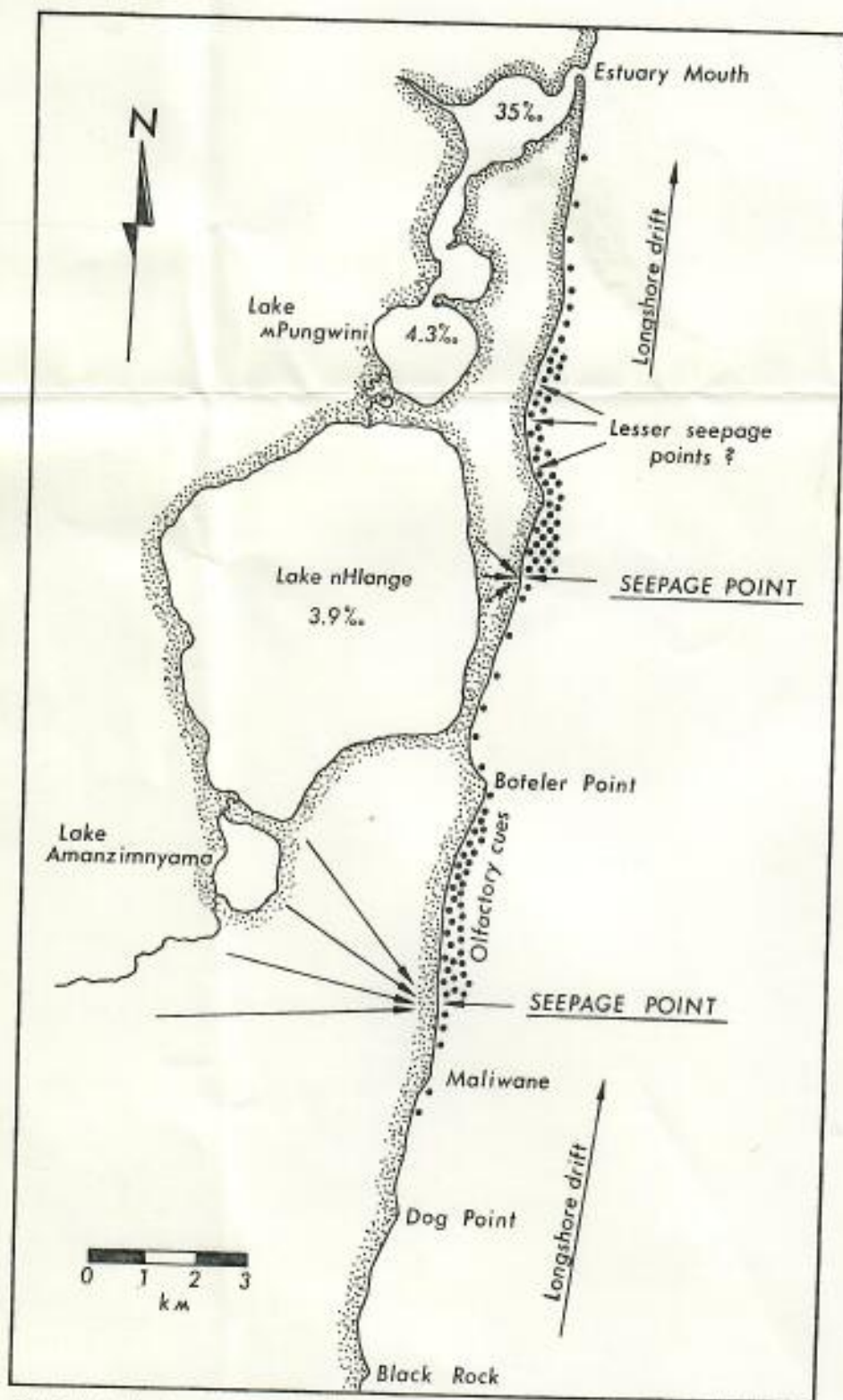


Fig. 21. The high density loggerhead nesting areas in Tongaland showing their position in relation to the Kosi Bay lake system with the hypothetical seepage points and northward distribution of the olfactory cue (see text for details).



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812
16 September 1981

Dr. Bob Johannes
Principal Research Scientist
CSIRO
North Beach, Western Australia

Dear Bob:

Many thanks for your letter of 21 August and the reprint- very much appreciated. I regret taking so long to respond, but I have been out at Pearl and Hermes Reef.

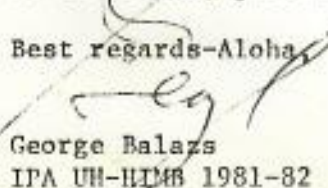
I think that its just great that you have taken an interest in W. Australian sea turtles- some work out there is long overdue. Describing and quantifying egg predation by crabs would certainly be a first big step. Your hypothesis on ground water and turtle nesting sounds intriguing and should be pursued. The infusion of fresh water is most definitely of importance for the establishment of certain algal foraging pastures here in Hawaii. I touched on this subject in my NOAA "synopsis" (p25) and hope to say more about it at a later date as more key pastures are identified and investigated.

Bob, land-basking behavior by green turtles is a subject that interests me greatly and, as I mentioned earlier, I have reports and a few photos of what appears to be greens hauled out at the waters' edge at North West Cape. Do you have any information along these lines?

If you haven't done so already, you should establish contact with Colin Limpus at the National Parks and Wildlife Service, Pallarenda, Townsville, Queensland 4810. He is involved in an extensive research program with sea turtles, and a fellow member in our SSC Marine Turtle Group. Actually, you were still at NIMB when Colin visited with me here in Hawaii and I took him out to see turtles and habitat in Kaneohe Bay. Sorry I didn't introduce him to you at that time.

I am happy to say that during mid-October I will be visiting the three atolls of Tokelau. If there is any special information you would like me to obtain, just let me know.

Best regards-Aloha

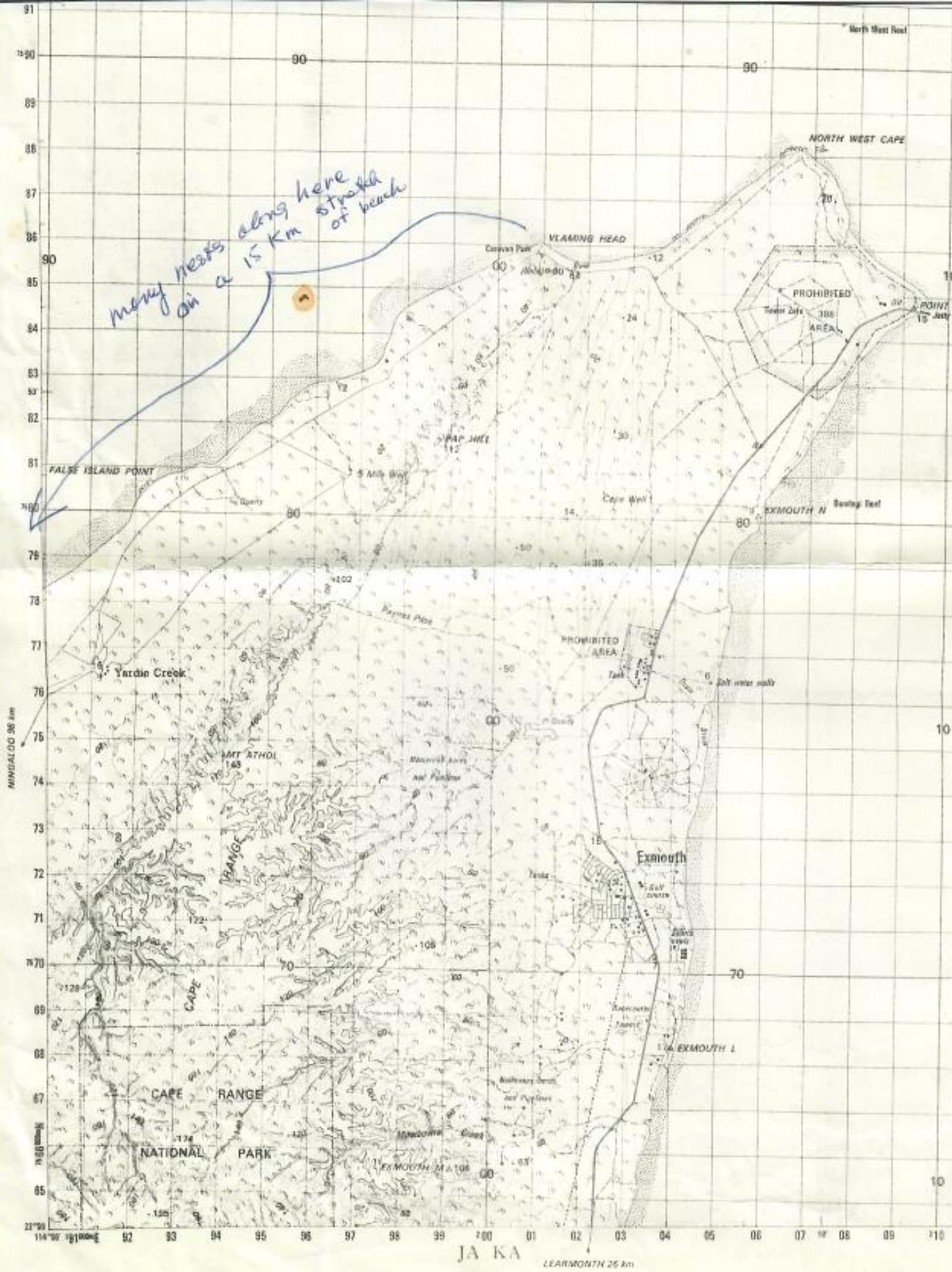

George Balazs
IPA UN-NIMB 1981-82

enclosure - ^{xerox copy of}
Applied Ecology
Research Monograph I

see page 35



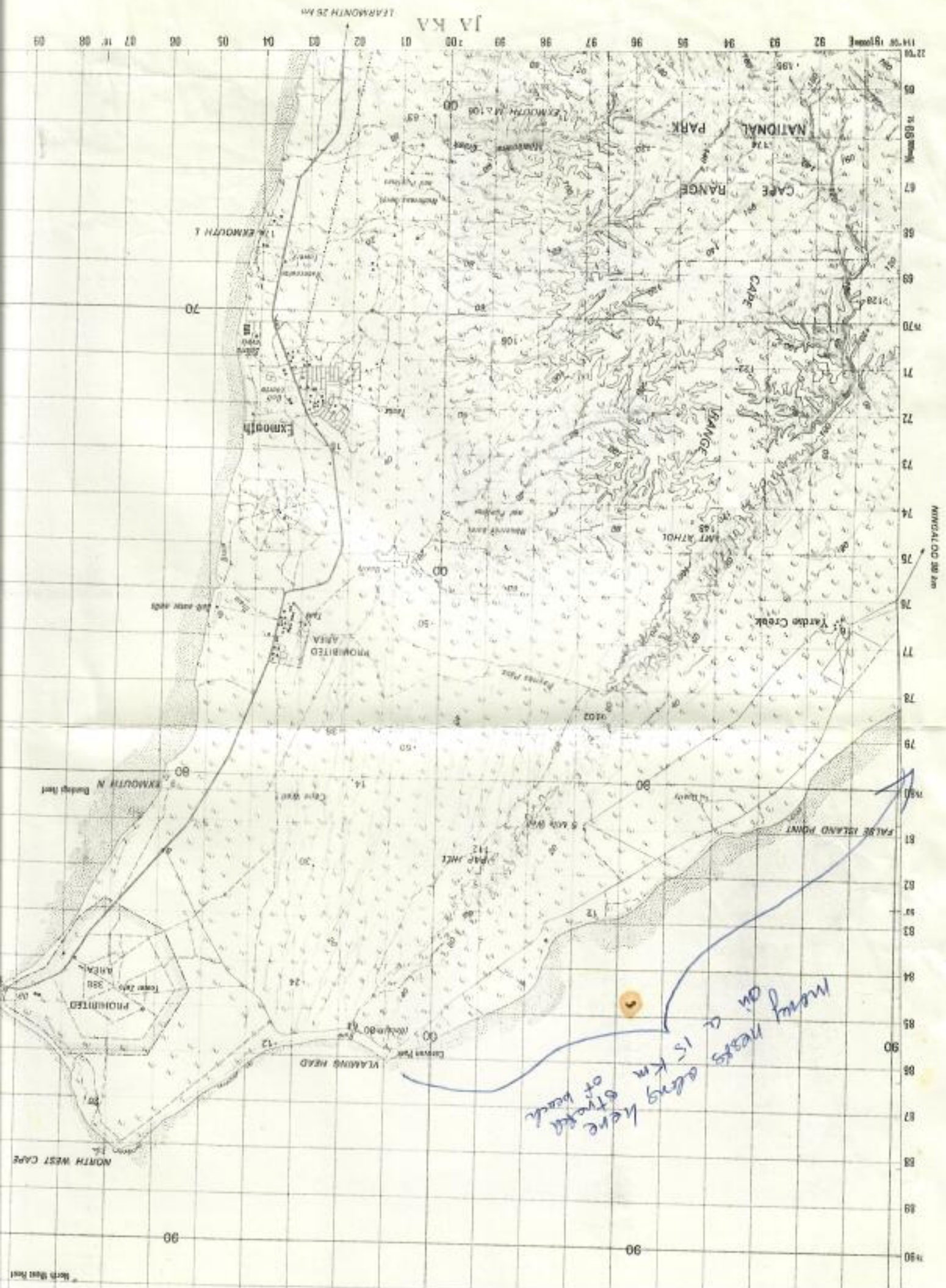
Reportedly many nests
around these islands
loggerheads and
possibly queens.



PRODUCED by the Division of National Mapping under the direction of the Minister for National Resources, as part of the national mapping program.
 MAP RELIABILITY: Topographic information shown on this map is reliable.
 PRINTED by authority of the Minister for National Resources, Canberra, Australia.

Scale: 1:50,000
 1:50,000

PRODUCED BY THE BUREAU OF GEOLOGICAL SURVEY UNDER THE DIRECTION OF THE DIRECTOR OF THE BUREAU OF GEOLOGICAL SURVEY
 MAP RELIABILITY: This map is based on data from the following sources:
 1. Aerial photographs of the area, taken in 1958 and 1960.
 2. Ground surveys of the area, conducted in 1958 and 1960.
 3. Topographic maps of the area, published by the Department of the Interior, U.S. Geological Survey, in 1958 and 1960.
 4. Other sources of information available to the Bureau of Geological Survey.
 The map is based on the datum of the North American Datum of 1983.
 Scale: 1:50,000
 Date: 1978



many nests along here at a 15 km of beach

W. Australian
references

REJ:jt

18th March 1981

Mr. George Balazs,
Hawaii Institute of Marine Biology,
P.O. Box 1346,
KANEHOE, HAWAII 96744, U.S.A.

Dear George,

A couple of months ago I was up at Ningaloo reef (along the outer coastline just south of Exmouth in central Western Australia in case you try to find it on a map) and ran into scads of nesting green turtles. On one beach (where the turtles had dug up one another's nests because there simply wasn't room for everybody's) the very abundant ghost crabs had dug holes down to nests made the night before (eight holes into one nest in one case). The sand around these holes was littered with empty egg shells. I presume this means that the crabs were digging down to get the eggs. The only turtle reference I have at hand in which ghost crabs are mentioned lists them as predators of hatchlings and says nothing about their preying on eggs. So I'm writing to you to ask whether this form of egg predation has been recorded. If not I'll do a little study on it because it appears to be a major source of egg predation in the area. Mind you the turtle population doesn't seem to be suffering. It seems amazing in this day to be able to drive on a paved road to within 100 yards of areas where you can find fifty big turtles in five minutes within 200 yards of shore.

Rumors are that support for marine science in Hawaii is going from appalling to indescribable. Hope you're managing to hang in there.

Cheers,



R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

TO OPEN SLIT HERE FIRST

BY AIR MAIL

PAR AVION

AEROGRAMME



Mr. George Balazs,
Hawaii Institute of Marine Biology,
P.O. Box 1346,
KANEOHE, HAWAII 96744, U.S.A.

COUNTRY OF DESTINATION

SENDER'S NAME AND ADDRESS

R. E. JOHANNES
CSIRO
FISHERIES & OCEANOGRAPHY
P.O. BOX 20,
NORTH BEACH
W.A. 6020

POSTCODE

SECOND FOLD HERE

SECOND FOLD HERE

FIRST FOLD HERE

FIRST FOLD HERE

26 March 1981
HIMB, Box 1346
Kaneohe, Hawaii 96744

Dear Bob:

Many thanks for your letter of 18 March. It was very good to hear from you, particularly in relation to a sizeable nesting aggregation of green turtles in W. Australia. Right now I'm at my office at the NMFS lab on Dole Street, but when I get out to my reference library at Coconut Island in a few days I will dig out references on turtles in your area. I'll make copies for you and send off whatever seems appropriate.

Yes, ghost crab predation on eggs has been documented in many areas of the world. We are fortunate that it doesn't occur at French Frigate Shoals here in Hawaii. The extensive predation on eggs and hatchlings in some areas has been the basis for starting up hatchery projects where the eggs are brought into a protected enclosure. As you may have read, this practice is now under fire as a result of the discovery that the sex of at least some sea turtles is determined by incubation temperature (cooler temperatures give mostly males). Many hatchery projects have incubated eggs in styrofoam coolers, or reburied them in the shade or at shallower depths, consequently leading to the criticism that they have possibly masculinized the population. Anyway, for your information, I'll send you some references on crab predation on eggs.

I would greatly appreciate receiving a xerox map showing me exactly where your nesting site is located. I have Navy friends living at Eschmuth that used to be stationed at Midway. They have sent me photos and told me about green turtles nesting (and possibly land basking!) at North West Cape on the aboriginal reserve. You may also be interested to learn that there was a tremendous turtle fishing industry in Western Australia up until about 1976.

Bob, please send me reprints of the articles you have been putting out since leaving Hawaii. Sylvia Spring heard one of your presentations in PNG and had some very good words to say.

You will hear from me again in the very near future.

Best regards—Aloha,


George H. Balazs

(IPA Contract between HIMB-UH and NMFS, Honolulu Lab)

NATIONAL MARINE FISHERIES SERVICE
HONOLULU LABORATORY
P. O. BOX 3830
HONOLULU, HAWAII 96812

Western Regional Laboratory
Leach Street, Marmion, Western Australia

P.O. Box 20, North Beach, Western Australia 6020
Telephone (09) 447 1388, 447 1375
Telex 93366

REJ:jt

21st August 1981

Mr. George Balazs,
National Marine Fisheries Service,
Southwest Fisheries Center,
Honolulu Laboratory,
HONOLULU, HAWAII 96812,
U.S.A.

Dear George,

Thanks for your note. I keep forgetting to mark my letters airmail - so the office sends them out surface mail - hence the long transit time.

I haven't done anything with turtles yet, except write a research proposal and try to nurse a one-eyed baby loggerhead washed up in a storm back to health. Gradually, amidst other duties, I'm trying to read the relevant literature. While doing so I came across an interesting observation by Bustard that stimulated an idea I'd like to bounce off you.

Bustard and Greenham (Ecol. 49: 269) found that the salinity of the sand moisture around green turtle nests at Heron Island was much lower than ^{that of} full strength seawater. They also found that eggs incubated in sand with moisture of a salinity approaching seawater strength resulted in considerable mortality, whereas those incubated in lower salinity moisture hatched well. They speculate that the sand "leaches" the chloride out of seawater - which is utter nonsense. Either the moisture is from rainwater or from groundwater, which, via capillary action is drawn up above the water table. Which generates the following thoughts.

Groundwater seepage in the intertidal and nearshore subtidal area is a common phenomenon. It occurs anywhere the water table is above sea level and the aquifer is in hydraulic contact with the ocean (see accompanying reprint). If green turtles need low salinity moisture in which to lay their eggs - and if they are good smellers (Manton et al. Biol. Bull. 143:184) and regularly smell the sand in shallow water just before emerging to nest - maybe they are searching for seepage of groundwater (which, in addition to having a low salinity, has a lot of refractory organic compounds, some of which might well be detected by a good sniffer). Consistent with this hypothesis is the observation that green turtles also often lay their eggs near vegetation. Recent research has shown that dune plants thought to be halophytes often have their feet in fresh-water in or just above the water table. **My** hypothesis is right

2/....

21st August 1981

it would help explain why there seems to be little rhyme nor reason to the kind of sand (color, grain size etc.) in which green turtles nest; i.e. the salinity of the sand moisture is more critical than the characteristics of the sand itself.

To carry the notion a step further. Along desert coasts where green turtles nest, their nesting sites might provide a clue to the existence of a locally high water table and thus retrievable water for man in areas where fresh water is at a premium. Secondly, extraction of underground water by man in the vicinity of green turtle nesting colonies could lower the water table to the point where successful nesting would no longer be possible.

Nine-tenths of my hasty hypotheses turn out to be hair-brained on closer inspection, but I haven't any turtle experts out here to shoot this one down yet. Do you think it has any merit? It would be a hard one to investigate except by someone like yourself who visits a lot of different rookeries and could take sand samples there and at similar beaches nearby that are not used for nesting - to compare salinity levels in the moisture.

On another subject - apparently juvenile green turtles (as well as young loggerheads) often wash up on Perth beaches during winter storms. By juvenile I mean five - seven inches long, from what I am told. Is this of any significance given the dearth of knowledge on where the young go for the first year of their lives. (I seem to recall one or two recent papers reporting offshore sitings). Is there any point in collecting information next winter on such individuals? The local papers would cooperate in asking the public to report such catches. If so, what should I be looking for that might be of interest to green turtle freaks?

Cheers,



R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

seen the minutes of the last meeting at which I believe charges were made and at which the decision was made to answer those charges. There is no condemnation of the action of the directors; I am condemning only their timing. If they have proof of some mismanagement or some wrongdoing on the part of Dr Bustard, I agree that he should have been dismissed. All that I am saying is that the Board of the company has to be reconstructed in accordance with the Government's decision. Three of the members on the Board at the present time meet the qualifications necessary for membership on the new reconstructed Board. Two of the present Board members represent only one interest, and the qualifications necessary for membership on the reconstructed Board include that members shall represent only one interest. Only two of the remaining members will be permitted on the Board for this reason.

I have been asked to reconsider the action taken in the light of the motion moved by Senator Byrne. I supported the motion calling for a full inquiry into the matter to show that I have nothing to hide. I think this is an unfortunate move because it is simply trying to smear a person connected with this company at a time so long ago that a Labor Minister was not even responsible for this matter. Such an inquiry would reveal many things which are not directed at the Labor Party because most of the things connected with the turtle farm happened before last December. But if the inquiry shows that there has been mismanagement or incorrect spending by Dr Bustard or anyone else, it does not alter the fact that we are trying to continue our policy of obtaining the best possible world expert advice. Unless we do so we can never justify the continuation of the turtle farm project and the continued employment of 120 farmers on the Torres Strait Islands at the present time.

ASSENT TO BILLS

Assent to the following Bills reported:

Wheat Industry Stabilisation Bill 1973.
Wheat Export Charge Bill 1973.

DEFENCE FORCES RETIREMENT BENEFITS ACT

Senator MURPHY (New South Wales—Attorney-General and Minister for Customs and Excise)—Pursuant to section 14 (2) of the Defence Forces Retirement Benefits Act 1948-1973, I present the first report of the Defence Forces Retirement Benefits Board dealing with the administration of Part III of the Act for the period 1 October 1972 to 30 June 1973, together with financial accounts.

METRIC CONVERSION ACT

Senator MURPHY (New South Wales—Attorney-General and Minister for Customs and Excise)—Pursuant to section 24 of the Metric Conversion Act 1970-1971, I present the third report of the Metric Conversion Board for the year ended 30 June 1973.

TURTLE FARMING PROJECT

Ministerial Statement

Senator MURPHY (New South Wales—Attorney-General and Minister for Customs and Excise)—For the information of honourable senators I present reports on an inquiry into the organisation, management and market prospects of a turtle farming project in northern Australia. They are reports by Mr L. P. Smart and Professor A. F. Carr and Professor A. R. Main on ecological implications of the turtle farming project. I ask for leave to make a statement relating to these reports.

The PRESIDENT—Is leave granted? There being no objection, leave is granted.

Senator MURPHY—I make this statement on behalf of the Prime Minister (Mr Whitlam). It is a ministerial statement on reports of investigations into a turtle farming project in northern Australia. For the information of honourable senators I table 2 reports which have been prepared by consultants retained to advise the Special Minister of State on the turtle farming project which has been initiated in Torres Strait and elsewhere in northern Australia. These consultants were retained following a letter which the Prime Minister wrote to Senator Willesee on 23 August asking him to arrange for various aspects of the project to be studied.

The report on the ecological implications of the project was prepared by Professor A. F. Carr of the University of Florida in conjunction with Professor A. R. Main of the University of Western Australia. Professor Carr is an acknowledged world authority on sea turtles and a conservationist of note. Professor Main, a zoologist, is a Fellow of the Australian Academy of Science and a member of the Council of the Australian Institute of Marine Science. These 2 experts were retained on the advice of the Secretary of the Department of Environment and Conservation and other expert sources. The report dealing with the organisation management and market prospects of the project was prepared by Mr L. P. Smart, a partner in Marquand and Co., the Melbourne firm of Chartered Accountants. He was engaged

in the light of his outstanding record as a business consultant and his background of relevant experience in the meat industry.

Mariculture, including turtle farming, is a relatively unexplored field of knowledge fraught with complexities. There is only one other significant commercial enterprise in the world and that is a capital intensive operation by a company called Mariculture Ltd, which was launched about 5 years ago at Grand Cayman Island in the West Indies. It is based on an approach different from that adopted in the project in northern Australia. Against this background it is apparent that every effort should have been made at the outset to ensure that the project was launched on a sound basis. It is clear, however, from both reports that the turtle farming project has been allowed to develop without there being a proper basis of adequate research and sound administration. Because of this it has made little discernible contribution to research, to the conservation of the species involved or to the development of a sound commercial industry. For this situation the previous Government, in whose term the project was initiated, must bear prime responsibility.

In commissioning these studies Senator Willesee sought to discover whether the project, as it now stands, can be developed on a basis that is ecologically and commercially sound. In summary, Professor Carr and Professor Main consider that at present the project is not having an adverse effect on the wild turtle populations or on other resources in the area. They observed no great adverse effect on farmed turtles from existing husbandry procedures, although some stunting of growth was apparent, and a worm infestation affecting turtles on at least one island in Torres Strait has subsequently been discovered. It is their view, however, that several years' research should have preceded the establishment of the project on a production basis and that further growth should be held back until a research program has provided answers to some of the biological and ecological uncertainties encountered. The consultants have stressed the absence of an adequate impact statement and recommend that such a statement be made a minimum requirement for any future growth. They also recommended a comprehensive program of research including the development of large enclosed areas in the sea—'sea crawls'—for growing turtles and the establishment of a breeding program to make the project independent of eggs taken from wild populations. A major theme in their recommendations is the need to

allay the fears of conservationists about the project's implications for the conservation of turtles throughout the world.

Mr Smart recommends that the growing of turtles for meat and shell should proceed as a commercial undertaking. The step to commercial production would involve establishing a large sea crawl in which turtles would grow from their two to three year weight of 15 lb reached on the individual farms to slaughter size of 100 lb plus at five to six years. This step need not involve—and for the present should not be allowed to involve—any increase in the present base of the project, that is, the annual intake of hatchlings by present farmers. Mr Smart recommends reorganising the management of the turtle project to establish producer co-operatives and a processing-marketing company. The present company organisation would be abandoned although the company Applied Ecology Pty Ltd would be retained with a new and limited role as a purely research and advisory body to serve the turtle project, and possibly other projects envisaging utilisation of particular native species by Aboriginal and Island people.

After consideration of the various courses open to it in the light of these reports, the Government has decided to approve the continuation of the turtle farming industry as a pilot experimental project in which research is emphasised, as recommended by Professors Carr and Main, to determine the feasibility of developing it on the lines described by Mr Smart. In view of the many complexities which the reports have revealed, a final decision on the commitment of the capital funds required will be deferred pending the preparation of an adequate environmental impact statement, study of the constraints identified by Mr Smart in his report and pilot research into the space and feed requirements of large turtles. The Minister for Aboriginal Affairs (Senator Cavanagh) will see to it that these studies are put in hand. At the same time other research of a longer term character which has been recommended by the consultants will be commenced.

The Premiers of Queensland and Western Australia, where the project is operating, have been advised of this decision by the Prime Minister. The Minister for Aboriginal Affairs will arrange for the Government's position to be fully and promptly explained to the turtle farmers and for appropriate consultations to be held with the National Aboriginal Consultative Council.

Motion (by Senator Withers) proposed:

That the Senate take note of the paper.

4191/1970

19.10.70

for the press

THE AUSTRALIAN NATIONAL UNIVERSITY

Commonwealth Grant for Green Turtle Study

The Commonwealth Government has made a grant of \$27,730 for the first year of a three-year investigation into a two-fold study of green sea turtles in Torres Strait. The study will be undertaken by Dr H.R. Bustard, Research Fellow in Environmental Biology in the Research School of Biological Sciences, Australian National University.

Dr Bustard's study will involve an analysis of the population ecology of turtles in the area, as well as a detailed work on the management of wild turtles, including their farming.

Dr Bustard said today it was important to appreciate that the management of a population was not possible until the population ecology was thoroughly understood. There was no such information available at present for any species of sea turtle, so management had not yet reached an applied stage for these animals.

Dr Bustard said, 'The understanding of a species' "life table" will allow the rational exploitation of populations on a sustained yield basis, and so will aid their conservation. Unfortunately, almost without exception, exploited wild populations of animals are "mined" rather than rationally exploited.'

Dr Bustard's research will be centred on Darnley and Murray Islands. On Darnley Island, as well as a study of the population ecology of the natural turtle population, there will be a pilot research project on battery rearing techniques with hatchling turtles. On Murray Island management of the wild population will be attempted by the reduction of infantile mortality, which is normally very high. Hatchlings will be reared in pens for periods varying from three to twelve months, then tagged and liberated. Their subsequent survival will then be compared with that of hatchlings marked and liberated as they emerge from the nest. This sort of information does not exist for any other turtle population in the world.

If Dr Bustard's studies show that turtle farming can be undertaken without threat to the turtle population it could mean the establishment of an industry in which the islanders and Aborigines could work happily.

Enquiries to Dr Bustard 49 4351 or 49 8176 (home).

ENQUIRIES TO THE ASSISTANT TO THE REGISTRAR (INFORMATION) TELEPHONE 49 2229

University Information

19 October 1970

which vary widely in their density and precise names. To navigators using the strait, the islands and their spires and conical mounds were regarded as part of the hazards of navigation, and of no particular importance or interest in themselves.

The islands. The islands of Torres Strait are of all sizes, and of two kinds, high and rocky, and low and coralline. There are about 100 of each, if you count the smallest rocks and sand-cays, but only about 30 are inhabited.

Australia and New Guinea are joined over hundreds of kilometres by the continental shelf, and in Torres Strait this becomes a shallow bank of less than 17 m depth. If the sea level fell by that amount we could walk across without getting our feet wet at any state of the tide. Fortunately for navigation, the sea level has remained constant for at least the 370 years since Torres' visit, but there is no doubt that in prehistoric times there was a land bridge right across the strait, especially during the Ice Ages. The last of these was at its height about 50,000 years ago, when man first came into the area, and the strait would have been dry for thousands of years after that, possibly until 10,000 years ago.

To the east the shallow waters of the strait are flanked by the Great Barrier Reef, which extends to the edge of the continental shelf. To the west the shallows merge gently into the Arafura Sea, though the shoal water follows the coast of Irian Jaya for hundreds of kilometres further.

From the earliest days of contact the natives of the strait were known as fierce warriors, with fleets of large canoes for raiding neighbouring islands and the adjacent coast of New Guinea, where the population was very sparse. In spite of a brisk trade for canoes, bows and arrows with villages near the Fly River, the islanders regarded the New Guineans as permanent enemies.

After 1606 there were several Dutch expeditions to the western side of the strait, including Tasman's in 1644, but no one approached the eastern side until Cook left himself with no choice but to find a way through the strait in August, 1770. He had no contact with the natives, but sighted a few wharves and arrows while he was taking possession of the east coast of New Holland on Possession Island, a few kilometres west of Cape York.

Bligh's visits. The next visitor to pass through the strait was Captain William Bligh in the 'Bounty' launch in June, 1789. He also passed close to Cape York, but missed Endeavour Strait, thinking it was a bay, and made his way through Prince of Wales Channel, which is today the main shipping channel. Bligh named Wednesday Island, setting the fashion for later navigators to name Tuesday Islets, and Thursday and Friday Islands, all in the Prince of Wales group.

During 1791 a boatload of escaped convicts from Sydney, including Mary Bryant, worked their way right up the east coast, through Torres Strait and on to Timor, but the long arm of the law was not far astern. In August HMS 'Pandora' was wrecked

five 1600, drawn at about 21 deg. S latitude (instead of between 9 and 11 deg. S) in order to retrace the known land of New Guinea from the mythical and undiscovered continent of Terra Australis Incognita.

Torres' report. Torres' report to the King of Spain did not become generally known, and lay buried in the archives until 10 years after the strait had been rediscovered by Cook in 1770. The story that a copy of the report was found in Manila in 1764 by Daifymple is quite untrue, though it has been repeated by writers from Flinders in 1814 to the most recent history books. Daifymple was sent a copy from Spain in 1780, and translated it himself for publication in 1806, just 200 years after the voyage of Torres.

The report was a very brief one, but a much fuller account came to light in 1929, written by a noble passenger who travelled with Torres, Captain Don Diego de Prado y Tovar, who also drew the charts of their discoveries. From Prado's narrative we can work out that they anchored off at least 10 islands, though they did not land on them all, and often when they did land the natives had taken off to other islands, or had hidden in the bush. The islands involved were Parama, Bristow, Duugeness, Turtle-backed, Cap. Gabba, Long, Mount Ernest, Twin and Prince of Wales. The last anchorage, in Endeavour Strait, was two miles south of Cape Cornwall, and here Torres' ship, 'San Pedro', bumped on the bottom during the night on a five-metre shoal. His consort, the launch 'Los Tres Reyes', though anchored closer to the shore, did not bump, and next day, October 4, Torres made the latitude 11 deg. at noon, before leaving the strait.

He had been in sight of the Australian coast for about two days, but did not know it was the coast he had been searching for in the Pacific, and in the Coral Sea, but thought it was just an extensive group of islands.

Jesse's voyage. He was actually preceded in the sighting of this part of Australia by the Dutchman Willem Jansz in the small vessel 'Deuyfken', who landed near the present port of Weipa, followed the coast south to Cape Keer-Weer, and then returned northwards. He passed up the western side of Torres Strait, and landed on Prince of Wales Island, which he named Hough Eylandt (High Island), and returned to Banda in the East Indies.

A fine chart of his discoveries was made, but no journal or log-book of the voyage exists, so we do not know the details or dates of his contact with Australia, which were probably in March or April, 1606, and therefore six months before Torres. To Jansz the strait appeared to be a large shallow bay or bight, so he and his successors, including Tasman, assumed that Cape York Peninsula was a part of New Guinea, despite the vague reports that Torres had sailed through a strait in the area.

Although Prado's charts of the southern coast of New Guinea were sent to Spain, they were later lost, and we only have a few rare hand-drawn copies

trying to enter Torres Strait near Raine Island, many lives were lost, including some of the ministers of the 'Bounty', who had been arrested in Tahiti.

Captain Edwards sailed the ship's boats through the strait to Timor, where he was able to add the escaped convicts to his prisoners, all bound for the harem's house in England. On reaching Java, Captain Edwards met the 'Resolution', a small vessel built by the ministers at Tahiti, but manned by some of the 'Pandora' crew before leaving Tahiti. They had also sailed through the strait in 1791, making it a busy thoroughfare for distressed mariners.

The next visitor was again Captain Bligh, this time with two ships carrying breadfruit plants from Tahiti to the West Indies, HMS 'Providence' and 'Assistant'. This time Bligh avoided the Barrier Reef by entering the strait near the coast of New Guinea, believing that Torres had taken a northerly track in better waters. He sailed down what is now called the Great North-east Channel, then through Basalisk Pass, and passed Gabba Island before being blocked by extensive coral reefs, as Torres had been in the same area. Bligh worked his ships down towards Banks Island, and then escaped to the open sea through Bligh Channel on September 18, 1792.

Next year two ships, the 'Shah Hormuzter' under Captain Bampton, and the whaler 'Chesterfield', Captain Ali, also looked for a passage in the northern part of the strait and after following the tracks of Torres and Bligh, pushed on through the shoals, keeping close to the New Guinea coast. The two ships took turns in running aground and in helping each other off, and it was a whole month before they finally cleared the shoals near Deliverance Islet on August 29, 1793.

The strait remained largely uncharted, despite these perilous passages by different ships, and Flinders made a chart of all the tracks followed for his book in 1814. He had passed through the strait three times himself, first as a midshipman under Bligh in 1792, then in command of HMS 'Investigator' in October, 1802, and finally in the much smaller HMS 'Cumberland' in October, 1804. On the two latter occasions he used Prince of Wales Channel, and therefore did not add much to our knowledge of the rest of the strait.

There is no foundation for the many reports of unknown Spanish galleons wrecked in the strait. The finding of stray Spanish dollars on the islands would be due to the fact that these were common currency in Sydney in the early years, being imported by Governors Macquarie and Brisbane to overcome the shortage of coinage in the colony. Many ships were wrecked in the strait and in the approaches through the Barrier Reef, and many boats' crews were attacked by natives. The warriors of 'Turtle-backed Island (Yam or Yama), tried to capture Torres' launch, but were repelled by firearms. Torres named the island 'Caribbee' or 'Can-

als', being impressed by the collection of skulls and horns found in the village where he landed. He also saw masks and figures made from tortoise-shell, similar to those seen in museums today. He also remarked on the very strong bows of bamboo, and clubs with heavy stone heads. Their canoes were later reported to be over 17 m in length.

Naval surveys. The fullest accounts of the natives of the Torres Strait Islands were written by various naval surveyors who charted the area between 1819 and 1875. Their ships included the 'Fly', 'Rattlesake', 'Stambla' and 'Basalisk' (Captain Moresby). In 1844 a beacon, almost 20 m high, was erected on Raine Island to mark an entrance through the Barrier Reef for ships making for Torres Strait.

An unofficial 'post office' came into use at Bounty Island, and here a supply of provisions was left for wrecked crews making their way towards Timor. The post office was unmanned, and consisted of a cave in which bundles of letters were left for other ships to pick up and deliver. The cave is also an archive of inscriptions made by passing ships and boatloads of survivors of wrecks and massacres.

In October, 1849 men from HMS 'Rattlesake' picked up a white woman, Mrs Barbara Thomson, on Prince of Wales Island. She was the sole survivor of the cutter 'America', wrecked nearby about four years before. She had been taken to wife by the chief, Boroto, and renamed G'Om after a dead girl of the tribe.

During her stay she had met the infamous runaway convict named Wini, who had become the war chief of Bado, or Malgrave Island, where he led the locals into killing all white men who came near their island. He was finally shot by a punitive expedition from the settlement founded at Somerset in Albany Passage in 1864, only nine kilometres south-east of Cape York. It was under the charge of John Jardine, with a garrison of 25 marines, and formed a harbour of refuge for castaways. During the next 11 years there were 14 wrecks recorded, and it was an important port for ships working in Torres Strait.

Modern period. The year 1871 marked the beginning of modern history in the strait, with the arrival of the first missionaries, and the development of fishing for beche-de-mer, pearl shell and trochus shell. By 1877, when the settlement was moved to Thursday Island, there were 16 firms in the trade, employing 109 vessels, 50 Europeans and about 700 natives. The area being worked covered 4,800 sq km, and the value of pearl shell was £200 a ton. The value of pearls found in the shells amounted to only a third of the value of the shell. The trade went through many vicissitudes through the following decades, and finally stopped about 1940, when the settlement at Thursday Island fell into decline.

Thursday Island's native name was Wyben, it used to be referred to as Port Kennedy. The island was fortified about 1880 to defend the navigational passage. The first nine official pilots were licensed in 1884 by the Queensland Government, and the

5/19/76
5/19/76

Dr. George H. Balazs,

Hawaii Institute of Marine Biology,
University of Hawaii,
Kaneohe,
Hawaii - 96744
U.S.A.

Dear Dr. Balazs,

Mr. A. Dunbavin Butcher recently wrote to Mr. ^{at} Henry Shugg of my Department concerning your interest in marine turtles.

I'm sorry to say that there is no-one working on marine turtles in Western Australia. I have worked on fresh-water turtles (see enclosed paper) (Lepidochelys 1974, Nov.) and have maintained an interest in marine turtles but my main work at present is on terrestrial ecosystems. A colleague of mine at the W.A. Marine Research Laboratories (the other main research centre operated by my Department) kept statistics on the green turtle fishery but since the taking of turtles was banned about two years ago he has not continued with this.

Much of my work is on islands off the west coast of Australia and I have some information on nesting sites etc., which has not been published. Perhaps you could write to me indicating the particular area of your interest and I will see what I can do.

Yours sincerely,

Andrew A Burbidge

Andrew A. Burbidge
Senior Research Officer

January 16, 1976.

CHRISTMAS 1975



AEROGRAMME
BY AIR MAIL • PAR AVION



Dr. George ~~H.~~ Balazz,
Hawaii Institute of Marine Biology,
University of Hawaii,
Kaneohe,
Hawaii - 96744
U.S.A.
Country of destination

Sender's name and address

Dr. A.A. Burbidge,
W.A. Wildlife Research Centre,
P.O. Box 51,
WANNEROO.....6065
WESTERN AUSTRALIA. Postcode

Fold flaps before moistening gum. For maximum adhesion,
press down for a few seconds. If anything is enclosed or

First fold here



DEPARTMENT OF
FISHERIES AND WILDLIFE

G.H. BALAZS,
P.O. BOX 1346,
COCONUT ISLAND,
KANEHOHE,
HAWAII, 96744

108 Adelaide Tce., Perth,
Western Australia. 6000
Telephone 25 5988

Telegraphic Address:

Fishfaun, Perth.

Your Ref:.....

Enquiries P. Kelly

Our Ref:.....

18th June, 1976

Dear Sir,

In answer to your letter of the 19.5.76 listed below are the figures for the catch of Green Turtle for the last eight years. All weights are in pounds live weight.

<u>Year</u>	<u>Live Weight in lbs</u>
1966-67	524,372
1967-68	887,457
1968-69	879,421
1969-70	449,907
1970-71	460,416
1971-72	Nil
1972-73	Nil
1973-74	Nil

I trust this information is of some assistance to you.

Yours faithfully,


DIRECTOR

PK:KK



DEPARTMENT OF FISHERIES AND WILDLIFE

Western Australian Wildlife Research Centre

Mullaloo Drive, Wanneroo W.A. 6065, P.O. BOX 51, Wanneroo, Western Australia, 6065. Phone 91 1555 Area Code 092

Dr. George H. Balazs
Hawaii Institute of Marine Biology
University of Hawaii at Manoa
P.O. Box 1346
Coconut Island
KANCOHE, Hawaii 96744
U.S.A.

Dear Dr. Balazs,

I am sorry I have not answered your letter of May 19 before but I have been overseas for the past four months. Thankyou for the reprints you sent me. I hope that the statistics on the green turtle fishery were what you wanted.

I too think it unfortunate that no studies on marine turtles are underway on the west coast of Australia. With our small population and vast area it is difficult to fund studies other than those of great immediate urgency. All the marine biologists employed by the Commonwealth and State Governments in Western Australia are working on commercial fishery management. We have little money available from Foundations in Australia for this sort of research. The only way I can think of getting such a study underway would be if some overseas organization wished to fund a study or send people already studying turtles elsewhere to do comparative work on a relatively undisturbed population. Have you any ideas along these lines?

Yours sincerely,

Andrew A. Burbidge

ANDREW A. BURBIDGE
Senior Research Officer.

September 22, 1976. ↙



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

March 18, 1980

F/SWC2:RSS

To: George Balazs, HIMB
From: *for Richard S. Shomura* Richard S. Shomura, Director, Honolulu Laboratory
Subject: Turtle research in Western Australia

From my brief discussions with researchers in Western Australia, there apparently is no ongoing research on turtles in Western Australia. Rod Lenanton (W.A. Marine Research Labs, P. O. Box 20, North Beach 6020 W.A.) I believe mentioned that he did some work on turtles; in any event he has some interest in the animals. He referred me to Dr. Robert Prince (W.A. Wildlife Research Centre, Toondalup, Western Australia), who apparently has done some research on turtles in the area.

Radioactivity at the Monte Bello Islands

THE Monte Bello Islands are a group of uninhabited islets and rocky outcrops off the north-west coast of Western Australia, lying on the line of an extensive coral reef at 20°50'S, 116°13'E, about 70 miles north-north-east of Onslow. The main islands of the group are Alpha, North-West, Trimouille, South-East and Hermite. About 10 miles to the south of the group lies the much larger Barrow Island.

The islands are coral and limestone covered with sand and spinifex, and with sheltered bays lined with mangroves. They are comparatively flat — the highest point, on Trimouille, is only 38 metres above sea level.

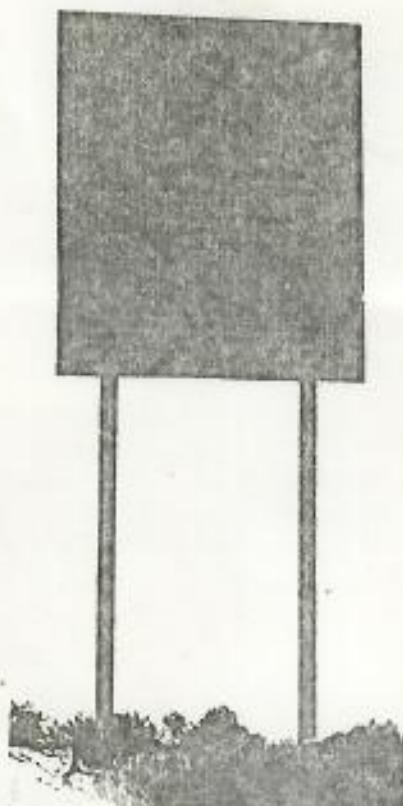
Wild cats, rats, wallabies and a number of bird species have been reported as inhabiting the islands, and green turtle and fish are plentiful. There appears to be no fresh water on the islands.

History

The recorded history of the Monte Bellos dates from 1622 when the English ship *Tryal* or *Trial*, under the command of Captain John Brooke, was wrecked on the night of May 25 on what subsequently became known as Tryal Rocks. Two boatloads of survivors managed to reach Batavia.

Subsequently the Dutch East India Company marked the Tryal Rocks in its charts but later, after the settlement of Australia, the position of the rocks could not be located and some doubt was raised as to their existence.

However surveys by Lieutenant P. P. King in 1818 and 1820 and by Captain J. C. Wickham in 1840 established that they lay at the



The Monte Bello Islands in Western Australia are well-known for catches of mackerel and other fish made around their reefs. But these islands were the scene of three atomic weapons tests in the 1950s and — although the Monte Bellos do not exactly glow in the dark — there is lingering radiation, and entry to the old test areas is controlled by the Naval Officer-in-Charge, Western Australia. Brenden Mooney of the Department of National Development and Energy (Radioactive Materials Branch) explains the background to the current situation.

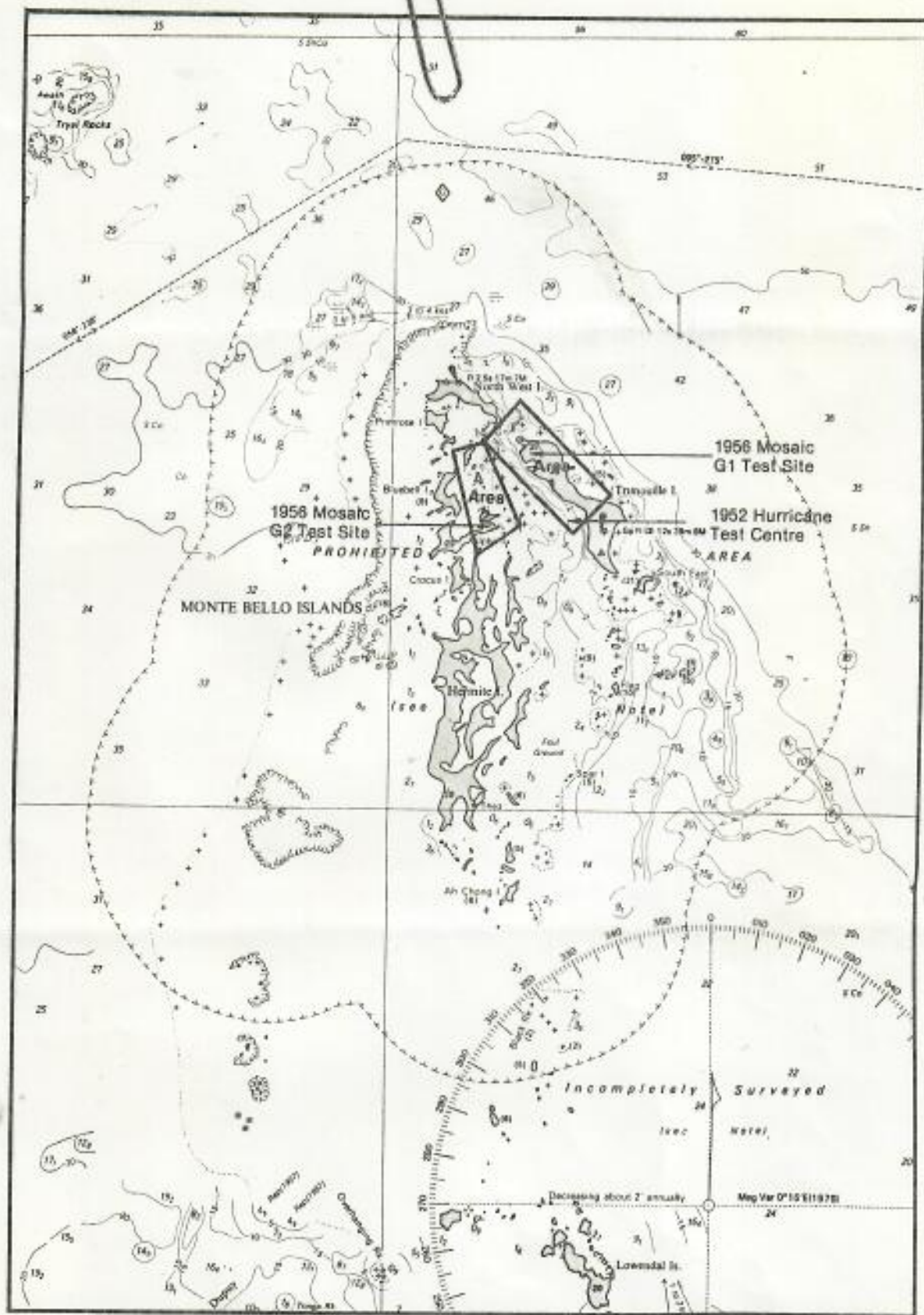
north-western end of the Monte Bello Reef. The islands had been named by Captain Nicolas Baudin, during a French voyage of exploration in 1801-2, in honour of Marshall Lannes, whom Napoleon created Duke of Montebello.

The various lagoons of the Monte Bello group have been used from time to time by pearling and whaling vessels, and an unsuccessful attempt was made in the 1930s to establish a factory on Hermite Island for canning fish and turtle flesh.

Atomic tests

Following agreement between the United Kingdom and Australian Governments the Monte Bello Islands were chosen as the site for three nuclear weapons tests. The first test was in 1952, offshore from Trimouille Island on an obsolete ship (*HMS Plym*), with subsequent tests in 1956 on Trimouille and Alpha islands. The 1952 test series was code-named Operation Hurricane and the 1956 series Operation Mosaic.

For the purpose of the tests the islands were declared a 'Prohibited Area' under the Defence (Special Undertakings) Act 1952. Under this Act the Australian Government in 1957 declared the Monte Bello Islands and their territorial waters to be a Prohibited Area and appointed the person occupying the position of Naval Officer-in-Charge, Western Australia, as Officer-in-Charge of the Prohibited Area. The Monte Bello Islands and their territorial waters are still a designated Prohibited Area today. (See the map.)



Rehabilitation, management

In 1962, 1968 and 1972 major radiation surveys of the islands were undertaken in the areas of radioactive contamination left by the tests, on behalf of the Atomic Weapons Test Safety Committee.

These revealed small areas on Trimouille and Alpha Islands where radiation levels, although declining, remained above the limits recommended for continuous occupancy.

In October 1978 a reconnaissance party comprising officers of the Australian Radiation Laboratory, the Western Australian State X-Ray Laboratory and the Department of Defence visited the former test sites on the Monte Bello Islands. A radiation survey was undertaken and subsequently the Australian Ionising Radiation Advisory Council (AIRAC) recommended in April 1979, that certain rehabilitation measures be implemented. (AIRAC's formal report — *Radiological Safety and Future Land Use in the Monte Bello Islands* — was tabled in Federal Parliament on November 13, 1979.)

In November 1978 the then Department of National Development was given responsibility for the care, maintenance and rehabilitation of former nuclear test sites including the Monte Bello Islands. As part of those responsibilities a program of radioactive waste management was undertaken on the islands in May 1979, based on AIRAC's recommendations.

Essential elements of this program include:

- erection of warning signs in English and eight other languages in the vicinity of the test sites on Trimouille and Alpha Islands, and on Trimouille Island adjacent to

the offshore test on HMS *Plym*; and

- construction of concrete pyramids at the two on-shore test sites with warnings inset into the concrete.

One of the recommendations contained in AIRAC's report was that considerations of radiological safety would not preclude the return of the islands to the administrative control of the Western Australian Government. The Commonwealth and State Governments have commenced consultations on the future management of the islands.

Island visits

The islands and their territorial

waters are still a Prohibited Area and any person wishing to enter the area is required to obtain permission from the Naval Officer Commanding, Western Australia, PO Box 228, Rockingham WA 6168.

Should any person or organisation wish to conduct operations of a commercial nature within the Prohibited Area they are required to obtain written permission. It may be anticipated that approvals will not be given for commercial operations in specified areas in the vicinity of ground zeros (the actual sites where explosions occurred) on Alpha and Trimouille Islands and adjacent waters. These areas are shown as Area 1 and Area 2 on the map.



This is one of the concrete pyramids that mark the sites of atomic explosions on Alpha and Trimouille Islands in the Monte Bellos.

The section of chart opposite shows the Prohibited Area and Areas 1 and 2 (boxed) around the atomic weapons test sites.

I also tabled Customs Tariff Proposals No. 19 (1973) which contain amendments arising from the Government's acceptance of reports by the Tariff Board on engines, motors, pumps and valves, etc., and fire hose. The Tariff Board has recommended an industry level of protection of 35 per cent general on the bulk of local production of goods covered by its report on engines, motors, pumps and valves etc. However, to allow the Australian industry time to adjust gradually to this reduced level of assistance, the Board recommended that the duties be reduced to this level over 4 years. The Board has concluded in relation to the major products covered by the report, pumps and valves, that there is a need for some rationalisation of the number of producers and specialisation in the range of goods produced. The Board considered that these actions, combined with efforts to expand export sales, should allow manufacturers to achieve higher volumes of production with a resultant situation where economic and efficient manufacturers would be able to produce under a general tariff rate of 35 per cent.

The Tariff Board drew attention to what appeared to be 'considerable scope for more local manufacturers of the goods under reference to develop export sales as a means of obtaining a more efficient and economic use of existing plant and other resources'. The Department of Overseas Trade, in consultation with the Department of Secondary Industry, will investigate the export prospects for the products concerned. Because of a commitment accepted by Australia in past negotiations under the General Agreement on Tariffs and Trade, the Government has decided not to increase the general rate of duty on pumps specially designed for use in the mining and metallurgical industries.

In its report on fire hose the Tariff Board recommended that all textile hose piping and similar tubing with an internal diameter of 110 millimetres or less should be dutiable at 20 per cent and that goods of larger diameters should be admitted free of duty. As both these reports were received prior to 19 July 1973 the duties will be subject to the provisions of the 35 per cent tariff cut. The new duties will operate tomorrow.

In accordance with Australia's trade agreements a margin of preference of 5 per cent is being provided in favour of New Zealand on non-protected items. However, as agreed with New Zealand, provision is being made

for these goods to be admitted free of duty under by-law, it being understood that the matter would be reviewed in the event of representations from New Zealand and to the effect that it had an important or substantial trade interest in the goods concerned. A comprehensive summary of the changes and duty rates is being circulated to honourable members. I commend the Proposals.

Debate (on motion by Mr Fairbairn) adjourned.

TARIFF BOARD

Reports on Items

Dr J. F. CAIRNS (Lalor—Minister for Overseas Trade)—I present the reports by the Tariff Board on the following subjects:

Engines, Motors, Pumps and Valves, etc; and Fire Hose.

Ordered that the reports be printed.

STANDING COMMITTEE ON THE ENVIRONMENT AND CONSERVATION

Report: Turtle Farming in the Torres Strait Islands

Dr JENKINS (Scullin)—On behalf of the Standing Committee on the Environment and Conservation, I present the report of the Committee on turtle farming in the Torres Strait Islands.

Ordered that the report be printed.

Dr JENKINS—I seek leave to make a short statement in connection with the report.

Mr DEPUTY SPEAKER (Mr Berinson)—Is leave granted? There being no objection, leave is granted.

Dr JENKINS—The report I have just tabled is the second from the House of Representatives Standing Committee on Environment and Conservation. The inquiry results from a reference from the Minister for the Environment and Conservation (Dr Cass) in June 1973 into the farming of turtles in the Torres Strait Islands, with particular regard to the International Convention on Trade in Certain Species of Wildlife. The Torres Strait farming project is based on the exploitation of 2 species which are referred to in the Convention, the Green and Hawksbill turtles.

Our inquiry considered firstly whether the farming operation is compatible with the Convention, and secondly whether the scheme,

even if achieving its commercial aim, is making a substantial contribution to the conservation of the species. The Committee held public hearings in August and September and planned to visit the Torres Strait in late August. However, the Prime Minister, for a number of reasons, requested us not to do so at that particular time. The Committee agreed to defer its visit. I would point out that the geographical isolation of the islands, together with their status as Aboriginal reserves, appear to have been the principal factors restricting independent assessment of the farming project to date.

I now refer to one of the most disturbing features which arose during the Committee's inquiry, and one which I believe indicates a lack of respect for this Committee and for the Parliament which created it. During late September we became aware that, without reference to or consultation with the Committee, an inquiry had been commissioned through the Department of the Special Minister of State into the very matters which the Committee already had before it. The Committee, therefore, at a meeting on 27 September resolved to discontinue its inquiry and report on the basis of evidence received to that point. To proceed further would have seemed to involve wasteful duplication. This report, therefore, is tabled with the knowledge that in other circumstances a great deal more information would have been sought.

At this point I would like to express the profound dissatisfaction of all Committee members for the manner in which the work of the Committee has been overridden. During the inquiry the Committee received evidence of serious financial maladministration of the entire project. Rather than carry out an in-depth study of these allegations which appeared to the Committee to be outside the direct scope of our inquiry, the Committee referred these matters to the Minister for Aboriginal Affairs with the suggestion that the Auditor-General should carry out an inquiry. I understand that such an inquiry is proceeding.

Returning to the subject matter of the report, I would like to make some brief comments and outline the Committee's principal recommendations. The turtle farming project when initiated, seemed an ideal way of developing a cottage type industry in an area of serious underdevelopment and lack of employment opportunities, with the benefit that it would bear a close affinity to the traditional life style of the Island people. It was also planned as a

positive step towards conservation of 2 species which are very seriously depleted.

The scheme proposed that Hawksbill turtles would be stuffed and sold as curios at retail prices of up to \$40 each. It was expected that by June 1973 3,000 Hawksbill would be available. In fact a total of 184 had been produced by that date. In relation to the Green turtle, which was to be produced for the 'lucrative' turtle meat market, the project aims have also not been realised. Growth rates, health and the production of Green turtles have not lived up to expectations.

Some criticisms have been made of the administration and management of the project and by implication of the Department of Aboriginal Affairs for not having carried out more groundwork before initiating the project and for continuing to justify it and increased allocations of funds to support it when it had clearly not been a success. There has not been a great deal of criticism of the project by the Islanders involved in it. However the principal reason for this appears to be that, badly off as they are, at least the farmers are assured of a regular wage, irrespective of the success or otherwise of their farm.

The Committee concluded that, despite the expenditure of at least \$574,000 to June 1973, the turtle farming project, no matter how idealistically conceived, had not achieved its objectives and did not appear likely to do so. Failure to research the project from either an environmental or commercial viewpoint and lax administration have resulted in the haphazard growth of poorly equipped farms run by untrained farmers. The effect on the turtle population is difficult to assess in the absence of records of egg collection and hatching mortality. However, we believe the scheme as presently operating is unlikely either to achieve its commercial aims or to make a substantial contribution to the conservation of the 2 turtle species concerned.

The Committee also concluded that emphasis in the turtle farming project should be away from that of a commercial enterprise to conservation or ecological research. I believe on this basis other species could also be investigated. The Committee does not share the view that, to protect the wild species, animals must be farmed. If research can show that wild turtle populations are sufficiently high to enable commercial harvesting without detriment to the species, this could be considered again.

Among the Committee's principal recommendations are: That the turtle farming project in the Torres Strait Islands cease as a 'commercially' orientated undertaking; that the project become one based on research into the ecology of the Green and Hawksbill turtle and on conservation per se; that the number and quality of turtles be rationalized, and that water reticulation and access to freezer facilities be essential features; and that the research and conservation project be placed under the control of a scientist not associated with the present commercially based operation. I should like to thank the members and staff of the Committee for their work and the interest they have shown in this inquiry and in the production of this report.

Motion (by Mr Daly) proposed:

That the House take note of the paper.

Debate (on motion by Mr Lynch) adjourned.

BILLS RETURNED FROM THE SENATE

The following Bills were returned from the Senate:

Without amendment—

States Grants (Capital Assistance) Bill 1973.

States Grants Bill 1973.

Social Welfare Commission Bill 1973.

States Grants (Housing Assistance) Bill (No. 2)

1973.

Mental Health and Related Services Assistance Bill

1973.

Without requests—

Wheat Tax Bill 1973.

HIGH COMMISSIONER (UNITED KINGDOM) ACT REPEAL BILL 1973

Bill received from the Senate, and read a first time.

CUSTOMS BILL 1973

Bill received from the Senate, and read a first time.

INCOME TAX ASSESSMENT BILL (No. 4) 1973

Second Reading

Debate resumed from 30 August (vide page 653), on motion by Mr Chalmers:

That the Bill be now read a second time.

Mr LYNCH (Opposition) (5.5)—The Bill before the House seeks to amend the Income Tax Assessment Act to eliminate the use of Norfolk Island and, to a more limited extent, of Papua

New Guinea, for tax haven purposes. The amendments proposed for Norfolk Island will also apply to Cocos (Keeling) Islands and Christmas Island.

Under the terms of this legislation Australian income tax laws will apply to the Territories—Norfolk Island, Cocos (Keeling) Islands and Christmas Island—as if they were part of Australia. The Bill's provisions will continue to exempt from tax the island and other ex-Australian income of people who live on the island and are not resident in Australia for tax purposes.

The legislation provides for three main exemptions: Territory residents and trusts are to be exempt for income derived from sources outside the Territories and outside Australia; Territory residents, Territory companies and Territory trusts are to be exempt for island source income; and persons not qualifying as Territory residents but resident in one of the Territories for periods exceeding 6 months are to be exempt in respect of employment income.

The Bill contains a number of supplemental measures which, in general, seek to prevent the exploitation of the new provisions. In addition, there is a transitional measure to assist island companies that now have a degree of non-island ownership but wish to re-organise their affairs to retain tax exemption. In this respect the Bill provides for a partial exemption for income derived up to the end of the 1973-74 income year for a company that becomes fully island-owned and controlled during the last 6 months of 1973-74.

The provisions relating to Papua New Guinea seek to prevent tax evasion by Australian private companies through the payment of such companies of dividends to special 'repository' companies set up in Papua New Guinea, where undistributed profits tax is not levied on private companies. The Bill will make dividends paid by an Australian private company to a private 'repository' company resident in Papua New Guinea ineligible to be counted as a dividend for the purpose of calculating whether the Australian company has a liability for undistributed profits tax. This will not affect dividends paid to a Papua New Guinea company in circumstances, as defined in the Bill, which do not involve tax avoidance.

AUSTIN E. LAMBERTS
1520 LEFFINGWELL, N. E.
GRAND RAPIDS, MICHIGAN 49505

MARINE ZOOLOGY

January 10, 1977

PHONE (616) 363-0803

Dr. George Balacz
Hawaiian Institute of Marine Biology
Coconut Island, Kaneohe
Oahu, Hawaii.

Dear George:

When I was in Hawaii a couple of weeks ago I mentioned that Charley Veron had told me about a huge turtle nesting he had observed on the Barrier reef. I saw him later and asked him for details and this is what he told me.

He says that about a year before he had seen turtles breeding on Raine Island so in Early December 1975 he was up by Murray Island going south and they decided to put in at Raine to see what was to be seen. Apparently Raine is due south of Murray island about 100 miles and even with the tip of the Cape of York. It is a phosphate Island of about 40 acres on the outer barrier.

When they got there the place was covered with breeding turtles. They were all breeding, covering each other, digging up each others eggs and he says the smell was terrible. They apparently were greens and Veron says that they actually counted 13,000 but estimated that there must have been 20,000 in the vicinity. They were kept busy turning over turtles that had become stranded. Looked like a tank battle had taken place there.

I'm not sure if any pictures were taken but I think he said that Bustard was there but I may be wrong on that.

Thought you would be interested. I was. Turtles were my first love back when I was a teenager. Somehow I got a long way from them but I've always enjoyed knowing and reading about them.

Sincerely

Austin

Austin E. Lamberts

Torres Strait turtle farms reach pre-commercial stage

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GEORGE H. BALAZS

Thirty small turtle farms successfully established on Torres Strait islands in northern Australia have reached a pre-commercial stage under the supervision of Dr H. R. Bustard of the Australian National University in collaboration with the Queensland Department of Aboriginal and Islands Affairs.

DR BUSTARD, who is head of the Applied Ecological Unit at the Australian National University in Canberra, has been working on sea turtles in Queensland since 1946. A strong advocate of sea turtle conservation (he is a member of the International Union for the Conservation of Nature and Natural Resources Sea Turtle Group) Dr Bustard sees in small-scale farming of green turtles (*Chelonia mydas*) an opportunity to increase the wild population of this species in northern Australia and at the same time provide employment and a cash income for Torres Strait islanders.

Commonwealth grant

In 1970 Dr Bustard received a Commonwealth grant to study green turtles in Torres Strait and started work on Darnley Island where he established a pilot farm. The project progressed well, the climate and abundance of fish food in the area proving ideal for the growth of turtle hatchlings. Three Torres Strait Islanders were sent to Canberra for six months to study turtle raising techniques in a laboratory and a film was produced of a farming venture in the West Indies which raises 46 000 turtles a year. The film is shown to Torres Strait Islanders interested in turtle culture.

Now five commercial farms have been established on Darnley Island and another 25 on 13 other inhabited reserve islands in Torres Strait.

Isolated

Many of the islands are extremely isolated and job opportunities are few, and to support their families the men frequently have to seek work on the mainland,

sometimes as far away as Western Australia.

Torres Strait islanders understand turtles, which provide them with their only red meat, Dr Bustard says. Turtles are totally protected in northern Australia, only islanders and aborigines being allowed to take them for their own use.

Before Christianity came to the islands in 1871 some islanders worshipped the turtle, and use turtle oil on their bodies in an attempt to cure many kinds of illness.

Farming turtles has an immediate appeal to the islanders who see in it an opportunity to work near home and earn money to support their families.

At present only Torres Strait islanders and aborigines have licences to farm turtles and Dr Bustard hopes that this arrangement will continue.

Cottage industry

Turtle farming is an ideal cottage industry and the capital required to establish a farm is small only about \$20. Those wishing to become farmers first undergo a period of training after which they are on their own. Initially they are supplied under permit with 150 turtle eggs and a further 250 eggs after three months. When they are one year old 10 per cent of young turtles are released to build up the wild stock and the remainder are kept on the farm for food and to be sold commercially.

Commercially green sea turtles are sought for their oil which is used in the manufacture of cosmetics and for their calipee, the cartilaginous material between the shell bones which is used to make turtle soup. Turtle skins are

also in keen demand. It takes about three years for a turtle to grow to commercial size but a new and profitable outlet for part-grown one-year olds has been found: they are killed, cured, stuffed and sold as ornaments.

A female green sea turtle lays between 600 and 800 eggs in a summer, in clutches of about 150 eggs at fortnightly intervals, but only breeds every fourth year.

The eggs hatch in about two months and the baby turtles make straight for the sea and do not stop swimming to rest or feed for several days. By the time this initial frenzy is over they may be 200 miles from their birthplace.

Predators

Turtles remain in the open sea until they are about a year old, a period known as 'the lost year', during which time many of them are eaten by predators. It has been estimated that only 1 per cent survive to return at the beginning of their second year to the shallow waters.

There is some evidence which suggests that the females return to their birthplace to breed.

The secret of turtle farming is to rear babies in captivity and so avoid huge losses by predation.

In Torres Strait large numbers of eggs can be produced by a few females held in captivity in pens on the reef flats or in cement pools.

Early in their life green turtles are carnivorous but after about a year they change to a predominantly vegetable diet. However, they are catholic in their tastes. Dr Bustard has found, and are happy to eat fish or meat throughout their life. Their green food need not consist solely of seaweed greenstuffs from the vegetable garden are just as suitable.

Australian Fisheries, November, 1972

Turtles and man is the subject of today's talk. Man's effect on turtles has been completely one-sided - to butcher them. The slaughter - for it is nothing less - has not been carried out by ignorant native people - they only kill what they need to eat and one turtle can feed a village - but by European commercial interests. While many seagoing natives catch turtles in the water using harpoons, taking a high proportion of males as a result, European man prefers to sit on beaches and turn female turtles as they come up to lay their eggs. Since turtles nest after spending several years feeding at sea, but can lay over one thousand eggs in a breeding season, this is an extremely foolish way to exploit them. Yet, despite legislation in various parts of the world, supposedly giving some protection, at least at the start of the breeding season, it still goes on.

Australia, with large populations of the green - I might say soup turtle - has forbidden any exploitation, and afforded full protection to all its turtles following my advice. This was not intended - by me at any rate - to prevent any utilisation, but to provide a break with the old methods and allow time to work out rational exploitation schemes. By rational exploitation I mean to exploit the population in such a way and at such a level of utilisation that one can go on indefinitely without the valuable resource being decimated or even exterminated. This is often referred to as sustained yield cropping. No sensible conservationist objects to it.

Apart from cropping wild turtle populations - which because of their ecological characteristics would permit only a low annual take of large turtles - there is another way to produce turtle products. This is by turtle farming. Game ranching, pioneered in South Africa, has a very bright future and can be applied to many animals including turtles. Properly carried out it would be extremely lucrative to the farmer, and if done on a large enough scale, would certainly reduce the pressure on wild populations. Commercial users of turtle products would much prefer a uniform farm product ordered in advance against known supply dates to having to get what they can from different regions of the world. At present there is one large turtle farm - Mariculture Ltd - farming the green turtle at Grand Cayman in the West Indies. Turtle farming is, however, an ideal cottage industry for tropical coastal peoples. Turtles occur naturally in the very areas where poverty and protein deprivation are most severe. I have already run a full field trial in the Torres Strait Islands between Australia and New Guinea. I can recommend turtle farming as an inexpensive way in which any developed country, wishing to aid a poorer nation, can bring about a quick beneficial result affecting the lives of many coastal-dwelling people. It may not be as impressive as a manufacturing plant

but it will work, it will earn money, and offer employment at a cottage-industry level to many village people.

I repeat that it must be carried out in a proper way. By this I mean that the very best scientific advice must be obtained to advise on the setting up and subsequent running of the farm. No one would go into cattle raising without a sound background and expect to make money. Yet the information needed to plan a cattle ranch is well known. Turtle farming, a new industry only at the pioneering stage, has even more need of that sound background and management expertise. Yet, unfortunately many attempts have been made and are being made using only well intentioned young volunteers without expert back-up or under the aegis of over-worked fisheries officers who not unnaturally tend to consider turtle raising as a fringe activity. What is needed today is a ^{large-scale} scientifically-run farm in which money making is not allowed to prevent the adoption of the best scientific principles and turtle conservation.

I have talked at some length about turtle farming as I believe it offers the best positive approach to saving the world's sea turtles.

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