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(Nouméa, New Caledonia, 11 - 14 December 1979)

THE TURTLE FARMING PROJECT IN TORRES STRAIT - NORTH QUEENSLAND

by

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WORKSHOP ON MARINE TURTLES

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The Turtle Farming Project in Torres Strait, Queensland

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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 Aboriginals 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 tranferred 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 accomodated 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.

Orignally 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 confimed 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). Tye site selected for nest conctruction 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 indivdual female cam ashore between three and eight times during the season. The number of egges produced varies between 300 and 800 per season.

It has always been assumed that female turtles msut 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 unkown. 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 trabsmissible 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 esteran 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 elsewehere 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 exoerimentation 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.

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

MARINE TURTLE RESOURCES OF THE SOLOMON ISLANDS REGION

by

J.K. McElroy and D. Alexander

ABSTRACT

The results of a Solomons-wide survey carried out between January 1973 and October 1974 on the marine turtles occurring in the waters of these islands are summarised. Local inhabitants were interviewed and, wherever possible, nesting sites visited. Particular attention was paid to identifying both those species of turtle nesting in the Solomon Islands and their most frequented nesting areas or beaches.

The species positively identified as nesting in the Solomon Islands were the Green turtle Chelonia mydas, the Hawksbill turtle Eretmochelys imbricata, and the Leathery turtle Dermochelys coriacea. Both the Loggerhead Caretta carreta and the Pacific Ridley Lepidochelys olivacea appear to occur, though no reports of either nesting in the Solomons were made.

The largest known nesting area (rockery) of the Hawksbill turtle in the Oceanic Pacific has been found in the Manning Strait, and is centred on the Arnavon Islands. Nesting occurs here throughout the year, though peak nesting periods (gleaned from observations, local fishermen, and records of shell purchases) appear to occur in May-July and October-January.

The main methods of capture employed by Solomon Islanders are described. An assessment of the numbers of turtles of each species occurring in the waters of the Solomon Islands is attempted, together with estimates of the numbers taken by fishermen, and on the beaches, for the period of this study. Indications of the amount of trade in turtles or their products, where available is also presented.

(1651/79)

MARINE TURTLES OF THE SOLOMON ISLANDS

Andrew McKeown

Ministry of Natural Resources
Fisheries Division
HONIARA 1977

CONTENTS

Preface

In late 1974 the Fisheries Division then of the Ministry of Trade Industry and Labour (later the Ministry of Natural Resources) identified the need for an assessment of the Turtle stocks of the Solomon Islands. This followed work by J McElroy then the Assistant Fishery Officer and resulted in a project application for United Kingdom aid.

Thanks are due to the United Kingdom for funding this survey and to Volunteer Service Overseas for supplying a project manager.

This report summarises the findings of the survey and precedes a second phase in which the present project will be extended to other areas in the Solomon Islands hopefully creating more nesting sanctuaries. Fisheries Legislation has recently been enacted including an extension of conservation measures in respect of Marine Turtles and introducing trading or processing licences. These measures have been based on the findings of this survey.

The Rt Hon P Tovua
Minister of Natural Resources-

Introduction

The Solomon Islands are situated between latitudes 5°S - 12°S and longitudes 155°E - 170°E extending some 900 miles in a south-easterly direction from Bougainville Island, Papua New Guinea. The six main islands are each roughly 100 miles long by 30 miles wide and form a double chain flanked by smaller islands with a total land area of 11,000 square miles and a population, in 1976, of slightly less than 200,000.

The climate is tropical/oceanic with day temperatures around 30°C, high humidity and rainfall varying from 90-300 inches per annum. Sea conditions are generally slight with south-easterly winds prevailing from April to November, North-westerly winds the remainder of the year, with the likelihood of cyclonic conditions in the latter period.

The Islands are of volcanic origin with highly convoluted topography which continues beneath the sea. Offshore waters are very deep and the fringing reefs very limited. However, the physical nature of the land masses and their location at the juncture of several major oceanic currents, together with many offshore shoals and reefs have provided a sea area rich in marine life.

Turtles have long played an important role in village life in the Solomon Islands. This is reflected both in the oral traditions and the 'ethnozoological' knowledge of the Islanders. It is noteworthy that turtle bones are found associated with the oldest archaeological sites, dating back 3000 years. Turtle meat is a rich source of protein and hawksbill shell is of economic importance in some of the villages. The need for cash in the villages is increasing and the old customs, some of which had a conservational affect, have largely died out. Formerly inaccessible nesting areas can now be visited by out board powered canoes and improved medical facilities have resulted in thriving communities in what once were sparcely populated areas.

THE GREEN TURTLE - Chelonia mydas

This is perhaps the most common turtle species in the Solomons, often seen floating near reefs or feeding in the lagoon shallows, though no rookeries are known to exist. It features regularly in the oral traditions there are names for it in all of the coastal languages, and is a totem in parts of Malaita, Rendova and Shortlands. However, little is known of the habits and ecology of this species here, the following gives a brief summary of the information available to date.

The colour is usually reddish brown with radiating streaks of olive or grey of the carapace. The top of the head is also brown with whitish spaces between the scales. The scales on the sides of the head and, to some extent, those of the flippers are blackish, again bordered with white. The plastron is whitish and always without markings. Occasionally a type is seen which is predominately grey with brown/black blotches over the carapace, this one is less common. Barnacles are never present on the shell. There is one pair of prefrontal scales on the head and normally five vertebral scutes on the carapace, though I have seen some hatchlings with a sixth vertebral scute and also with five instead of four inframarginals. Most of the green turtles that have been measured and tagged were juveniles, bought from fishermen round Wagina. Fig. 1. shows the weight/carapace length relationship of 66 green turtles.

Feeding. Although they are found feeding in most of the lagoons, the following is a list of the places where most are found:-

Roviana/Marovo lagoon system
Ontong Java Atoll
Reef Islands - notably Nupani Atoll

They are also fairly common in the lagoons around North Ysabel and South Choiseul.

Breeding.

No rookeries have been found, nor are there any stories of these animals ever having nested in aggregations in the Solomons, it is highly unlikely that any exist. There are, however, many places where occasional nesting takes place. Four nested on Kerehikapa between December 1976 and March 1977, (three others beached without nesting), Oroa island (Makira) - two in February 1977 (one of which was killed while nesting there again, 42 days later), two in Lilika Bay (Santa Ysabel) in January 1977, one in the Hele Bar Islands (New Georgia) 28/6/77. With the exception of Lilika, these are all places where hawksbill turtles usually nest, this seems to be fairly common - occasional nesting being reported on the hawksbill nesting beaches and perhaps more so on the beaches where leathery turtles usually come ashore - see report on leathery turtles. The times of nesting are usually reported as 'around Christmas' or January and February or, in the Eastern Outer Islands, from about October till December. Not enough nesting has been reported to give any more accurate picture, however, it seems unlikely that there is enough breeding in the Solomons to support the present population. It is likely that the Green turtles here are going elsewhere to breed, perhaps there is a movement here to feed. The only evidence of migrations to the Solomons is from one green turtle which had been tagged in French Polynesia (August 1973) and was subsequently caught in Malaita (August 1975). Villagers in the Shortlands report that turtles move down the coast of Bougainville to the Solomons though the numbers, size and actual species were not stated. Green turtles from Heron Island have been caught in the Trobriand Islands, it is possible that they come here too but they have never been reported to do so. Of 60 juvenile greens tagged - three have been recaptured within three months of release and within 50 miles of the places where they were released. It is generally thought that, although the adults are wide ranging, the juveniles are more stationery.
It is of note that basking behaviour is unknown here.

Utilization and Methods of Capture.

Both the eggs and the flesh of this animal are relished almost everywhere in the Solomons. Turtle meat is common at feasts of all kinds, however, it is not generally thought of as 'everyday' food and apart from feast-times there is little organised hunting for them. Occasional ones may be caught while fishing, these may be eaten or sometimes held in coral ponds for later consumption. Most of these *'random catches'* are juveniles.

Very large numbers are usually caught for feasts, normally using nets. I saw 22 caught in Baola in November 1976 and 39 in Samasodu in July 1977. These latter people report that formerly 100 was not uncommon for a days catch. Methods used - tangle netting, spearing, diving and holding while the turtles are sleeping, shooting with bows and arrows, nets baited with pawpaw, on the beaches and hook and line fishing using pawpaw as bait.

There is also some trading in live adults especially in Santa Cruz - green turtles there were being caught in the south and also in Vanikoro and shipped to Graciosa Bay where they were sold to the workers at the Allardyce Timber Company base. Prices in August 1976 were around 12 dollars for an adult. Turtle shells are also bought by some traders in Honiara both for local sale and for export. One trader says he exports about 20 shells per month to Japan, but the bulk of the sales are local - some people decorate their houses with them. Polished and varnished shells are also sold to tourists. Most of the shells are, however, thrown away by the villagers, the prices paid for them in Honiara make freighting them there fairly unprofitable and in some places the turtles are cooked in their shells, making them worthless.

There is no trade in either turtle leathers or in stuffed ones, nor are they imported. Turtle soup is on sale in some of the stores - imported from Australia.

Kerehikapa Data.

The mean carapace length of four green turtles nesting on *Kerehikapa* was 85 cms - measured as a straight line, limits 78-89. Weights varied from 184 lbs-210 lbs with a mean of 197.75. Other parameters are given in Fig 2. Five clutches were laid, sizes being 156, 88, 65, 45 and 69 - mean 84.6. The mean emergence was 68.4 (93-42%) after incubation for 60 days (63-57). The hatchlings are blackish dorsally with white trailing edges of the flippers, underneath they are white except for the distal parts of the flippers which are black. The weights varied from 17-26 gms (mean 22.6) and carapace lengths ranged from 4.5-5.2 cms (mean 4.9).

Twenty-five hatchlings were transferred to galvanised iron tanks for 'growing on', mortality was low - 12% in three months and growth was much more rapid than hawksbill kept under similar conditions - see Fig 4, also report on hawksbill.

FIG. 1.
WEIGHT / LENGTH RELATIONSHIPS OF 64 GREEN TURTLES TAGGED THROUGHOUT THE SOLOMONS. M =MALE, N =NESTING FEMALE.

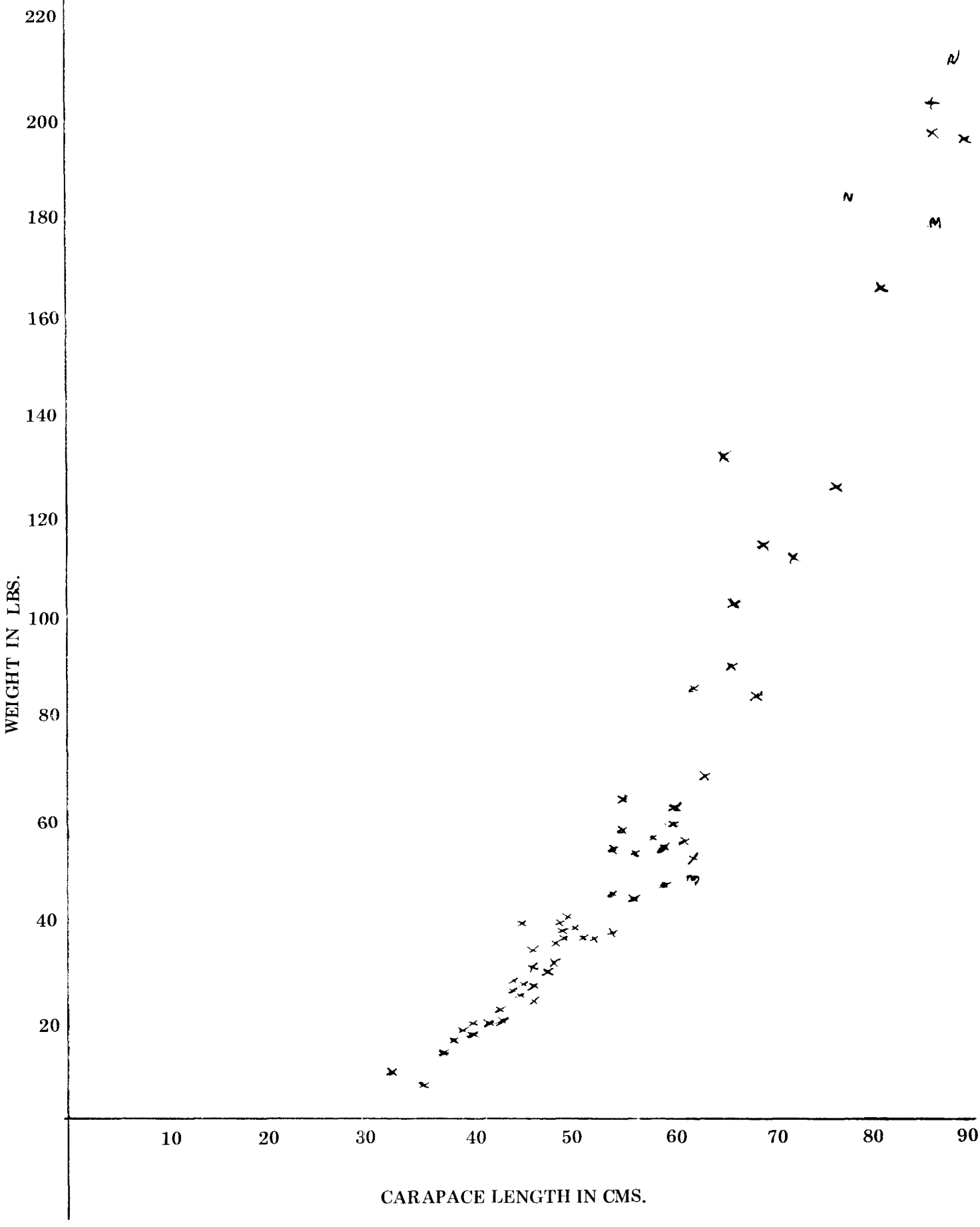


Fig. 2

GREEN TURTLES TAGGED WHILE NESTING ON KEREHIKAPA

Date	Tag Numbers	Weight (lbs)	Carapace Length (cms)	Carapace Width	Plastron Length	Head Width
17/12/76	26/27	210	88	68.5	70.5	12.5
6/1/76	43/44	202	86	71	70	13
1/3/77 15/3/77	85/52	195	89	67	74	11
30/3/77	154/155	184	78	58	64	10
Mean		198	85	66	69.5	11.6

Fig. 3

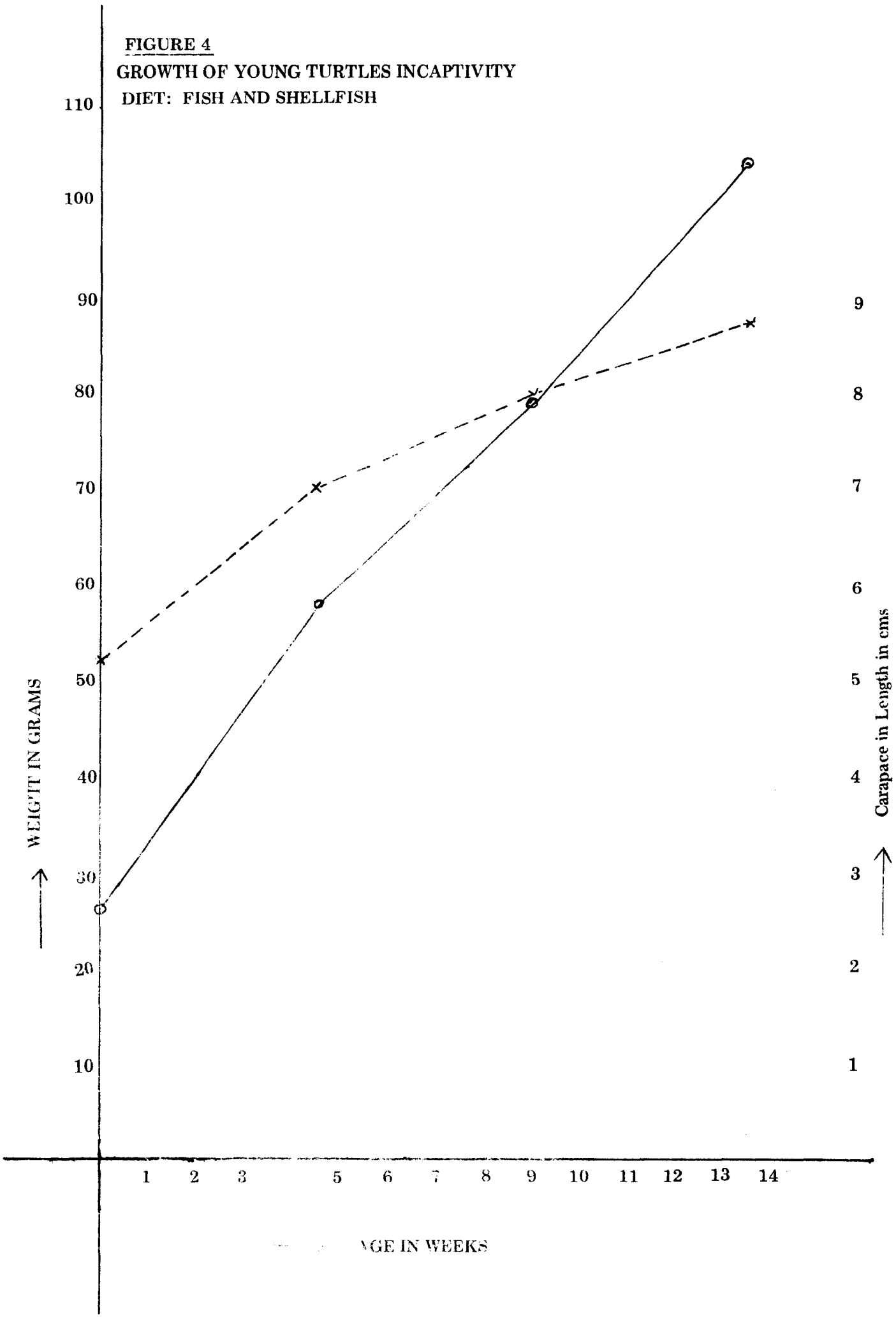
DATA ON FIVE GREEN TURTLE NESTS ON KEREHIKAPA

Clutch Size	Incubation period	%Hatch	Hatchling Weight	Carapace Length	Nest No.
69	57 days	64	22.5g	5 cms	168
156	57	77	17	4.5	47
88	63	66	-	-	59
65	62	42	26	5.2	166
45	61	93	25	5	167
84.6	60	68.4	22.6	4.9	Mean

FIGURE 4

GROWTH OF YOUNG TURTLES INCAPTIVITY

DIET: FISH AND SHELLFISH



The Hawksbill Turtle - Eretmochelys imbricata

This turtle occurs throughout the Solomons and is commonly seen feeding on the reefs and sleeping in holes in the coral. It nests either singly or in small groups on isolated patches of beach both on the main islands and the offshore cays. Both the meat and the eggs are eaten almost everywhere but the greatest pressure on this animal comes from the 'tortoiseshell' hunters. In recent years prices paid for tortoiseshell have rocketed and even the Seventh Day Adventist communities, who do not eat the meat, hunt the hawksbill for its shell. Not surprisingly, it is reported everywhere to have declined considerably. The most detailed work has been carried out on the Arnavon Islands, (following report), but some information is available for most parts of the country.

Malaita - Lau Lagoon area, formerly frequent nesting on Manaoba Island and round Malu'u, now nesting very rare. In general, Malaita has had a lot of coastal development, (roads and cattle projects), and is a very densely populated island.

Eastern Outer Islands - Tikopia and Anuta have very high populations and the villages are built on the beaches, hence it is unlikely that any nesting turtle would go undetected. Utupua and Vanikoro - low populations but increasingly, hamlets or single houses are being constructed on the areas of beach. Turtle numbers reported to be greatly reduced. Reef Islands - very densely populated, good hawksbill feeding places but juveniles very commonly killed, traders in the Reefs are buying undersized shell. No nesting known. Santa Cruz - Tomoto Noi was, at one time, a site of very heavy nesting but about twelve years ago Reef Islanders began settling there. When I visited the island in October 1976 there were 29 nests on the beach, 26 of which had been plundered: also the scrub vegetation had been extensively cleared from the beach platform, many turtle bones on the beach and egg shells being used to decorate the houses.

Santa Ysabel - Population very low but there is a gradual movement of people from the south along the coasts northward. The leathery turtle beaches seem to have suffered most but again the hawksbill is said to be declining very rapidly. One saving characteristic is that it nests on many tiny beaches which are scattered and inaccessible.

Choiseul - Very similar to the situation in Santa Ysabel.

Shortlands - The islands near Kariki, the Oema group and Orau are reported to have some nesting, as well as the northern-most part of Fauro. Eggs are very often eaten; killing of beaching females and spearing are the common hunting methods. The people say that they hunt hawksbills when they want to buy something expensive and there is a noticeable reduction in the numbers.

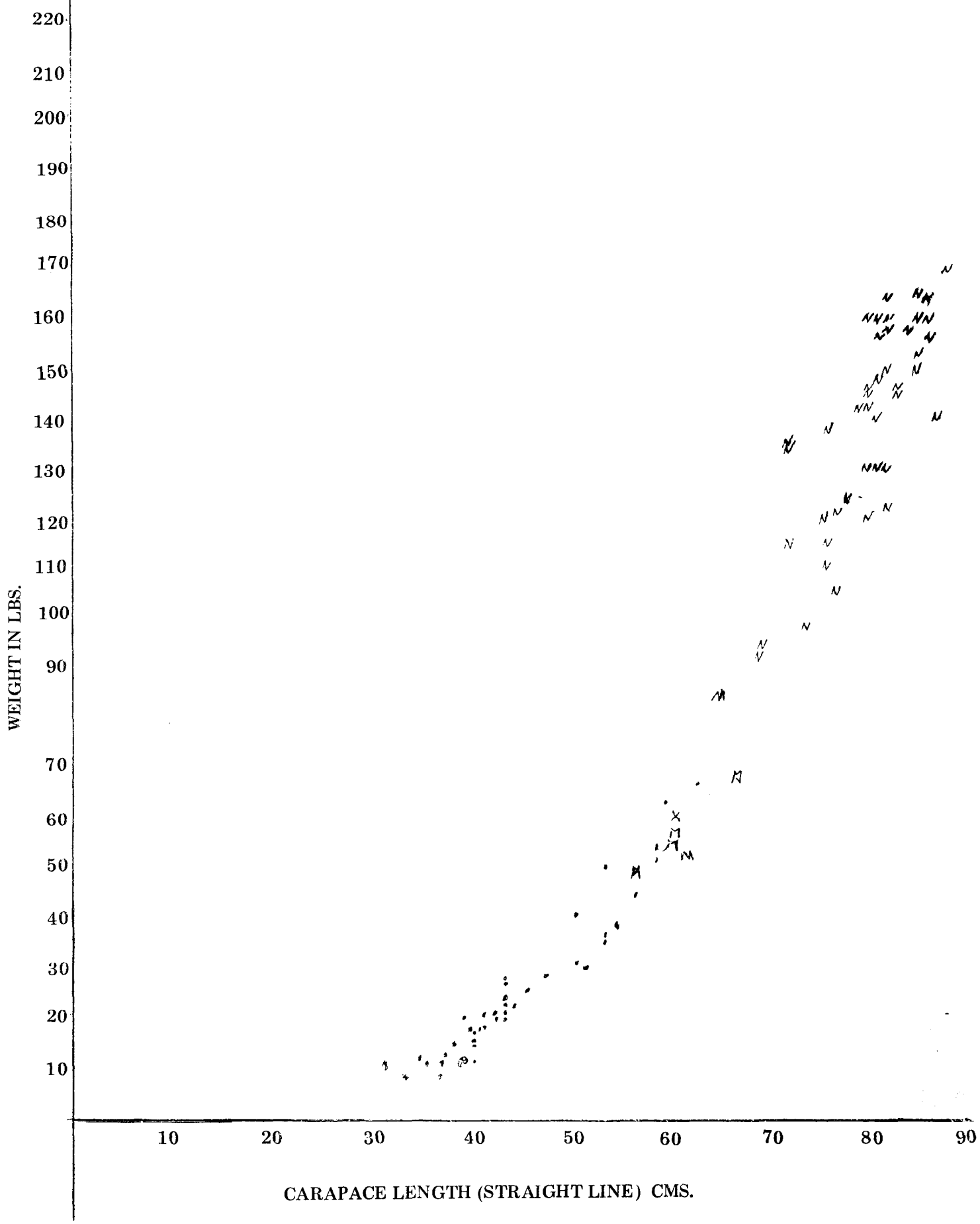
New Georgia Group - Very good feeding areas in Roviana and Marovo lagoons. The only place I've found repeatedly reported as a good nesting place is the Hele Bar group of islands, again they are declining there.

Florida Islands - Reported large numbers of turtles seen on the reefs south of Small Nggela, nesting on Bugana and Lagale, islands. These are probably hawksbills.

Of the hawksbills tagged in the Manning Straits area four (2-3%) have been recaptured within 30 miles of the releasing place and up to six months later. No long-range recoveries have been reported for this species anywhere and generally the evidence would indicate fairly parochial populations. This is also afforded by the animals' choice of beach, solitary habits and extended nesting seasons: yet its numbers are declining fast.

Fig 5

CARAPACE LENGTH X BODY WEIGHT OF 91 HAWKSBILLS.
N =NESTING FEMALE, M =MALE , X =COPULATING FEMALE.



THE HAWKSBILL TURTLES OF THE ARNAVON ISLANDS

The Arnavon islands are a group of cays lying between latitudes 7.25-7.35S, and longitude 158 E, in the Solomon Islands. There are two main islands, namely Sikopo and Kerehikapa and numerous smaller ones. Most of the observations have been made on Kerehikapa. The island is horseshoe shaped, about 2.5 miles long with a long sand beach on the south western side and having a shallow lagoon on the eastern side.

The vegetation comprises mainly trees and bushes of the genera *Pisonia, Casuarina, Pandanus, Scaevola, Callophyllum, Cordia* and the coconut palm. There are also several species of herbaceous plants, including at least three kinds of grasses and sedges.

Vertebrate like is restricted to birds and small skinks and geckos, with two species of turtle, the Hawksbill, *(Eretmochelys imbricata)* and the Green, *(Chelonia mydas)* coming up to nest. There are no snakes or mammals, though in contrast the invertebrate life is abundant and varied. The reefs are rich in life including patches of turtle grass within the eastern lagoon. The surrounding seas are shallow, currents between South Choiseul and north Ysabel are very strong and storms are frequent.

Formerly these islands had been visited by fishermen from Wagina and North Ysabel, Hawksbill turtles were taken for the meat and shell and also all the eggs, which are considered a delicacy in both communities. In recent years however, it has been noted that the number of turtles had become reduced to a fraction of its former size. Consequently, in November 1975 the Arnavon group was designated as a sanctuary by the Fisheries Division and a base was established on Kerehikapa to facilitate study of the turtle population and to protect the sanctuary against intrusion.

The beach on Kerehikapa was patrolled nightly and nesting turtles tagged, nests were ring netted, both as a means of collecting incubation/hatching data and so that hatchlings could be transported to the sea. A small proportion of the hatchlings were transferred to galvanised iron tanks for growing on. In addition young turtles caught by diving (mostly round Wagina), were tagged and released, sometimes from Kerehikapa.

Morphology of the Hawksbill Turtle

The straight-line carapace lengths of nesting females varied from 68 to 93 cms. with an average of 80.5 (see Fig 8). This measurement was always taken. Over-the-curve measurements of 40 individuals nesting in 1977 varied from 93 cms, *(= 88 cms straight)* to 75.5 *(70)* with a mean of 88cm *(83)*. The heaviest weighed was 170 lbs and the lightest 92 lbs with an average (40 samples) of 146. The carapace exhibits little longitudinal curvature, the head is relatively small varying from 10-12 cms (means 10.5) at its widest part (Fig 7). There are two pairs of prefrontal scales. It is perhaps noteable that one female caught at Sikopo while copulating had a carapace length of 61 cms (st.)

The colour of the carapace varies from amber/green/grey streaked to varying degrees with red, brown or black. Often they are so heavily mottled as to appear completely black, this is especially so in the older (larger) individuals. The plastron varies from pale white/lemon to a bright orange/yellow. The orange ones invariably have some degree of spotting on the plastron, almost always on the intergular scale, often on the small scale near the front flippers and sometimes on the infra-marginals or generally over the pastron.
The hard portions are frequently encrusted with barnacles. The top of the head and flippers is normally dark coloured - blackish though there is sometimes a reddish sheen - the scales outlined with orange/yellow, pinkish or whitish shades. This colour will also predominate on the sides of the head, and the undersurface of the flippers, with some of the larger scales darkly coloured. The beak is pale- coloured and usually streaked with darker colours on the sides.

Nesting Times, Seasonality and Behaviour

Fig 9 shows the incidence of nesting per month for the period studied. Peak nesting is seen to have occurred May-August, with a smaller rise in December. It is of note that the peak 'tortoiseshell' production in Wagina is in November/December. Nesting usually occurs during the hours of darkness with the exception of one fairly small female which beached and nested successfully between 3.30 and 5.00 pm in June 1977. There are, however, many who claim that in former times daylight nesting was common during peak seasons on the Arnavon islands. Bustard has also noted daylight nesting of Hawksbills in some of the Torres Straits islands.

To state a definite relationship with other physical features is rather more difficult, however, I have noted that emergence (beaching) always occurs on a rising tide and that about 60% of the time it occurs in the three hours preceding high tide.

It is noted too that if two or more turtles beach on the same night they will choose almost the same time to emerge, even though the nesting sites may be a mile apart. The position and brightness of the moon and stars appear to have no effect, also the degree of cloud-cover, rain and wind.

The actual nesting behaviour is very similar to that described for the green turtle with the following differences. On emergence the female pauses and peers around before proceeding up the beach. Crossing the beach is rapid, locomotion is typically quadrupedal. On bright nights the course taken seems to be towards the least cluttered part of the sand bank; on dark nights it is more-or-less perpendicular to the surf line. An examination of the tracks also sometimes suggests that orientation may be caused by the animal continuing to compensate for a strong transverse current. Occasionally a turtle will amble around somewhat on the beach before reaching the undergrowth these ones frequently return to the sea without nesting. In general those which do nest begin fairly quickly, (this contrasts with Pritchards findings) though the animal may decide that the first hole is unsuitable - usually due to too many roots in the sand. In that case it may dig a second, third or even fourth hole before laying. Sites chosen are usually under low bushes, (- Scaevola being the most common), or places well shaded by large trees. There is no body pit excavation, though the turtle may make a few sweeping movements with the fore flippers. During laying the egg-chamber is effectively covered by the rear portion of the shell and the rear flippers are splayed out to the sides. The front flippers are drawn up close to the body. Covering the nest and disguising it are essentially the same as with the green turtle but the Hawksbill takes a much longer time; the return to the sea is usually very rapid without rests.

It is well known that turtles will not come ashore to nest if there are bright lights on the beach. This may be explained in terms of a mechanism for finding a nesting site. It has been noted that they always nest under some sort of cover, low bushes being preferred. It is also noted that they never nest on a bare sand-bar on Maleivona Island, even though it is several feet above the highwater marks in places and is fairly stable. Occasionally they will nest below the bank on the upper beach - this has been observed only on the parts of Kerehikapa where fallen trees overhang the middle beach.

When excavation has commenced there is no light reaction given by the animals. However, a female hawksbill returning to the sea will follow an artificial light source; even though it is near the watermark it will change course and follow a torch shone on the ground before it. This is markedly so on dark nights but on reaching sea it heads quickly out through the surf.

From these observations it would appear that before excavation they behave negatively phototaxic; during the actual process they display no light reaction and after nesting their behaviour is strongly positively phototaxic until they reach the sea.

This would enable the animals to find the cover of the islands' vegetation the survival value of which is that it will prevent the animal laying below the spring high water mark, when the eggs would be waterlogged or washed away. The cover of the bushes ensures that the sand does not overheat: this is important as the eggs are not deeply buried, also the fine root system in the sand, and the shade provided by the bushes are important factors in the regulation of the water content of the sand. For incubation of the eggs humidity and temperature are critical factors. (Bustard.)

RENESTING

Of 91 hawksbills tagged while nesting on Kerehikapa (June '76-July '77) only four (4.4%) were seen to come back to lay another clutch. The intervals between clutches were 13, 17, 15 and 28 days the latter probably being two 14-day intervals. Note that 66 hawksbill nested unobserved during this period so the true re-nesting percentage may be higher.

The people from North Ysabel claim that the turtles should invariably return to nest at 14 day intervals and that this was one of their methods of catching them. There are several possible explanations for this discrepancy:-

(1) Methods used by the workers are scaring away the turtles; this is claimed by the village people.
(2) Perhaps the proportion of the population that was programmed to return to the same beach has, due to the local hunting methods, been selected against.
(3) Although the turtle population is probably parochial, they may not be so narrowly restricted to one nesting beach

With respect to (1) .....

During the period in question 16 hawksbills were observed to beach without laying, seven of those (44%) returned the following night. If our methods were scaring away the turtles, surely they would be much more vividly enforced after a one day interval. It is also unlikely that an instinct, strong enough to make them return 'invariably' to the same beach could be switched off by methods employed in tagging operations.

It is of note too that all four Green turtles that nested returned to the same beach at least once.

(2) If the 'programmed' individuals were selected against over a long period of time, one would expect the population to change. However, the usual methods of capture on these islands was for a party of people (several families) to stay there for a period of several weeks and to kill all beaching turtles and to take their eggs. If one was missed it might well return after two weeks, however these calculations were derived from examining the eggs and tracks - hence a positive identification could not be made. There is an element of truth in the statements of the villagers but this is knowledge handed down for many generations and its derivations are lost.

(3) The facts that a high proportion of 'non-nesters' return the following night but a low proportion of nesters return after a two-week interval might suggest that the animals were coming ashore to nest in the areas where they happened to be feeding - hence its more likely that they will have moved to another reef system after two weeks. It has also been suggested by Pritchard that they are 'opportunistic' nesters. Of 70 female hawksbills tagged while nesting at Tortuguere (Carr) between 1956 and 1964, none renested in the year that they were tagged but two renested after periods of three years and six years respectively.

In some areas - notably Ontong Java - the 'custom' states that the Hawksbills will return to the same group of cays at 14 day intervals to nest, but not necessarily to the same island; hence their methods of catching them is to light fires on all the cays but one and to wait on the one which has no fire. It is likely that the turtles nesting on the Arnavon Islands represent a single population, though one female that nested on Kerehikapa was subsequently killed at Kia on North Ysabel.

It is of note that mating hawksbills are very rarely seen round the Arnavon Islands, though solitary ones are often seen swimming or floating just off nesting beach especially during peak nesting periods.

Incubation Period, Clutch Size, Percentage Hatch

Fig 10 shows the frequency/distribution of incubation periods of 174 nests. There is positive variation around the mean of 64. It is independent of the clutch size as shown by scatter diagram. There is also no correlation between the incubation period and the percentage hatching.

The variation may be due to fluctuations in the rainfall affecting the sand temperature. The variability of figure may be due to the sample size. The clutch size varies between 75 and 250. Figure 11 shows that the frequency distribution is multimodal. Villagers say that the first clutch laid will be small - less than 100, successive clutches will increase, then decrease by about 30 each time. If this were the case then one would expect a multimodal distribution. Figures for only two turtles are available, one that first laid 140 eggs then 179 two weeks later, another which first laid 132 then 165. Clutch size apparently has no correlation with the size of the turtle though one might expect total egg production per season to be affected by the size of the animal.

Carr et al. report a mean clutch size of 161.10 for Tortuguere hawksbills range 53-206 (57 nests).

Fig 12 shows the percentage hatching (emergence) of 179 nests investigated up till July 1977. In addition 21 nests were destroyed by rough seas washing away the nesting sites (10 in December/January 1975-76 and 11 in January/February 1977). The mean percentage hatching of 179 nests is 84.28.

The highest reported mean emergence for marine turtles is 89.25. This was for eight nests of E. imbricata artificially hatched (Raj, Fiji). This difference of less than 5% is probably not significant as his sample size was so small. For comparison he uses data from C. mydas, both artificial and natural. It is of note however that for five nests of C.mydas on the same beach on Kerehikapa the mean emergence is 69%.
The only other statistics for comparison is from 13 clutches of hawksbills from Tortuguere, (these were moved) : Mean hatchling emergence was 46.7% with a range of 12-80%.

Hatchlings and Growth

The hatchlings always emerge at night. They weigh about 13 grams, carapace length is c. 4cms, total length 6cms. The Carapace and top of the head are pale brown in colour and may have irregular small black spots, especially round the margins of the scales. There were two pairs of prefrontal scales and three dorsal keels. The upper surface of the flippers and the whole of the under-surfaces are generally dark brown of blackish, the margin of the carapace is pale where it shows underneath. There are two well-defined ventral keels also the inframarginal scales display slight keels - these become more pronounced with growth. The scutes of the hatchlings are not imbricate, 20399 hatchlings were released into deep water between February 1976 and July 1977. No immediate predation was ever noted, on release the hatchlings either floated or began to swim against the current.

A further 1000 hatchlings were transferred to galvanised iron tanks for 'growing on'. They were fed several times a day on either shellfish, chopped fine, or else flaked fish, and the water was changed twice daily. They were originally kept at a density of 100 per tank - the tanks 1.4 metres in diameter filled to a depth of 15cms. At this density it was found that the turtles were prone to biting and fighting over food. Densities were progressively reduced to about one tenth of the original. Overall mortalities were 73%. Most of this was caused by a fungal infection which developed suddenly and caused the deaths of c.400 hatchlings in two days. Later infections were treated with potassium permanganate added to the tank-water at a rate of c.5 grams per tank for 30 minutes. This was fairly effective in reducing mortality, severely infected animals were treated by painting a very concentrated solution of KMn04 onto the wound and letting it dry. Fungi usually affected the areas around the eyes, neck and trailing edges of the flipper areas also frequently bitten. Before death the turtles became sluggish, did not eat and often became 'bloated', having difficulty in diving.

After five months 284 were surviving, 274 of these were released at Kerehikapa, the remaining 10 were transferred to a coral pond at Wagina and were fed by the villagers. Growth is shown in Figs 13 and 14. In the year in Wagina there were no deaths but four escaped when storms partly broke one of the walls of the pond.

The pond measures c. 8' x 10' and even at a density of 4 in this pond there is some aggression displayed at feeding time. It is hoped to grow these four until they are large enough to tag and release. Growth rates have improved markedly since they were transferred to Wagina. However it fluctuates somewhat as they are fed irregularly. At four weeks the overlapping of the scutes can be seen, this gets more pronounced with growth. At first the growing parts of the scales are darkly coloured but by about six months the plastral scutes begin to grow a yellowish colour on the inner margins. At one year the belly scutes scutes are generally yellow/white with dark tips and irregular spots. By this time too the jaws are like those of the adults and the carapace had developed its characteristic mottled colours.

Note J.P. McVey kept young hawksbills in captivity and achieved a growth rate of c. twice that of the Kerehikapa - reared animals, reference cited.

Sikopo, Maleivona etc

Sikopo is the largest cay with a greater proportion of nesting beaches, they are, however, more scattered than on Kerehikapa and less suitable for night work. Workers go there regularly to ensure that it is not being visited by shell hunters and to check up on nesting activity. It is estimated that there is just over twice as much nesting activity on Sikopo, compared to Kerehikapa.

At first the base camp was set up on Maleivona, but it was found that there was less nesting there than expected and also the island was less than stable during the cyclone season of 1975. It is estimated that there are c. 120 nests per year on Maleivona and the two tiny islets between it and Kerehikapa.

Estimated nesting in the group is about 600 per year.

There are also numerous small beaches on the islands off north Ysabel and the islands round Wagina. Young turtles tagged on Kerehikapa have been seen both in Ysabel and Wagina and one female which nested on Kerehikapa was killed near Kia on Ysabel. None of the females nesting on Kerehikapa have been known to nest on any of these other beaches but this possibly does happen.

Hunting Pressure

It has been claimed by people all over the Solomons that the Arnavon Islands was the site of very heavy nesting activity in former times; Kia people estimate up to a hundred per week in peak seasons. Wagina was uninhabited until some Gilbertese people were resettled there - beginning in the late 1950s. These people tend to get all the blame for the decrease in numbers of turtles. However the decline, though obviously accelerated by the greater population, was due mainly to the increase in shell prices. This has increased from less than one dollar per poind to more than six dollars in the past five years. Also this decline has occurred throughout the Solomons.

At present Wagina people take turtles from the beaches of the small islands round Wagina, also they dive for them at night. Egg eating has almost completely stopped since I have been working in the area and I gather that it was never customary for them to kill young animals. The traders at Wagina will not buy small shell. Co-operation has been very good.

Kia people also take nesting females from beaches but probably the most common hunting method is spearing them in the numerous passages around Kia. Most of the remains that I have seen at Kia were from juveniles. Eggs are still eaten. Traders in Kia will buy any size of shell and I have seen young green and hawksbill shells used for decoration in Kia houses.

Fig 7.

DIMENSIONS (cms) OF 40 FEMALE HAWKSBILLS NESTING KEPEHIKAPA

JAN - JULY 1977

NESTING ADULTS KERE.

Tag Numbers	Carapace Length (Curved)	Carapace Length (Straight)	Plastron Length	Carapace Width (Straight)	Head Width	Weight in lbs.
15331/15332	88	85	69	66	11	160
299/300	92	86	64	67	11	156
283/284	91	85	68	65	11	153
295/296	88	82	67	68	10	150
73/748	86	80	64	68	10	142
285/286	87	81	64	69	10	140
293/294	87	81	66	68	10	148
15081/15082	86	81	66	62	11	130
15306/15307	85	81	65	62	11	156
15083/15084	80	77	64	61	11	121
1101/1102	93	88	68	68	11.5	170
15336/15337	81	76	62	58	10	115
15304/15305	80	76	64	62	10	110
291/292	87	84	64	68	10	158
15308/15309	89	86	68	67	11	160
15340/15343	90	86	69	70	11	164
15218/15219	86	82	62	64	11	122
15180/15181	75	72	65	61	10.5	135
15334/15335	81	77	62	62	10	105
289/290	85	80	62	66	10	145
297/298	90	83	62	65	10	146
287/288	87	82	65	68	10	160
15089/15091	86	82	67	62	10.5	158
15087/15088	88	83	68	64	11	145
281/282	90	85	68	68	11	165
276/277	85	80	64	65	11	130
99/100	85	80	63	66	11	146
72/96	80	76	56	60	10.5	138
744/745	85	80	63	63	11	120
746/747	85	80	67	64	11	130
65/66	84	78	62	60	9	124
63/64	88	80	67	65	10	160

Tag Numbers	Carapace Length (Curved)	Carapace Length (Straight)	Plastron Length	Carapace Width (Straight)	Head Width	Weight in lbs.
53/54	85	79	63		11	142
85/52	91	89	74	67	11	195
35/42	76.5	69.5	58	55	9	94
38/39	88.5	87	64	62	12	140
30/31	85.5	82	61	63.5	10	145
28/29	89	82	69	69	12	164
36/37	75	72	66	62	10	134
732/733	78	74	72	70	9	98
Average	(87.6)	(82.7)	65	65	10.5	146
			(64.9)	(64.8)		

Fig 8

STRAIGHT-LINE CARAPACE LENGTHS OF 85 FEMALE HAWKSBILLS NESTING
KEREHIKAPA MAY 1976 - JULY 1977

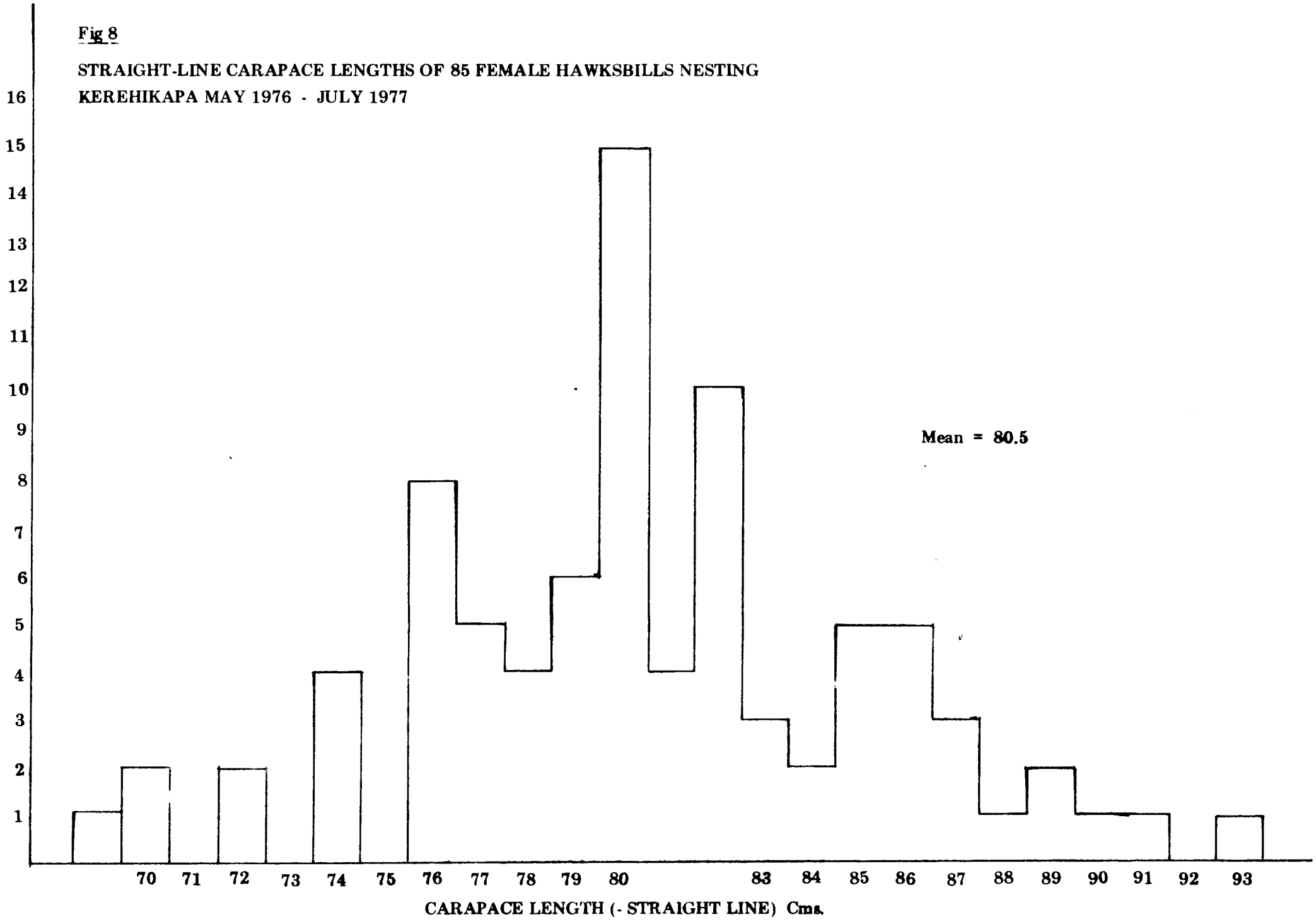


Fig 9

INCIDENCE OF HAWKSBILL NESTING KEREHIKAPA NOV. 1975 - JULY 1977

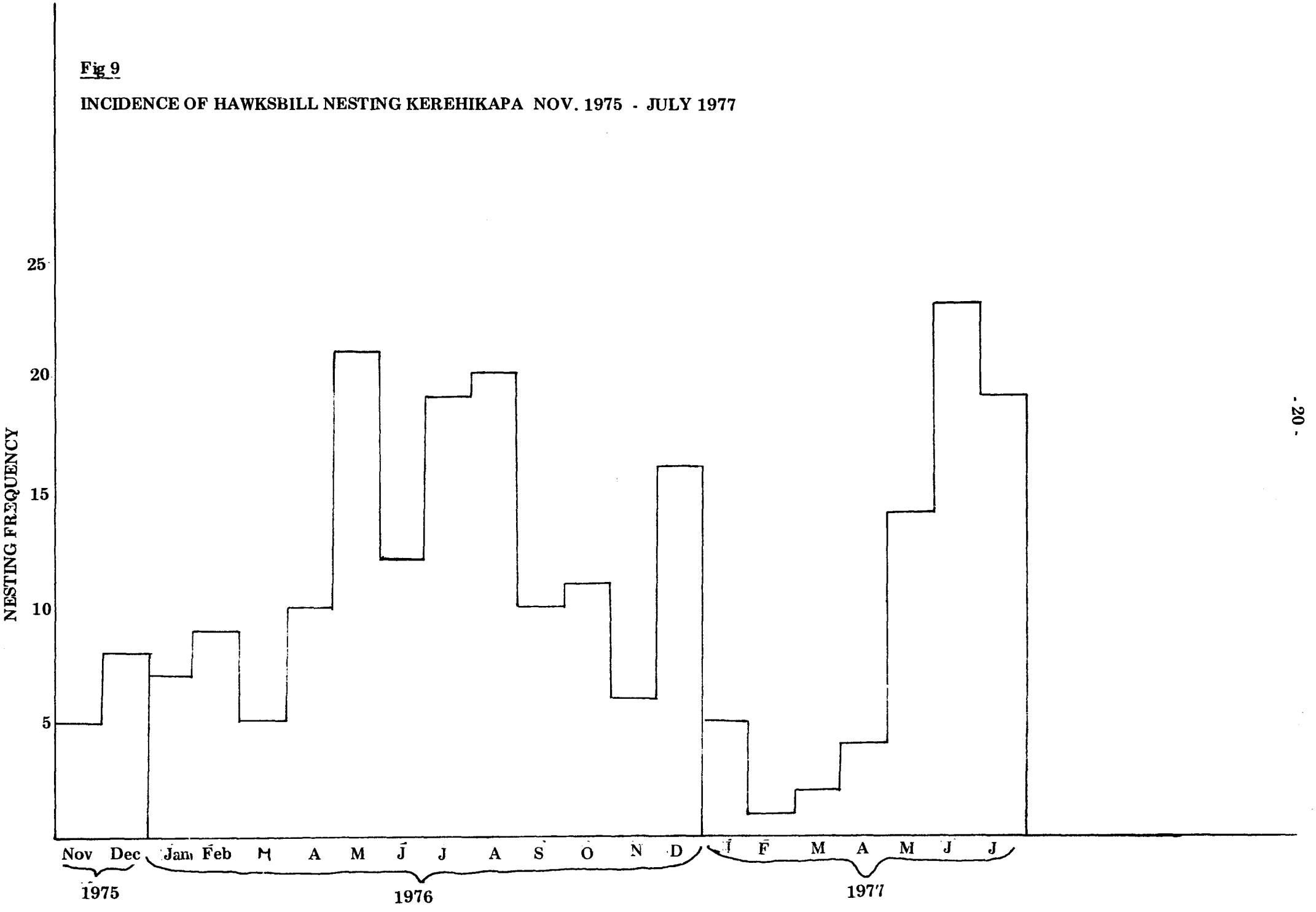


Fig 10

INCUBATION PERIODS OF 174 CLUTCHS OF HAWKSBILL TURTLE EGGS
KEREHIKAPA AND MALEIVONA. 1976 AND 1977.

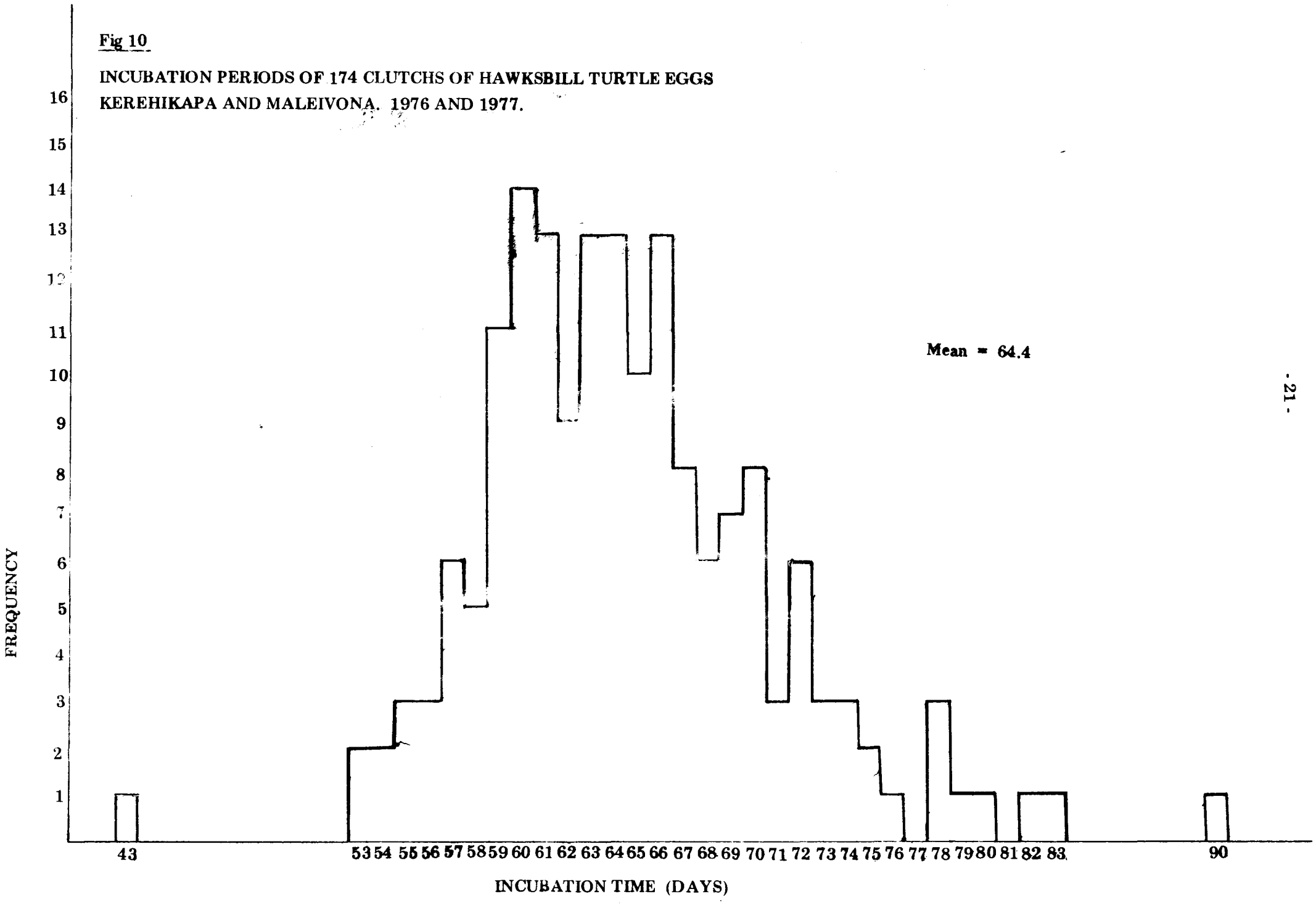


Fig 11

SIZES OF 175 HAWKSBILL CLUTCHS. KEREHIKAPA AND MALEIVONA NOV. 1975 - MAY 1977. NOTE: ONE CLUTCH CONTAINED 250 EGGS; THIS HAS BEEN OMITTED FOR SCALE REASONS.

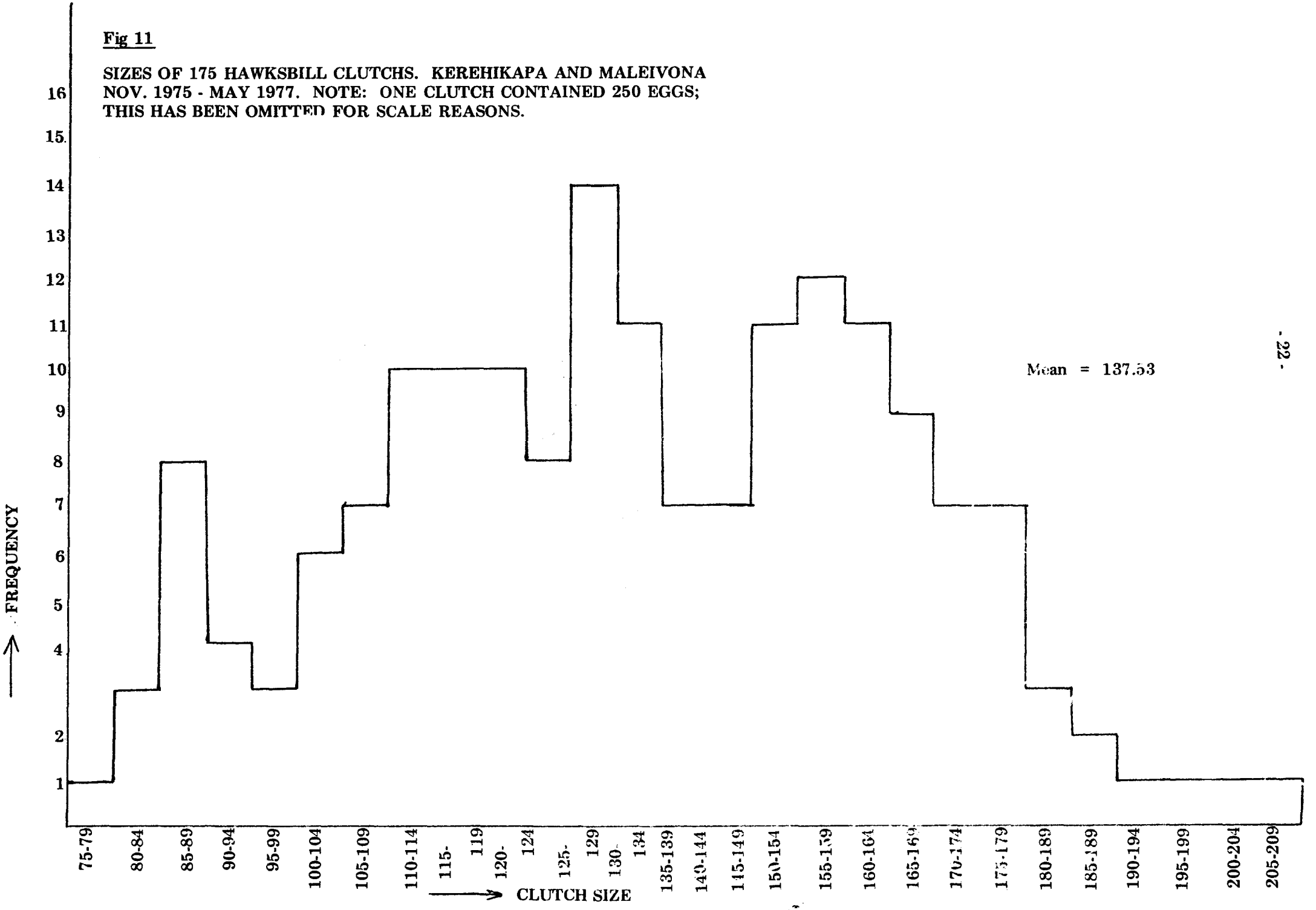


Fig 12

PERCENTAGE HATCHING EMERGENCE OF 179 HAWKSBILL CLUTCHS KEREHIKAPA AND MALEIVONA. NOV. 1975 - JULY 1976.

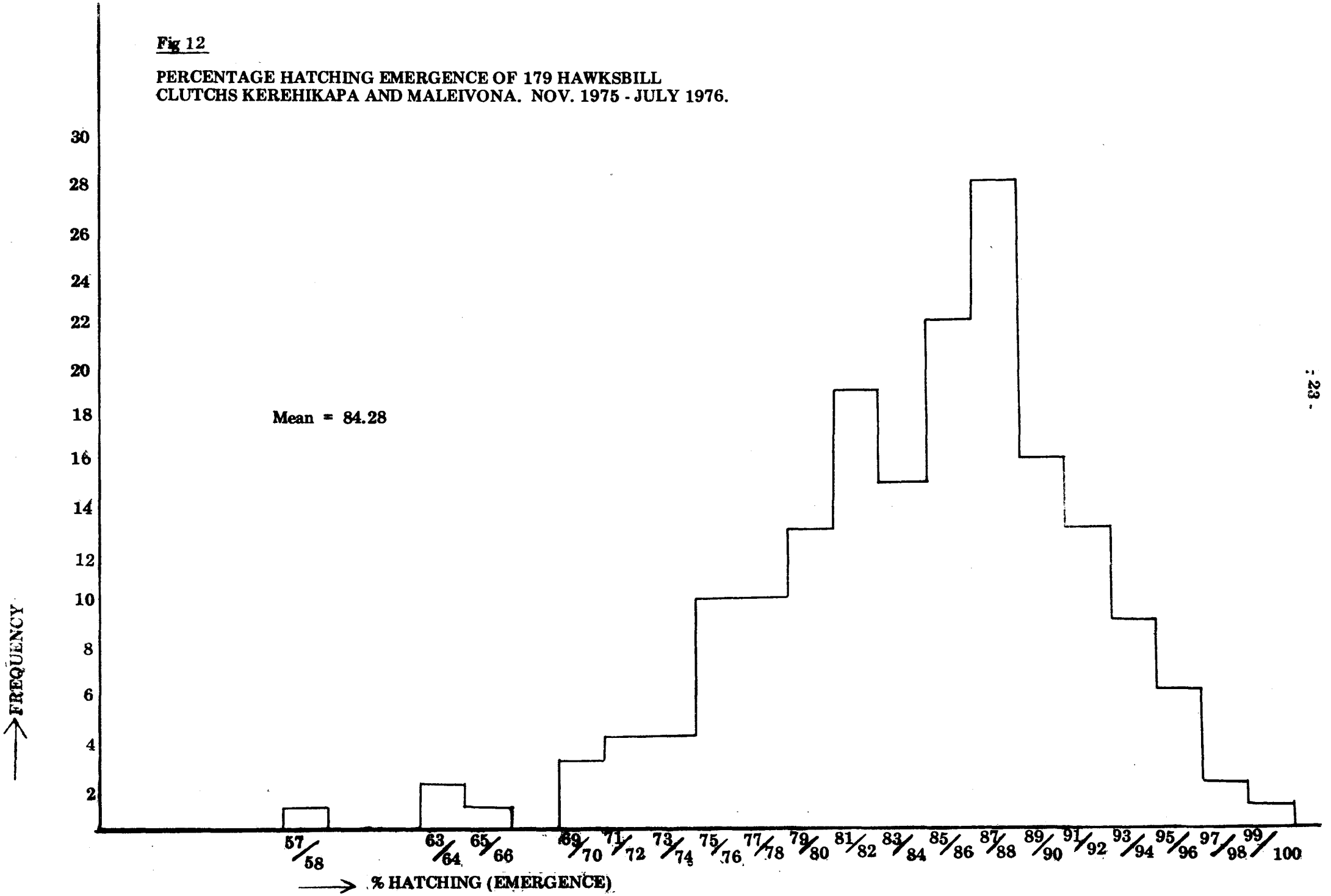


Fig 13

GROWTH OF YOUNG HAWKSBILLS IN CAPTIVITY
DIET. SHELLFISH AND GISH

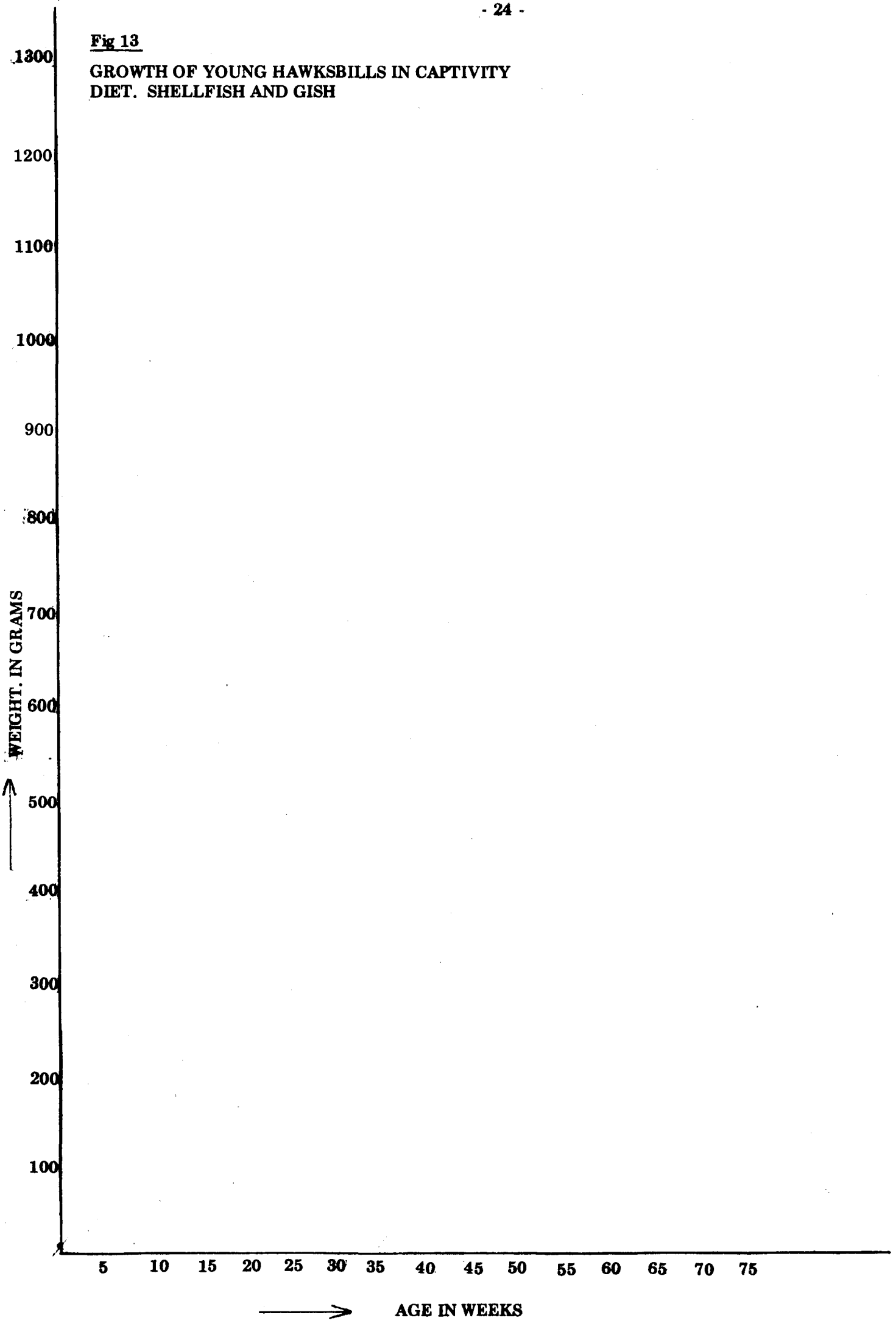


Fig 14 Growth of Hawksbill Hatchlings in Captivity

Date	Age in Weeks	Mean (gms) Weight	Sample size	Location
10/2/76	0	13.5	Several Hundred	Kept in Galvanised Iron Tanks on Kerehikapa
9/3/76	4	20		
13/4/76	9	33.5		
4/5/76	12	50		
8/6/76	17	68		
22/6/76	19	74		
8/9/76	30	130	10	Kept in Coral Pond in Wagina
12/11/76	39.5	229	10	
14/12/76	44	444	8	
21/ 2/77	54	644	8	
1/5/77	64	1131	6	
18/6/77	70.5	1250	4	

The 'Tortoise shell' Trade in Western District

"Our trade records in Japan show that one of our most important sources of tortoise and turtle shell in the British Solomon Islands". This is quoted from a letter from T Kajihara of The Ocean Research Institute (Tokyo) dated 30th June, 1973. Total imports to Japan of that year amount to 72,963 Kg! (source I.U.C.N. marine turtle newsletter No 2 January 1977). The same article fails to list the Solomon Islands in its list of countries supplying more than 1000 Kg of shell to the Japanese market in 1975.

It is extremely difficult to gather accurate information here as in the export statistics turtle shell is lumped within the category 'marine shells' and so I am very much dependant on the traders themselves to provide information. There is no licensing system and none are there fore compelled to give information and in fact only one - Trader A - has opened his books. Some of the others have given rather dubious figures, the rest refused any information. The only other source of information has been the co-ops or village stores which sells to the trader. In most cases that we saw either no records are kept, or they are only sometimes kept.

Very good records are kept at Nikumaroro Co-op (since 1973) and Orona Co-op (since January 1976). Both being on Wagina Island. This is particularly fortunate as this area has been most intensively studied from the point of view of nesting and incidence of Hawsbill turtle.

Refer to Fig 15
Line (1) shows the total amount of shell bought by Trader A between August 1973 - when he started trading and May 1977 (inc).

Line (4) shows the amount of this attributed to Wagina Co-ops.

Lines (2) and (3) show the figures recorded at the Co-ops. There is an obvious disparity between lines 2 and 3 and line 4 in 1976. This may (or may not) be accounted for by noting that there is a considerable time lag between records being entered in Wagina Co-ops and shell being bought by Trader A.

Line 5 shows the average top price paid in the village stores. This is arrived at by averaging the price of first grade shell and taking into account the proportion of the year that each price was offered. This gives a more accurate idea of 'incentive'.

Points 1973 and 1977 are incomplete years and hence cannot accurately be compared with the other points. However, comparing the other points it can be seen that the amount of shell bought by Trader A between January 1974 and December 1976 has declined enormously - the 1976 figure being 46% of the 1974 figure. While the incentive offered to the shell hunters has increased steadily - the 1976 figure being more than double that of 1974. The figures for Wagina have dropped by 75% during this period whereas those for all other areas combined shows a 22% drop from 1974 - 1975 and a 12% increase 1974 - 1976. Note that 229 lbs of the 1976 figure was bought from Honiara. So the Western District (apart from Wagina) figures steadily decline from 1974-1976 (Graph I 6b) by 25%.

In Wagina no new industries have been started in the period of study - apart from a small cattle project - started in 1975 involving few families and is presently not helping the village economy. In fact the trade in shark fins and teeth, dried shark, fish and other traditional foodstuffs has declined over the past two years. The price of copra is at present rising but very little copra is produced at Wagina.

Another complicating factor is the closure of the Arnavon Islands. This was effected from December 1975. It would perhaps partly account for the fall in Wagina catches in 1976 be would have very little effect on the 1975 figures, also it should be noted that there are many other islands round Wagina where turtles nest and many of the most successful hunters dive for their turtles at night.

In conclusion it can be stated that the incentive for catching turtles in the Wagina area has increased steadily since 1973, and other 'exports' have decreased, but the sale of shell had declined very markedly in the comparable period. This can only indicate an equivalent decline in the numbers of turtles in that area. The catches in the rest of Western District as

reflected by Trader A's data have also declined though less drastically. Trader A since 1975 at least, has kept his prices considerably higher than other traders in the West - Trader B and Trader C in Wagina Trader B buys only the shell which Trader A (i.e. the Co-ops) reject; the situation is similar with Trader C. I should expect Trader A's figures to be the best reflection of the shell business in the West and hence the state of the Hawksbill turtle population in the Western Solomons District.

There are, however numerous verbal accounts from villagers all over the district stating that these turtles are on the decline.

Much of the information so far gathered suggests that the Hawksbill is not a wide ranging species but stays in a fairly restricted area. Tag/recaptures suggest this as does its general morphology a structure hence it may be afforded localized protection.

Note that in July 1977 the price of turtle shell in Wagina was increased to $6 - 50 per lb for *All* Grades!

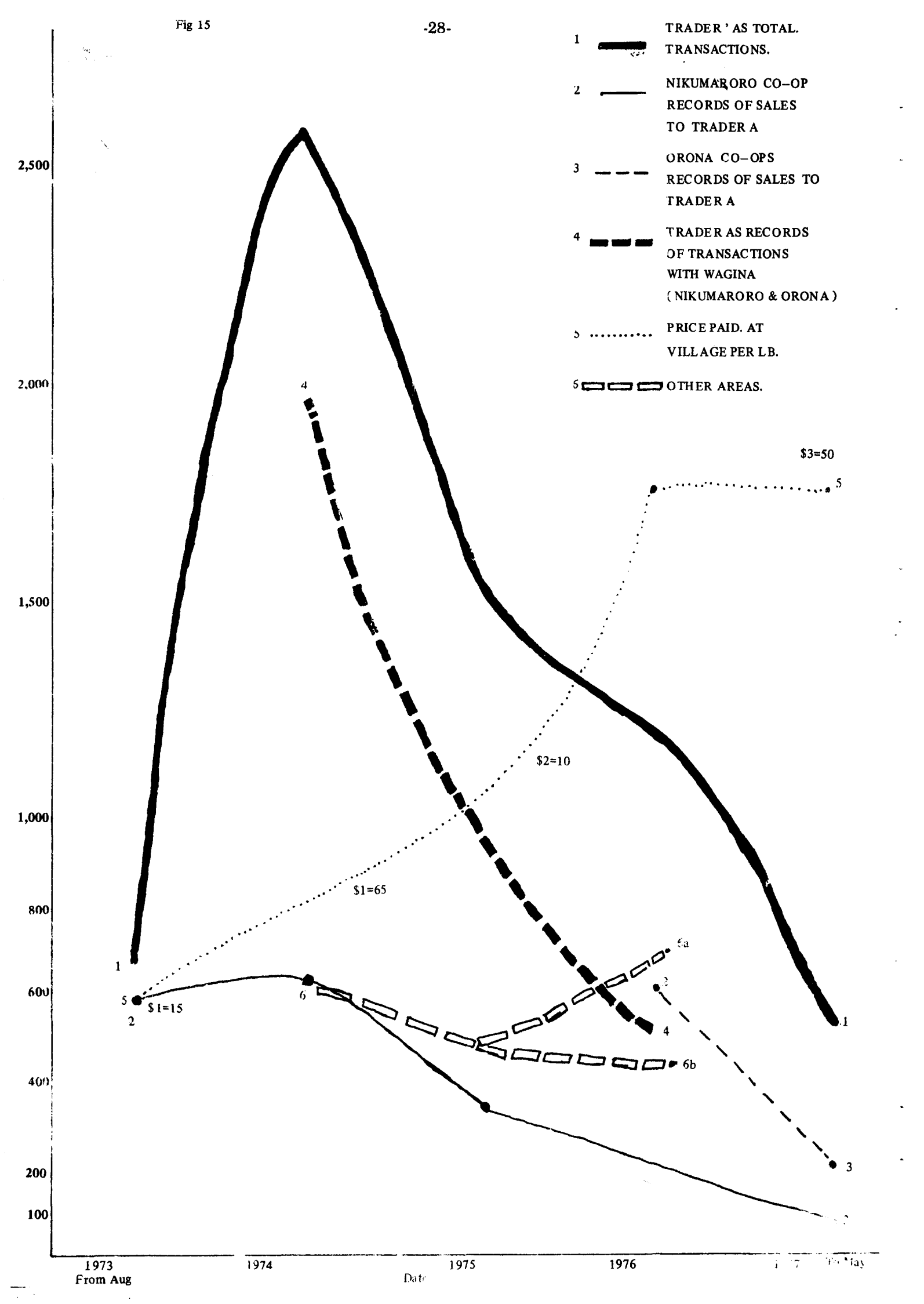

1 TRADER ' AS TOTAL. TRANSACTIONS.
2 NIKUMARORO CO-OP RECORDS OF SALES TO TRADER A
3 ORONA CO-OPS RECORDS OF SALES TO TRADER A
4 TRADER AS RECORDS OF TRANSACTIONS WITH WAGINA (NIKUMARORO & ORONA)
5 PRICE PAID. AT VILLAGE PER LB.
6 OTHER AREAS.
2,500
2,000
1,500
1,000
800
600
400
200
100
$3=50
$2=10
$1=65
$1=15
6a
6b
1973
1974
1975
1976
From Aug
Date

TABLE I

TURTLE SHELL BOUGHT BY TRADER A

Year	Total Shell	Shell from Wagina
1973 (from Aug)	674.5 lbs	?
1974	2584.25	1960.45
1975	1503.75	931.75
1976	1177.00	511.00
1977 (to May)	529.00	?

TABLE II NIKUMARORO CO-OP TURTLE SHELL SALES (in lbs)

	1972	1973	1974	1975	1976	1977
Jan	-	35.00	41.25	26.75	10.25	21.5
Feb	-	38.75	31.5	14.00	5.25	5.0
Mar	41.5	10.5	29.5	3.5	0.00	23.25
April	59.5	13.75	28.0	5.25	2.75	6.50
May	85.5	12.00	96.0	29.5	3.75	19.75
June	70.25	50.5	64.5	0.75	9.5	82.25
July	89.00	53.25	46.5	13.75	8.25	45.25
Aug	74.75	68.5	39.5	42.00	3.25	49.00
Sept	78.5	22.5	40.25	10.25	0.00	
Oct	133.75	82.5	92.75	6.25	74.75	
Nov	94.5	74.75	92.75	66.00	59.5	
Dec	72.00	107.00	31.5	118.75	22.25	
Total	799.25	568.00	634.00	336.75	199.50	

TABLE III

ORONA CO-OP TURTLE SHELL SALES

Months	1976	1977
Jan	64.00	102.50
Feb	18.75	65.00
Mar	14.00	4.00
April	37.25	16.50
May	30.00	9.50
June	125.5	11.50
		Price $6.50 p.lb. July 23
July	81.00	49.50
Aug	44.5	96.00
Sept	45.5	
Oct	36.00	
Nov	26.00	
Dec	55.5	
Total	588.00	197.5 (Till Aug)

NIKUMARORO CO-OP TURTLE SHELL SALES

Year/Month	Shell Wt(lbs) (Total)	Price 1st Grade	Price 2nd Grade	Total Price Paid	Average Wt of sale
1972/Mar.	41.5	1.00	0.90	40.15	2.0 lbs
April	59.5	1.00	0.90	58.68	2.3
May	85.5	1.00	0.90	82.88	2.7
June	70.25	1.00	0.90	68.12	2.2
July	89.00	1.00	0.90	85.19	1.8
Aug.	74.75	1.00	0.80	116.99	2.8
Sept.	78.5	0.90	0.80	67.45	2.1
Oct.	133.75	0.90	0.80	116.99	2.8
Nov.	94.5	0.90	0.80	82.61	2.6
Dec.	72.0	0.90	0.80	62.96	1.9
Total	799.25	0.96		733.51	2.3
1973/Jan.	35.00	0.90	0.80	30.63	1.9
Feb.	38.75	0.90	0.80	34.14	1.7
Mar.	10.5	0.90	0.80	9.16	1.2
April	13.75	0.90	0.80	11.94	1.7
May	12.00	0.90	0.80	10.30	1.7
June	50.5	0.90	0.80	44.20	1.8
July	53.25	0.90	0.80	46.42	1.8
Aug.	68.5	0.90	0.80	59.32	1.9
Sept.	22.5	0.90	0.80	19.30	2.0
Oct.	82.5	1.10	1.00	85.87	2.6
Nov.	74.75	1.10	1.00	102.34	2.2
Dec.	107	1.70	1.60	194.65	2.7
Total	569	1.00		648.27	
1974/Jan.	41.25	1.70	1.60	68.54	2.1
Feb.	31.5	1.70	1.60	52.06	1.8
Mar.	29.5	1.70	1.60	48.20	1.6
April	28.00	1.70	1.60	46.88	2.1

Year/Month	Shell Wt(lbs)	Price 1st Grade	Price 2nd Grade	Total Price paid	Average Wt of sale
1974/May	96.0	1.70	1.60	160.99	2.2 lbs
June	64.5	1.70	1.60	104.18	1.6
July	46.5	1.70	1.60	77.87	1.6
Aug.	39.5	1.70	1.60	62.83	1.2
Sept.	40.25	1.70	1.60	67.55	1.4
Oct.	92.75	1.70	1.60	160.10	1.8
Nov.	92.75	1.40	1.30	131.60	1.9
Dec.	31.5	1.40	1.30	44.01	1.6
Total	634.00			1024.81	
1975/Jan.	26.75	1.60	1.50	40.28	1.3
Feb.	14.00	1.60	1.50	21.99	1.1
Mar.	3.5	1.60	1.50	5.54	0.6
April	5.25	1.60	1.50	8.22	1.05
May	29.5	1.60	1.50	56.45	2.1
June	0.75	1.60	1.50	1.17	0.4
July	13.75	1.60	1.50	21.74	1.5
Aug.	42.00	1.60	1.50	66.04	1.7
Sept.	10.25	1.60	1.50	16.08	1.1
Oct.	6.25	1.60	1.50	9.92	1.6
Nov.	66.00	3.50	3.50	230.90	2.3
Dec.	118.75	3.50	3.50	416.44	2.3
Total	336.75			894.77	
1976/Jan.	10.25	3.50	3.50	35.87	
Feb.	5.25	3.50	1.50	11.84	
Mar.	0.00			0.00	
April	2.75	3.50	1.50	6.87	
May	3.75	3.50	1.50	9.37	
June	9.5	3.50	1.50	22.67	
July	8.25	3.50	1.50	18.07	
Aug.	3.25	3.50	1.50	6.45	

Year/Month	Shell Wt(lbs) (Total)	Price 1st Grade	Price 2nd Grade	Total Price paid	Average Wt of Sale
1976/Sept	0.00	3.50	1.50	0.00	
Oct	74.75	3.50	1.50	174.00	
Nov	59.5	3.50	1.50	150.00	
Dec	22.25	3.50	1.50	58.50	
Total 1976	199.50			471.64	
1977/Jan	21.50	3.50	1.50	[illegible].00	1.4
Feb	5.0	3.50	1.50	12.50	1.0
Mar	23.25	3.50	1.50	50.75	1.8
April	6.50	3.50	1.50	15.50	1.3
May	19.75	3.50	1.50	52.00	1.8
June	82.26	3.50	1.50		2.2
July	45.25	3.50* 6.50	6.50		1.7
Aug	49.00	6.50	6.50		

* Price changed July 23rd.

LEATHERY TURTLES

The leathery turtle, *Dermochelys coriacea* is known to occur throughout the Solomons group. It is often sighted in the coastal waters especially November - January when it comes to nest on the black volcanic sand beaches, usually near river mouths. Very little work has been carried out on this species. The following is a summary for all the information so far gathered. The numbers after names refer to Fig. 16.

Eastern Outer Islands. One very small nesting beach on east *Santa Cruz* Island.
(1) One or two nestings per year. Occasionally taken for food. None nested there in 1976.

Unknown in the rest of E.O.I. - no suitable nesting beaches - no language names.

Makira (San Cristobal)
Little known about turtles in general in Makira. Surveys begun early 1977. Nesting of leatheries in Wainoni Bay (2) and Waimasi Bay (3) (- east coast). These are large reefless bays and the numbers nesting there have been variously reported by local inhabitants - average claims c 20 per mouth in Dec/Jan. Other areas may exist. One leathery was reported killed at Arohane (Wainoni Bay) 22/8/77. Had letter 'N' painted on its back and flippers notched.

Malaita
Three nesting areas known. Biggest reportedly between Aluta and Ambe Rivers
(4). Between four and six nested in September 1973 - all were eaten plus their eggs.
Between Hauhue and Waitaha River (5) none nested in 1973
Mapo Harbour (Small Malaita) (6)
Ulawa (19) one known to have nested Christmas 1972.

Ontong Java
Well known to the inhabitants, it is said to nest there too. No nesting beaches identified as yet.

Guadalcanal
Frequently found on the Weather (South) Coast, reported in 1973 to be declining. Nesting beaches scattered between Koli'ula point and Visinaoru (7) estimated twenty nestings per year.

Russell Islands. No information

Florida Islands. No information

New Georgia Group - Reported nesting on Rendova Island (8). One nested neat Mbaniata village during July. Leathery turtles are reportedly eaten there about once a month, although they were totems before. Reported nesting on Tetepari (8a) island, very few people there and it is said that the turtles nest frequently, - warrant investigation.

Nesting on *Vangunu* (9a) island - one during July neat Saira village. Also nesting on *Vella* - no information.

Shortland Group - Konagaliu Island (10) - one leathery killed on the beach in 1975. Occasionally sighted in other parts of the group.

Choiseul - Reputedly there are many leathery turtles - nesting places on Choiseul; however, the only places positively identified are near the Birabira River (11) mouth and at Mondomondo (Vurango) (12). At the latter place c 3 were being killed per mouth in the 1972/1973 season.

Also near the Kamangga River mouth (12a) - two nested 29/30 June 1977. Reportedly one killed there per week.

Santa Isabel - Several nesting places are known on Santa Isabel, mostly short stretches of black sand near river mouths. Allardyce Harbour (13) - people from Kia report c 12 nested December 1976 - three killed.

Litoghahira Bay (14) October 29th - six nests on the beach, four had the eggs removed.

Hive Plantation (15) no information re numbers.

Dedeu Village (16) - Occasional nests only, relatively new village. None reported in past two years.

Samasodu Village - (17) as Dedeu but occasional nests. 100% eaten.

Lilika Bay area - (18) a short tagging programme was centred here in Nov/Dec 1976, See Fig 17.
November 14th - four nests on the shaded area of beach - two of these had the eggs removed - possibly by goannas as there are many in this area, though egg shells were noted in one of the dwellings. Twenty nests were laid during the period November 14th - December 16th. Ten leatheries were tagged, no re-nestings were observed, but one turtle which had been mutilated 3/4 years previously on the beach at Hivo was observed to nest at Lilika December 19th 1976. It is interesting to note that in several parts of Isabel it has been a "custom" to mark leathery turtles when they are found on the beach - notching the flippers or carving names on the carapace being the most usual methods. One marked at Litoghaira some years ago reputedly nested the same season at Hivo. Apparently they do not necessarily return to the same beach in successive seasons or even to lay successive clutches.

The nearest village to Lilika is Baolo. The residents took a keen interest in the work being carried out and since then have been keeping a watchful eye on the area. They reported that there was at least one nest laid most nights during late December 1976 and early January 1977. The 10 turtles were tagged with monel metal tags - one on each fore-flipper. Carapace lengths were measured over the curve along the mid-dorsal ridge. The carapace lengths ranged from 150 cms to 172 cms with a mean of 161.3. All the turtles observed beached in the period four hours before high tide.

In some of the languages of the Solomons eg. Baolo language and Ontong Java language there are two names for the leathery turtle. In both these places the inhabitants describe two morphs, one which is small (i.e. the ones tagged!) dark coloured with seven dorsal ridges and one which is considerably larger, paler coloured and having many more dorsal ridges ! Apparently there are no intermediate sizes and both come up to nest.

Regulation 17 of the Fisheries Regulations 1972 forbids the taking of the leathery turtle.

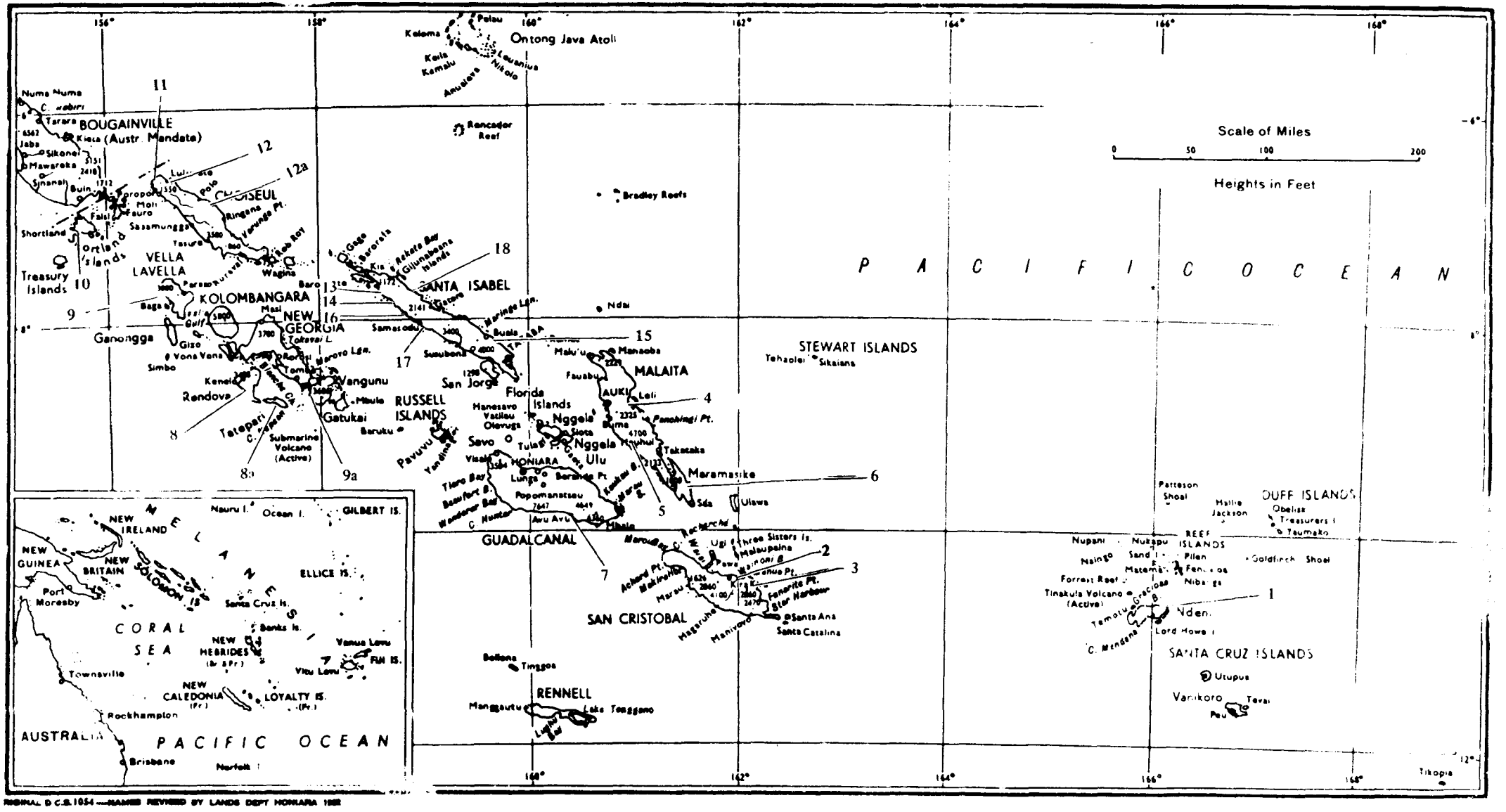


Fig 16 LEATHERY TURTLE NESTING BEACHES.

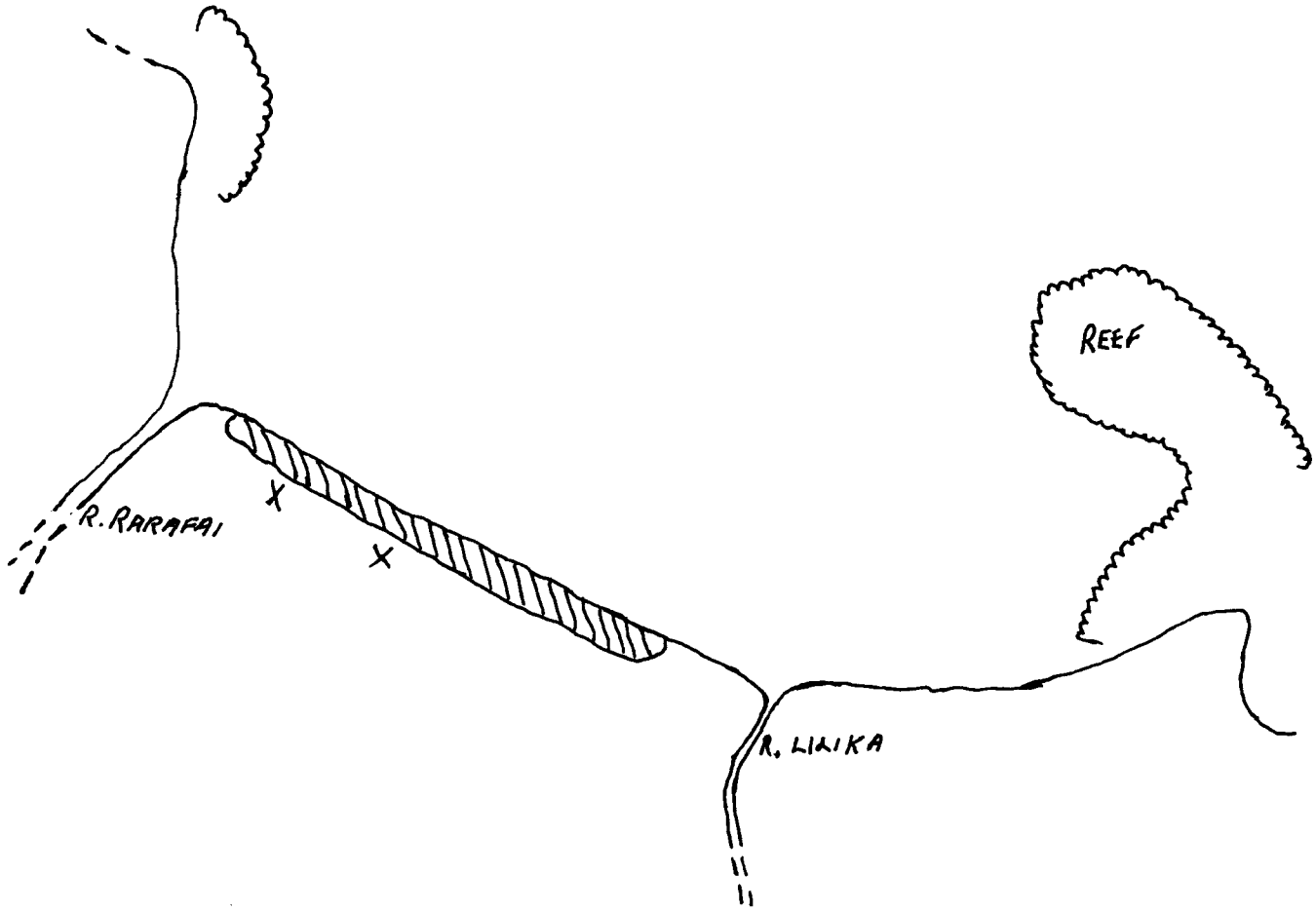


Fig 17

Lilika Bay Nesting Beach.
x= Temporary Dwelling
SCALE: 6 cms = 1 Mile.

THE LOGGERHEAD - *Caretta caretta*

This turtle is often described by old men in the villages in many parts of the country; there are names for it in many of the languages. It was first positively identified in Utupua from a skull - Sept 1976. It is also reported to be easily found in Nupani (Reef Islands). Two have been caught in Wagina during the past year, one was released as the people were unsure if it was edible but the other was held and I was able to positively identify it as a loggerhead.

The carapace, head and flippers were a distinct reddish/brown colour, the plastron pale yellowish/white. The head is very large, flippers are shorter than green turtles of a comparable size. The mouth is broad and beaklike being very thick and powerful. The head scale pattern is very similar to that of the Olive Ridley (Lepidochelys olivacea) but other features - colour size and general appearance make them readily distinguishable. The carapace scutes are unlike greens or Hawksbills being dull and apparently flaking off in parts. The animal was photographed before tagging and releasing.

Loggerhead Tagging Data

Species	Caretta caretta
Sex	Female
Weight	165 lbs.
Carapace length:	
Curved	87 cms
Straight	82.5 cms
Carapace width	
Straight	67 cms
Plastron length	65 cms
Head Width	17 cms
Barnacles	present on the Numerals pectorals and Abdominals
Damage	Front right flipper half bitten off (-shark?)
Caught	Te Onni Piki (Wagina)
Released	Kerehikapa
Tag Type	Monel metal
Tag Nos	727/728/729
Date Caught	9/4/77
Release	12/4/77

Notes - from faeces it apparently had been feeding on 'Pen' shells.

Villagers always report that the loggerhead can be found feeding on deep reefs but never nests in the Solomons.

The Olive or Pacific Ridley - Lepidochelys olivacea

To date (Sept 1977) three of this species have been positively identified in the Solomons. A mating pair were captured by staff of Fisheries Division, off north Guadalcanal - near Honiara - February 1976 and in July 1977 a juvenile was found in Makira. It is of note that there are apprarently no language names for this species. There is a possibility that the ridley is confused with the loggerhead though this is unlikely as the coloration is so different.

Morphological data of the mating pair are given below, no further information is available on this species.

Species	... ...	L. olivacea	
Sex	... ...	Male	Female
Weight	... ...	80 lbs	85 lbs
Carapace:			
	Length (Curved)	66 cms	70 cms

Tagged and released at Honiara 9/2/76.

APPENDIX

SOLOMON ISLAND LANGUAGE NAMES OF TURTLES

Island/Language	Turtle	Green Turtle	Hawksbill Turtle	Leathery Turtle	Loggerhead	Other
Solomon Pijin	Totel	Sofbak Totel	Strongbak Totel		Bikhet Totel	
SHORTLANDS						
Alu	Palusu	Kovuru Palusu	Nahesi P.	Raurau		
FAURO AND TREASURY						
Mono	Palusu	P Vasivavare OR P Muko	P Sa-e OR Purai (Smaller)	Raurau		
CHOISEUL						
Mbambatana	Vunu		V Tango	Galo		
CHOISEUL						
Vaghua and Varisi	Tengge	T Mbusui ( ) T Mumuko ( )	T Tanggo	Mokolo		
CHOISEUL						
Avaso	Tenge	T Mogaga	T Suri	Alo		

APPENDIX (contd)

SOLOMON ISLAND LANGUAGE NAMES OF TURLTES

Island/Language	Turtle	Green Turtle	Hawksbill Turtle	Leathery Turtle	Loggerhead	Other
VELLA LAVELLA						
Mbilua	Vo vognu	Vo gnugnu Vognu	Vo sori vognu	Vo tavatolu vognu		
SIMBO	Modoko					
NEW GEORGIA						
Roviana	Kohale	K igana	K Kapa	K tavatolu		
NEW GEORGIA						
Marovo	Vonu	V ihana	V pende	V Kariatolu		
RENDOVA						
Mbaniata	Gonu	G Foforo ( ) G Soreke ( )	G Safi	Oihare		
ISABEL						
Zabana	Tege	T Mogaha	T Ngapo	Babaru	T Kakapodoko	
ISABEL						
Laghu	Fotogigiro					

APPENDIX (Cont'd)

SOLOMON ISLAND LANGUAGE NAMES OF TURTLES

Island/Language	Turtle	Green Turtle	Hawksbill Turtle	Leathery Turtle	Loggerhead	Other
MALAITA						
Are Are	Honu	H. para	H. hapa	Oropi		
SMALL MALAITA						
Sa'a	Honu		H. Rama	Kulune		
MAKIRA						
Arosi	Aroha'i	A. Menamena	A. Una	Orobiu		
SANTA ANA	Gharofai					
SIKAIANA	Honu		H. Masana			
ONTONG JAVA	Nanumea	Tehongu* or Kengumea or Keunamea	Kemasanga	Susulu or Keioho		* I suspect one of these may be a loggerhead.
RENNELL & BELLONA	Honu					
SANTA CRUZ	Nau	N. no	N. daling	la'ata		

APPENDIX (Cont'd)

SOLOMON ISLAND LANGUAGE NAMES OF TURTLES

Island/Language	Turtle	Green Turtle	Hawksbill Turtle	Leathery Turtle	Loggerhead	Other
UTUPUA						
Asimbau	Gningignavo	Rambarau	navete	La'ata	Tekea	
VANIKORO						
Buma Language		Tukteleu	anairo		Tekea	
TIKOPIA	Te fonu		f. Koroa			
DUFF ISLANDS	Te fonu	Te vai vai	Te fonu Kanaga		Te kea	
REEF ISLANDS	Toponu	T. Aumalu	T. nembe		T. sekea	

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I am greatly indebted to Father John McKenna, Sisters Patrick, Michael and Denise, missionaries at Wagina who extended limitless hospitality and who made communications with the Arnavon Islands possible.

Thanks are due also to those who sent reference material, advice and encouragement, notably Peter Pritchard and George Balazs; to countless people who collected information on sightings, nestings and language names. I will always remember with affection the people of the Solomon Islands whose help and warm hospitality was readily given everywhere.

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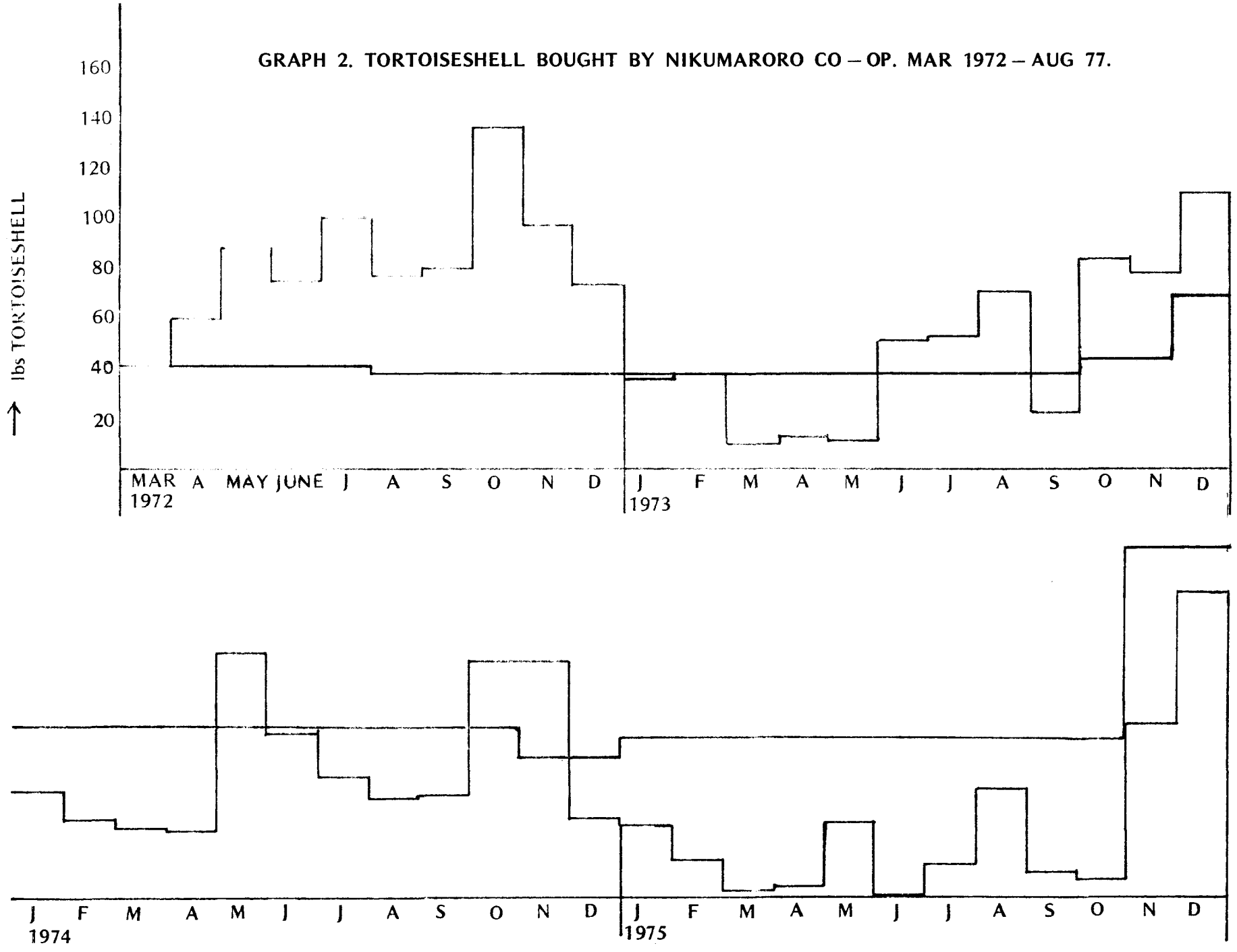
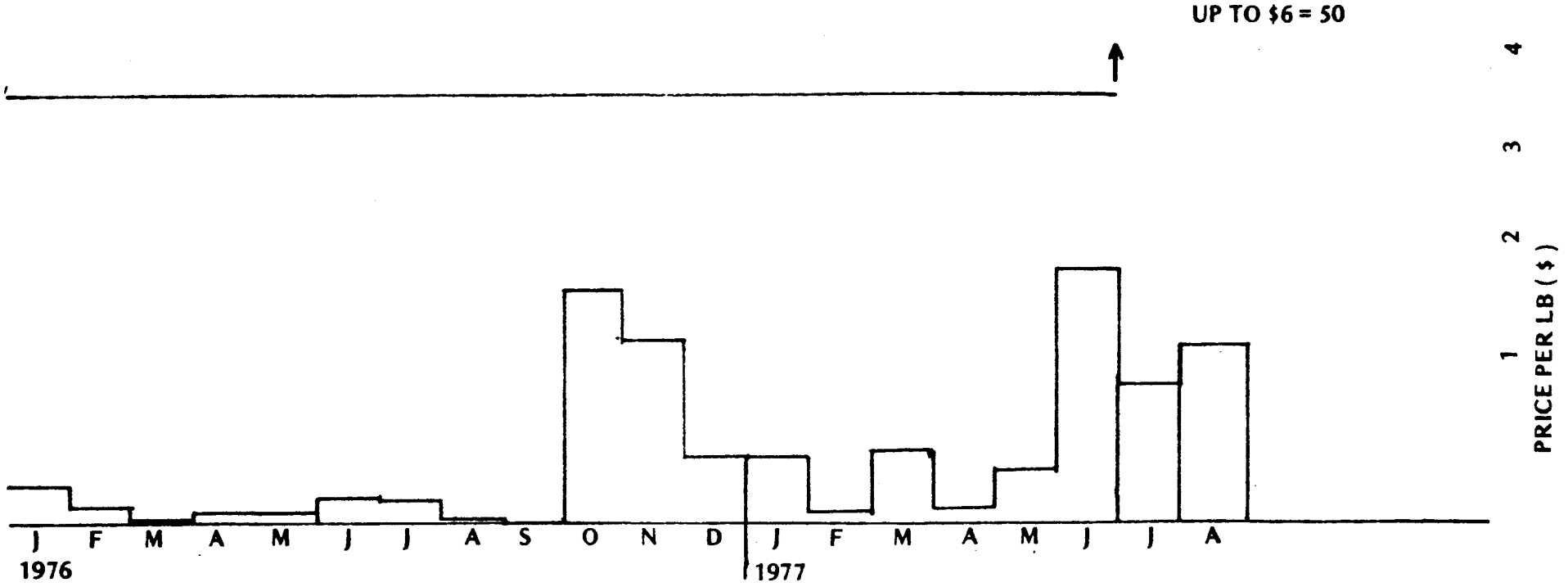
GRAPH 2. TORTOISESHELL BOUGHT BY NIKUMARORO CO – OP. MAR 1972 – AUG 77.




UP TO $6 = 50
4
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PRICE PER LB ($)
J F M A M J J A S O N D J F M A M J J A
1976
1977

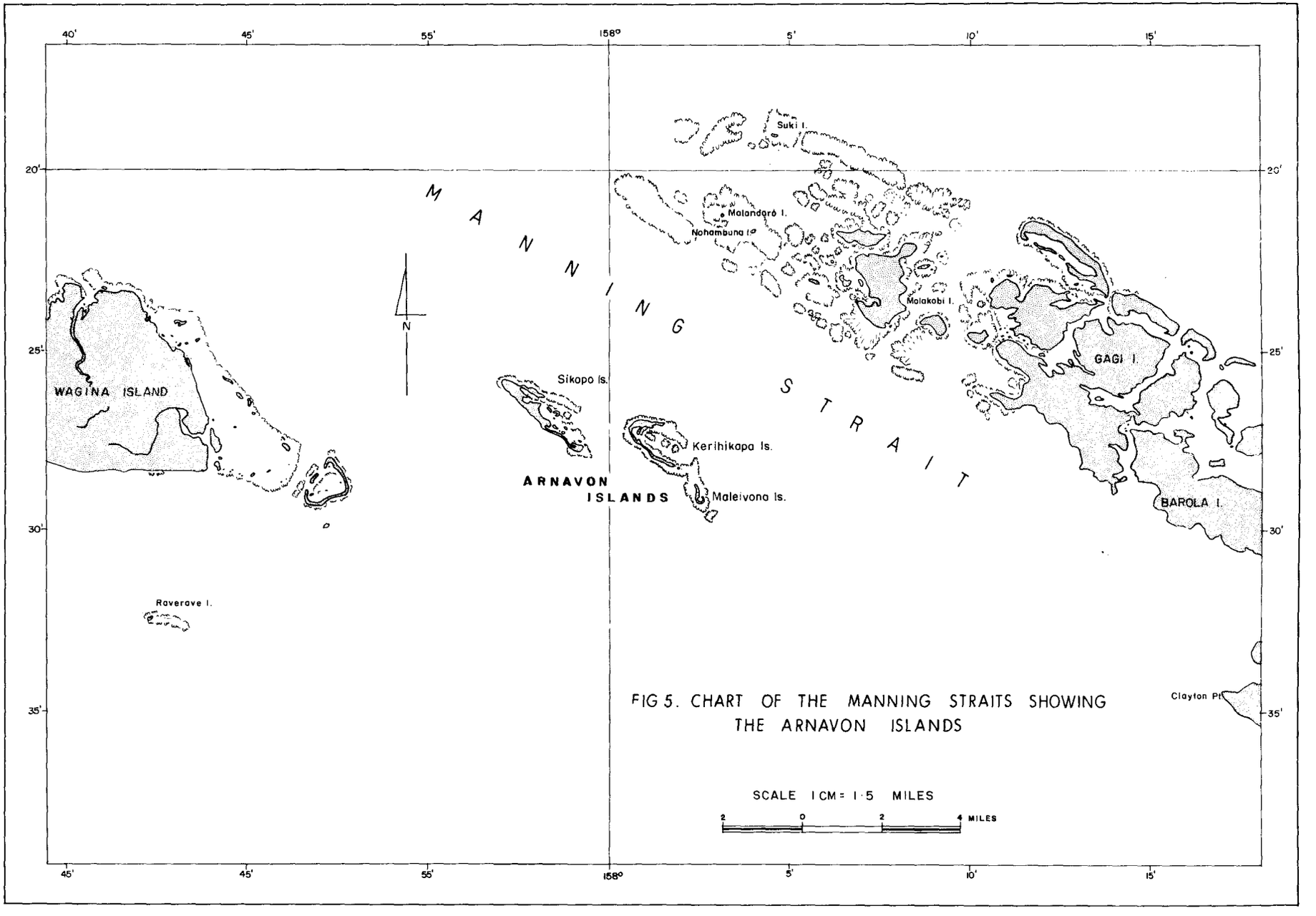

FIG 5. CHART OF THE MANNING STRAITS SHOWING THE ARNAVON ISLANDS