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CONSERVATION OF TURTLES
HAWKESBAY AND SANDSPIT, PAKISTAN.

WORLD WILDLIFE FUND PROJECT 1451

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WORLD WILDLIFE FUND INTERNATIONAL

AND

SIND WILDLIFE MANAGEMENT BOARD

KARACHI, MARCH 1984

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ACKNOWLEDGEMENTS

The agencies that initiated and subsequently supported this Project are the World Wildlife Fund (WWF),and the International Union for the Conservation of Nature & Natural Resources (IUCN), the World Wildlife Fund, Pakistan (WWFP) and the Sind Wildlife Management Board (SWMB). It is not possible to acknowledge by name all the individuals, who contributed to this study, but special thanks must go to certain persons in each agency without whom this Project would not have started, or now be running.

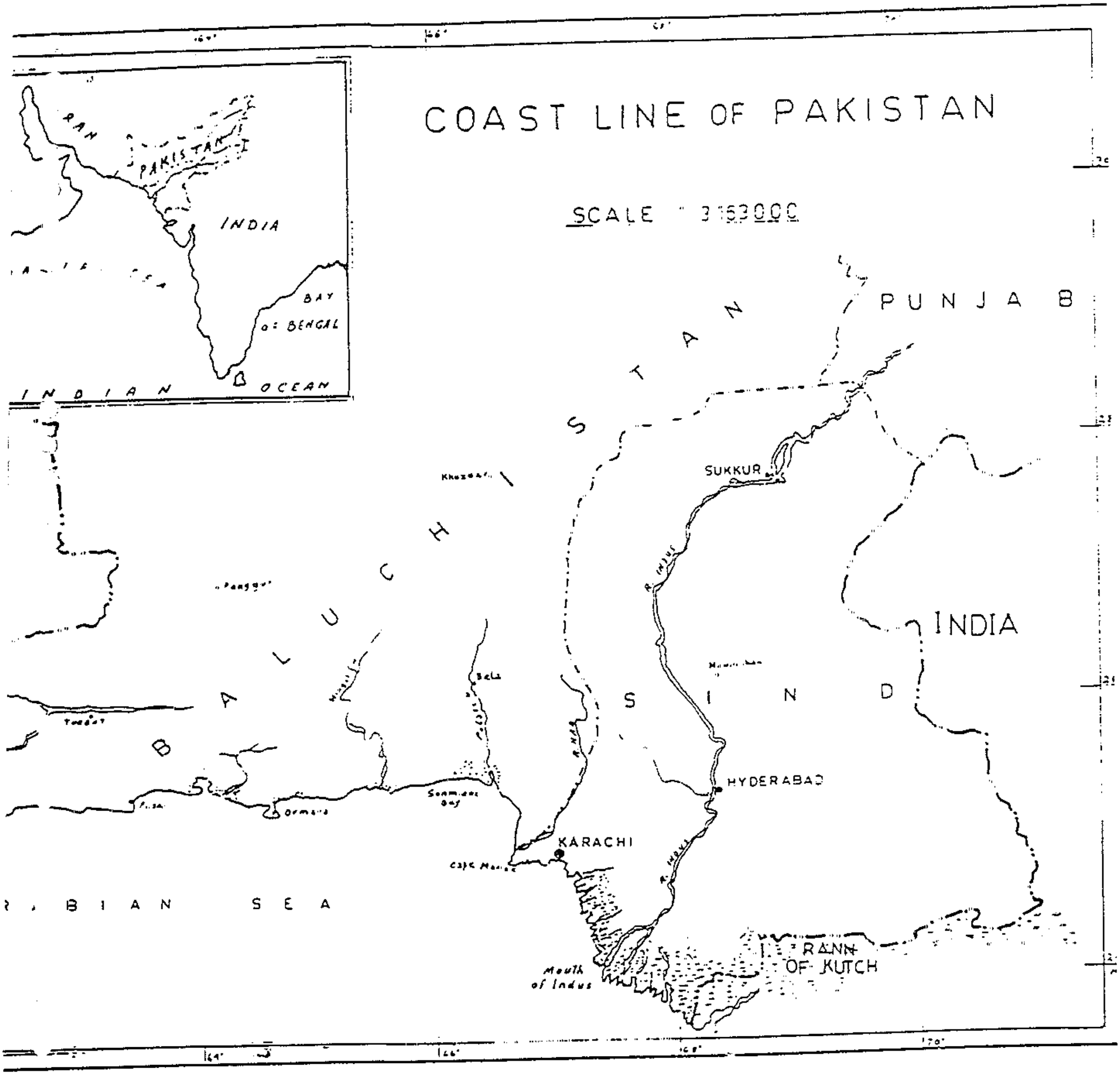
At WWF/IUCN thanks are due to the Project Committee that approved the original proposal, and to Anton Fernhout, the Project Manager for Asia, who invariably managed to meet all our requirements - both important and trifling - with equal efficiency and courtesy. Special thanks are due to Mark Halle for his initial and continuing interest and support to the Project. It is largely due to his efforts that the trip to Oman by the two investigators took place.

Syed Babar Ali, President, Dr Khalid Hamid Sheikh, Honorary Administrator and the Board of WWFP have been ever supportive both financially and in terms of advice and guidance to the Project.

T.J.Roberts, a naturalist in the finest tradition, as an active member of SWMB and WWFP, was particularly well placed to help and advise on problems in running of the Project, which he did unstintingly, and beyond the call of duty.

Finally, thanks and appreciation are due to the organisation that actually implemented the Project and was responsible for its logistics for the past four years and continues to do so for the next five - the SWMB. The proposal to WWF/IUCN was originally conceived by the then Secretary of the Department of Wildlife and Forests, Government of Sind, W.A.Kermani, and to him must go the credit of the achievements for the first founding years. Hameed Ahmed, present Secretary of the Department is owed particular thanks, for overseeing and making possible the transition of the Project from being funded by a foreign agency to being entirely taken over and run by Pakistan's resources and management. Khan Mohammad Khan, as Deputy Conservator of Wildlife in the Department of Wildlife & Forests had much of the responsibility of solving day to day problems of the Project. All these he handled with a seasoned hand which allowed things to proceed smoothly.

Thanks are due to numerous unknown volunteers, who motivated purely by their conservation instinct have been acting as an effective deterrent to would-be poachers, and in educating tourists not to harass or harm nesting turtles and hatchlings!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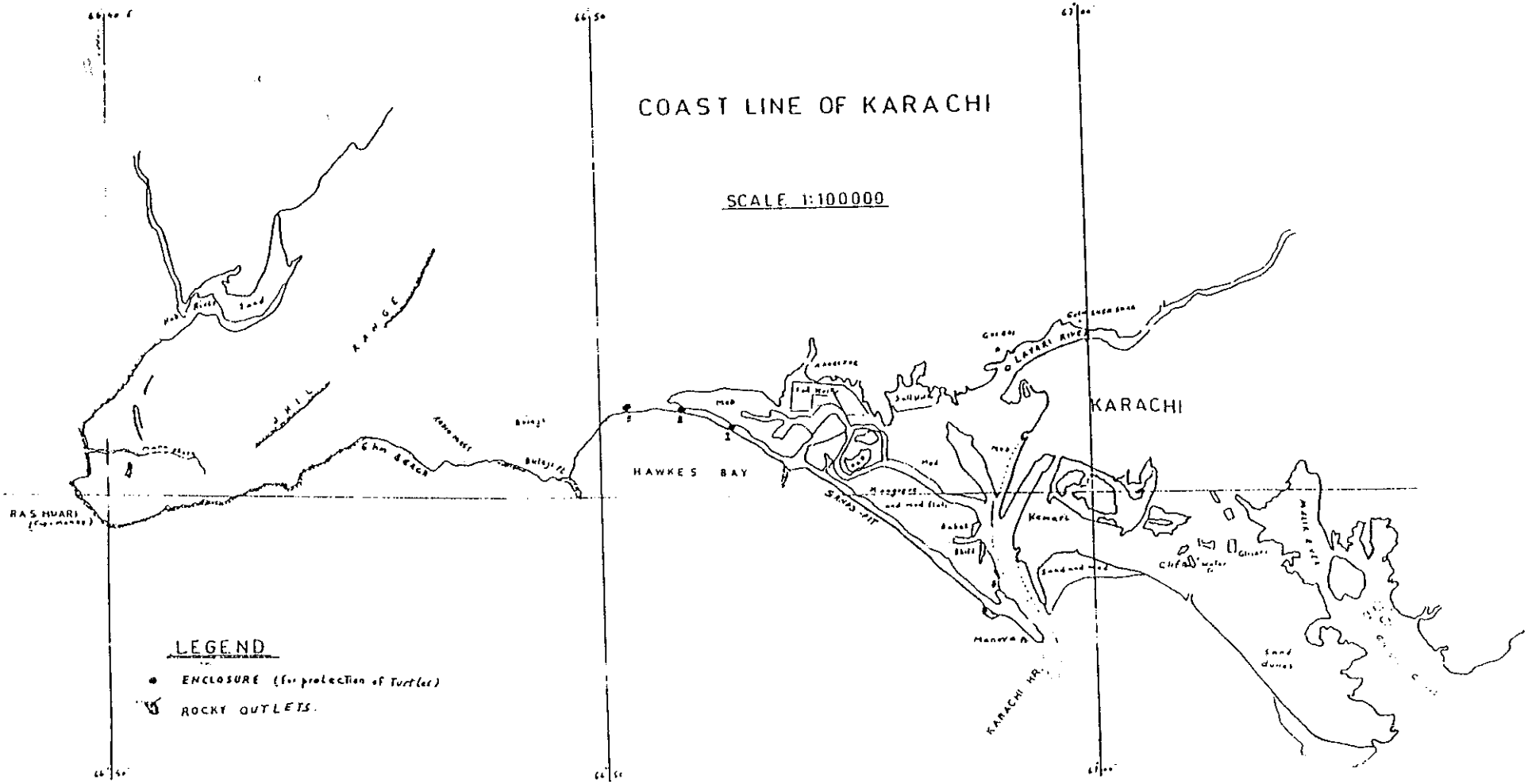
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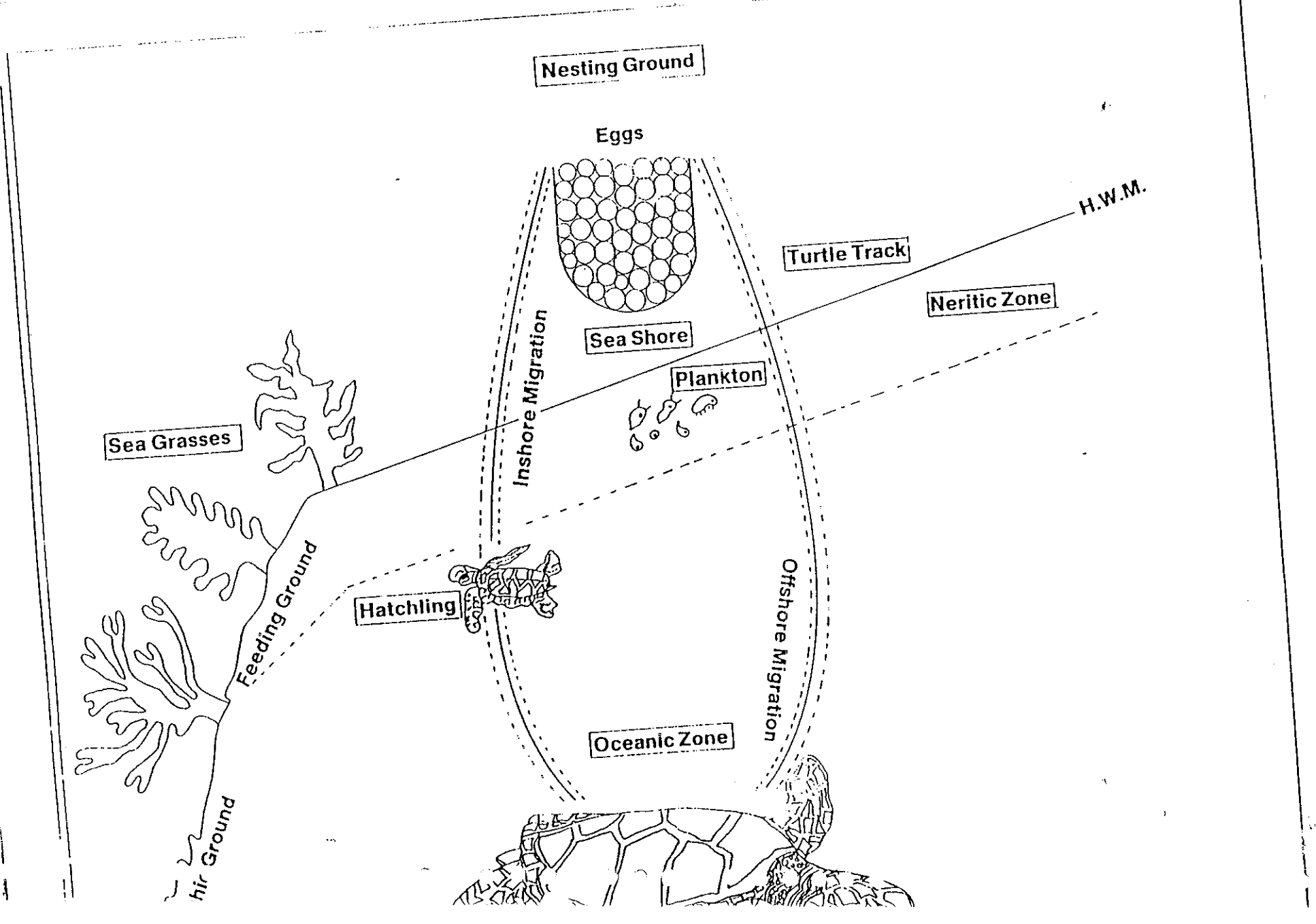
LEGEND
ENCLOSURE (for protection of Turtles)
ROCKY OUTLETS.

SECTION - I

ABSTRACT

The beaches of Hawkesbay and Sandspit near Karachi have long been recognised as nesting habitats of marine turtles. It was not until 1980, however, that adequate funding was received and a conservation-cum-research and education project under the WWF began. This project, which was originally conceived for a three year period, has now received a five year extension (until 1988) and is being run by the Government of Sind Pakistan.

In the area of conservation, legal protection was implemented and a hatchery programme where endangered nests were transferred to protected enclosures was begun. This programme in turn formed the basis for the collection of research data on the two species of marine turtles nesting at Hawkesbay-Sandspit; the Green Turtle (Chelonia mydas) and Olive Ridley (Lepidochelys olivacea). Surveys were conducted along the coast to determine nesting beaches and rookeries and estimate population spread and size. Studies were made of nesting and breeding seasons, size, weight, colour, feeding habits, nesting, eggs, incubation periods, hatchlings and other aspects of the life cycle of both species. Tagging of adult females was also started. Simultaneous to the other activities an education programme was run which, using the marine turtle as its model of an endangered species sought to spread awareness as to the value of conservation and wise resource management.


Nesting Ground
Eggs
H.W.M.
Turtle Track
Neritic Zone
Sea Shore
Inshore Migration
Plankton
Sea Grasses
Feeding Ground
Hatchling
Offshore Migration
Oceanic Zone
hir Ground

SECTION - II

INTRODUCTION:

HISTORICAL AND LEGISLATIVE BACKGROUND

In 1966 on the invitation of the Government of Pakistan, the World Wildlife Fund sent a team of experts led by Guy Mountfort, to survey the Wildlife and Habitats of Pakistan, with a view to drafting a Conservation strategy.

Among the recommendations submitted was one to set up a Wildlife Enquiry Committee to consider the various questions relating to conservation with particular reference to endangered species, their conservation and administrative arrangements. The Wildlife Enquiry Committee in their Report of 1970 listed Sea Turtles (of the Genera Chelone, Dermochelys, Caretta and Eretmochelys) as Endangered Species and in need of protection.

The province of Sind, which with the province of Baluchistan shares the coastline of Pakistan and consequently the habitat of marine turtles, played a pioneering role in the implementation of the Committee's recommendations and instituted the Sind Wildlife Protection Ordinance in 1972. This classified the marine turtles as Protected Animals and therefore made it illegal to exploit (commercially or otherwise), or to harass the marine turtles, their eggs and hatchlings.

Up to this time all the relevant information available about marine turtles along the coast was contained in a few papers (Minton, 1966; Salm, 1976) where brief references to their presence in off shore waters and along the beaches was recorded. Various foreign scientists who paid visits to Pakistan also noted that immediate measures should be taken for the protection of the turtles, and studies were undertaken and addressed to WWF/IUCN suggesting they look into the problem.

The WWF/IUCN as part of its campaign 'The Seas Must Live' gave the Sea Turtles Priority status and listed the development of a 'Conservation of Turtles, Hawkesbay and Sandspit' Project 2.6.3 in its Bulletin of December 1976. This project was also included in the 'Conservation Programme for Sustainable Development 1980-82' item 6.2.2:20.7. Pakistan became a signatory to CITES in 1976, which implicity forbade any allowing of trade or exploitation.

In early 1970's a certain amount of commercial exploitation was taking place, of adult female sea turtles and their eggs. The adults were caught and butchered, and the meat exported (mainly to Japan). The eggs were collected and sold in the main grocery market of Karachi, as a cheap alternative to poultry eggs, and bought mostly by big bakeries who used them for bread and cakes. The problem of exploitation was brought to the notice of SWMB by prominent biologists, notably Sir Julian Huxley and Sir Peter Scott. Following a successful clampdown by SWMB in 1972 this trade came to a stop, and subsequent threats to sea turtles appeared to be largely from random poaching, development, tourists and feral dogs. No systematic scientific study had ever been undertaken however. Largely due to the efforts of SWMB over the period 1972-1979, a lot of attention was focused on the plight of the turtles.

In 1979, modest funds were made available by SWMB and the WWFP for a small pilot project to be established at Hawkesbay - Sandspit. This envisaged the recruiting of a guard to patrol the beach looking for poachers or tourists harassing and disturbing nesting turtles, and a small enclosure where such nests along the beach deemed to be under greatest threat from feral dogs could be dug up and the eggs reburied within the enclosure.

The WWF/IUCN were then approached by SWMB with a proposal for funding a Project which took as its broad objectives; a survey of the beaches to determine the status, species and estimated population of the sea turtles, and the main threats to their existence. Running alongside the collection of such facts would be a conservation and protection programme and also an attempt to raise public awareness and educate school children as to the benefits of conservation and bring home the threatened status of the sea turtles.

It was proposed that both SWMB and WWFP put in a certain amount of funding, with SWMB providing all logistical and administrative support, while the WWF/IUCN would supply scientific equipment and pay for two scientists (The Principal and Co-Investigators) to plan and implement the project.

This proposal was accepted by WWF/IUCN, and it agreed to fund and supply $ 42,460 worth of equipment and other project costs for the period July 1980 - June 1983. The actual cost of the entire project for three years and the amount contributed by each sponsor is listed in the Reports in Appendix I.

At the end of the WWF/IUCN Project 1451 in June 1983, a proposal was submitted (Appendix I) to the Government of Sind for funding for the continuation of the project. Approval was received and the Project at present continues with the same broad objectives under the sponsorship of SWMB, with a small contribution by the WWFP (ref: Section VII - Future of Conservation Programme).

SCIENTIFIC & CULTURAL BACKGROUND

As stated earlier, scientific knowledge and data on the sea turtles off the coast of Pakistan, before the beginning of the project, was restricted to occasional papers (Minton, 1966; Salm, 1976) where reference to the existence of the turtles and the need of protection and scientific study is stressed.

Minton's paper suggests the presence of the Leatherback (Dermochelys coriacea) nesting on islands near the mouth of the Indus although the results of the pilot project and subsequent observations by these investigators have only confirmed the presence of two species, the Green Turtle (Chelonia mydas) and the Olive Ridely (Lepidochelys olivacaea) in our coastal waters and nesting on the beaches of Hawkesbay & Sandspit.

It must also be made clear that this project took as its task the investigation and conservation of the coastline of Sind, west of the city of Karachi, which is roughly one 18th of the total western coastline of the country, the rest (the Makran coast) lying in the jurisdiction of the province of Baluchistan. On the coast south-east of the city of Karachi, until the border with India, one meets first the mouth of the delta of the River Indus, and then the marshes of the Rann of Kutch, neither being suitable nesting grounds for turtles.

Reports of the presence of nesting turtles (and more recently, their illegal exploitation) have been made for stretches of the Baluchistan coastline, and during the course of this project, an attempt to enforce a clampdown through the Forest & Wildlife Department of the Government of Baluchistan has been made. The coast is even wilder, more inaccessible and impoverished than that of Sind however, and until a scientific survey is carried out an exact assessment of the situation cannot be made.

Culturally, the marine turtles are in a fortunate position in Sind, as they are not, and have never been accepted as a food source. At very most, the eggs are sometimes used in indigenous medicines (Hikmat) and considered to be of therapeutic value as a cure for asthma, but not once during the duration of the project has anyone been apprehended poaching for this purpose.

The fishermen of the area who are Muslims, consider turtle meat and eggs 'Makru' which roughly translated means that one may eat or drink a particular food but it would be religiously desireable not to.

The rather advantageous situation therefore exists, where the turtle is not considered an indigenous or native food resource, and until recently has never been widely commercially exploited for export. The threats to its existence therefore are more in the nature of development of the beaches and consequent disturbance of the natural habitat, feral dogs and other natural predators, and the occasional, (usually South-East Asians) poacher for whom the marine turtle or its eggs is a delicacy, regarded as an aphrodisiac or a natural food source. Turtles also form part of the incidental catch of the local fishermen.

The coastline of Sind is therefore uniquely placed as one of the best marine turtle nesting beaches in the world where the protected species is not a food source and therefore conservation does not imply direct economic competition (with all the cultural and political overtones) with the local population. In fact the conservation programme provides secure government employment for the local people of the area, and they therefore have a vested interest in the protection of the species. It is therefore clear that if a long term conservation programme were to exist, and natural and manmade predators controlled, together with a continuing ban on commercial exploitation, the nesting habitat can be preserved, and the species allowed to multiply.

SECTION - III

OBJECTIVE OF THE PROJECT

The project started from the premise that no accurate information was available on the number of species, their status, biology, population or breeding habits, of the marine turtles found along the beaches of Hawkesbay and Sandspit; and therefore took as its aim the verification of such information as existed in the literature, and the establishment of a data base which would provide extensive information on all aspects of the status and biology of the turtles.

The objectives can be detailed as follows :

O B J E C T I V E S

PRIMARY STAGE OF PROJECT: STATUS SURVEY.

To survey extensively the coastline of Karachi and locate the major marine turtle nesting beaches and establish the presence or absence of rookeries and feeding grounds.

To identify the various species of marine turtles and their hatchlings.

To carry out an intensive status survey of the population of turtles on the beaches of Hawkesbay and Sandpit where the greatest number of turtles come to nest.

To identify the principal threats to the turtles' existence.

To continue to extend protection to the turtles along an already designated stretch of beach by patrols.

To continue to transfer eggs from nests for reburial in guarded enclosures.

To continue to raise public awareness by information hoardings on the road to and along the beaches.

To publicise and educate the people of Karachi by writing articles for the newspapers and publishing'information advertisements'. The possibility of television programmes on wildlife in general and the turtles in particular are likely as are postage stamp carrying the pictures of the most threatened s species.

SECONDARY STAGE OF PROJECT: CONSERVATION PROGRAMMES.

To design and implement a conservation programme the content of which will only be established after the results of the status survey are studied and analysed.

To devise means to combat identified threats to the turtles' existence.

To implement fully the legal protection which is already extended to the turtles.

To collect data from turtles tagged in the first stage of the programme and to evaluate the benefits of protective enclosures.

To encourage a more favourable breeding environment by selecting for those factors which prove beneficial to the turtles' nesting habitat.

To continue the public awareness and educational programme on a national basis.

The above, for purposes of greater coherence, have been grouped under the categories of Research, Conservation and Education and the results obtained and their analysis discussed in Section V of this Report.

SECTION - IV

METHODOLOGY

In the initial stage the small pilot project run by joint collaboration between WWFP and SWMB established one protective enclosure and employed two guards ("chowkidars") and a field officer to collect basic data on nesting turtles (eg. how many eggs laid, transference into nests within enclosure, and emergence of hatchlings) in the area around the enclosure. During this period (September 1979 to June 1980) the Principal Investigator to the present project worked in/ honorary capacity. One of the main drawbacks was transport, and the ability to establish an accurate data base without tags to identify nesting turtles.

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Formal approval for the present project was received in October 1980, and funds, backdated to July 1980, were received in December 1980. At this point it was possible to employ both Principal and Co-Investigator and order such scientific equipment as was considered necessary.

Transport (a Toyota Landcruiser), tags and the boat arrived between September 1981 and July 1982, so there was a long period between the official start of the project, and the actual wherewithal to carry out proper research. Until such time as the equipment arrived, work continued with the use of transport supplied by SWMB whenever available. Progress was therefore made mainly in the realm of Conservation and Education.

From July 1982 to June 1983, when the transport, tags and boat were all functional the project made the maximum progress, and much of the data presented in this report, relates to that period.

Although the project area was defined as the beaches of Hawkesbay and Sandspit, the coastline westwards to the border with Baluchistan was also surveyed as far as a jeepable road existed, and the essential features of nesting beaches and their topography noted.

Surveys by boat were carried out along the coast during the non-monsoon times of the year i.e., September to March, when the sea is calm enough to use a small boat. Turtles were seen in the water during these periods, which also coincide with the peak nesting time, September to November.

The carapace length and breadth of a sample of green turtle and olive ridley adults and hatchlings was measured. Both straight line measurements using a caliper and over the curve measurements using a flexible tape measure, were taken. In all cases length was measured from the front of the carapace (nuchal scute) to the anterior point of the division between the last pair of marginals (notch to notch), and breadth over the widest part of the carapce approximately between the second and third costal scutes.

Weight was taken by suspending the specimen below a spring balance.

Tagging was carried out by both investigators, on female green and olive ridley turtles, nesters and non-nesters. Monel metal ear tags (National Band and Tag Company Size 19) were applied to the trailing edge of one or both of the front flippers, 10-15 cm. from the body. The turtles were tagged either just after laying, when they were quiescent, or on their way back to the water, after having abandoned the attempt to lay. Each tag bears an identification number with the prefix 'W' (eg. W0001) and the following inscription:

RETURN FOR REWARD. SIND WILDLIFE, P.O.BX 3722,
KARACHI - PAKISTAN

For each turtle tagged the following information was recorded:

Tag number, Date of tagging, Location, Species, Size (Carapace length & breadth), Weight, Nester/Non-nester, Number of eggs laid, Date of recovery, Location of recovery, Interval, Nester/Non-nester at the time of recovery, Number of eggs laid at the time of recovery.

Egg transference from vulnerable nests on the open beach to protected enclosures formed a major part of the conservation programme. Three enclosures were constructed during the first two years of the project, and these were all within the 5 km 'high density nesting' zone. Six watchers/guardians (two to each enclosure), were employed on a full time basis to guard the enclosures, transfer eggs, and patrol the beaches. Unfortunately it was not possible to be particular in our choice of watchers/guardians, as the local people of the area have the beach divided up into 'territory' belonging to different ethnic groups. Therefore enclosures in any one area could only employ men from the group that laid claim to that part of the beach. Fishing and housing rights follow the same pattern and no man from a different group, or from 'outside' (i.e., the city of Karachi) would infringe this unwritten law and work in an area not 'belonging' to his group. As a result, the watchers/guardians are all barely literate and there are continuous problems in the collection and recording of accurate data.

There is a reverse advantageous side to this situation, in that by employing the local people, we get the benefit of their knowledge and familiarity with the area, and do not have to provide board or lodging. The people of the area are fairly poor, and since the turtle has never provided any nutritional or economic benefit to them, they have a vested interest in its protection when this provides full-time secure employment by the government.

The egg transference and tagging procedure is as follows :

When a female turtle emerges from the water she is observed quietly until she begins to lay. If she returns to the water before laying, due to disturbance or a variety of other 'natural' reasons (eg. sand particle size, humidity) which make the nest site unsuitable, she is 'held down' while a tag is clipped on. Turtles are never tipped over (as a precautionary measure after (1982) P. Pritchard's suggestion that this may cause egg yolk peritonitis) and tagging is always done while the animal is in the normal 'crawl position'.

If a body pity is dug and a nest hole excavated and laying begun, we wait until the last egg has been deposited, and filling in of the nest hole begins. At this point the turtle is tagged on the front flippers (which are usually inactive while the back flippers do the work), and measured across the carapace. At the same time, one of the guardians digs a passage into the nest hole and removes the eggs to a straw basket. The eggs are then carried to the nearest enclosure, where a pit is dug into the sand, approximately 70 cm deep. The eggs are then placed gently at the bottom of the pit, buried by sand and the nest encircled by wire mesh and numbered. The date, species, number of eggs, their size and weight and in some cases temperature of the clutch after burial are all noted. When hatchlings emerge, they are gathered from each nest and carried down to just before the high tide line. They are then allowed to walk to the sea under 'escort' to save them from predatory crabs, dogs etc. At emergence the hatchlings are counted, identified, weighed, measured and checked for any abnormalities.

Monitoring of temperatures within a clutch of incubating eggs also takes place. An instrument (C- 8150-60 Thermistor-Thermometer by Cole Palmer) is used, and a probe buried within the centre of the clutch, at the end of a wire which can be

attached to the meter for reading the intranest temperature. The nest is filled with sand, and left to incubate as would naturally occur. The probes are water-proofed and can withstand the burial in sand, without having their sensitivity affected. Readings are taken at regular intervals and a nest temperature profile plotted, which shows how gestational development is reflected by the temperature within the clutch.

Nests are then excavated, unhatched eggs and shells tallied with the original count, and unhatched eggs opened and embryos checked for arrested development so that a reason for the phenomenon might be postulated. All the sand and debris of rotting eggs are removed from a nest during excavation and it is left open to the sun, and wind until it gradually fills up again, naturally, and can be used again.

Each enclosure (as functioning at present) has a nest capacity of 400. During peak season, this is quickly filled. Only such nests as are considered particularly 'vulnerable' (to predation, disturbance or are too close to water's edge) are transferred to the enclosures and wherever possible, open beach protection of undisturbed nests is attempted. The most vulnerable nests are near enclosure 1 (see map) as that is closest to a village (and therefore disturbance and feral dogs), and this is also a very high density nesting zone for the green turtle right through the year.

Since the project began, we have used different materials to make the nests number plates and enclosures as corrosion and maintainence have been constant problems. Enclosures are of approximately eighty sq. feet in area and are fenced by galvanised iron mesh (100 x 50 mm x 8 swg) painted with anti-corrosive marine paint. Each circular wire mesh around the transplanted nest is made of the same material with a smaller mesh size and is approximately 60 cm in diameter. Plastic number plates are used to number the nests. In the three year project period, two enclosures (1 and 3) became totally useless as they fell apart, and were replaced by two more at sites 100 - 200 ft distant from the original. As before, the funding for these and the nest meshes which are constantly being repaired and replaced, came from WWFP.

As part of the public education aspect of the project, the investigators contacted schools, tourist organisations and various clubs and institutions and gave talks accompanied by film shows (made by the Ministry of Information and Pakistan Television), and guided tours of turtles nesting to visitors.

RESULTS AND DISCUSSION

A) CONSERVATION

Conservation & Protection

Conservation and protection of the turtles takes the following forms:-

1. Transference of eggs from natural nests to protected ones.
2. Hatchlings escorted down to the sea after emergence.
3. Patrolling the beach to ensure that adult turtles are not harassed or hurt during the nesting cycle, and that poaching of eggs does not take place.
4. Rescuing such stranded turtles as make their way into the marshy area behind the spit, and cannot then find their way back to the sea.

The eggs are collected as soon as possible after laying. The best method is to locate a nesting turtle and wait until the female is just ready to lay. Then a tunnel is dug in the sand and the back wall of the nest removed, so as to enable a person to take the eggs from the nest hole as soon as they drop into it. When the motions of 'filling in' begin, the eggs are taken in a basket to the protected enclosure, where they are placed at the bottom of a hole excavated in the sand (at approximately the same depth as the original hole), which is filled in, and a wire mesh placed around it. When emergence is about to occur, the sand within the mesh cakes and forms a crater - like depression. The hatchlings may emerge over 72 hours, or all at once. They are then counted, measured and weighed and carried out of the enclosure (past the many nesting pits) and put down on firm sand where they then make their way down to the sea.

On occasion, we come across nesting pits where the turtle has finished laying and is covering up. It is difficult in these cases to locate the nest hole, but one of our watchers uses a probe and manages to locate the eggs by the "softness" of the sand. We are aware of Schulz's (1975) findings that damage to the eggs by the use of a probe lowers the hatch rate considerably - and were ourselves sceptical the first time our watcher insisted he could find the nest hole by inserting the probe no more than 30-45 cm below the surface of the covered pit. When he succeeded in finding the clutch repeatedly, and no eggs were ever seen to be broken, we were convinced and are now training the other watchers to be similarly receptive to the "looseness" and "softness" of the sand over a nest hole.

2. As most hatchlings emerge at night, predatory birds are not a threat, and the watchers keep feral dogs and people away from the stretch of beach where hatchlings are released. If the hatchlings emerge during the day however, there is a very high mortality rate, from the gulls that swoop down upon them in the water, and we sometimes "store" such hatchlings until the hours of darkness, when they can be released. In winter it is possible to drape the wire mesh with heavy sacking, and keep the hatchlings in the nest until sunset, after which they are released, but this is not possible in summer, when dessication occurs very fast.

3. Our watchers patrol the beach at all hours, and we are trying to make the local people aware of the need to protect the turtles. Generally, we have found a receptive audience and since the locals do not eat turtle eggs or meat, the children of the villages often come to us with reports of sighting of adults and hatchlings emerging from unprotected nests. We have instructed them on the release of such hatchlings, and the need to keep the dogs and birds away -

The Municipal Corporation is carrying out a campaign of killing the pye dogs on the beaches.

4. Stranded turtles are often found in the marsh behind the spit, at a distance of 0.5 to 1 km from the sea. One way of transporting them back to the sea has been found to be the use of a camel! The turtle is turned over on its back (carapace) and ropes are tied to each of the front flippers and then to the camel. The camel pulls the turtle out of the marsh and across the sand to the water's edge, where she is untied, righted and makes her way into the water. Another more conventional method is to flip the turtle over into a net, and carry her back to the sea.

Poaching does occasionally take place, usually by foreigners to whom turtle meat and eggs are a delicacy, but it is far less frequent than previously, and poachers have been caught and punished.

Development Schemes

There are occasional inquiries to our department as to the feasibility of commercially exploiting the marine turtles. The aim is to export them as there is no real demand in the local market, and countries most frequently mentioned as unofficially demanding turtle products are France, Thailand and Malaysia. So far these enquiries have been firmly refused the possibility of commercial exploitation in view of the total protection afforded to the turtles, but our task would be made far easier if other countries banned the import of turtle meat and products.

The Karachi Development Authority (KDA) has drawn up plans for developing a housing colony very close to the beaches of Hawkesbay and Sandspit. This scheme also envisages development of the beaches for recreational purposes. The impact of any such development on the nesting cycle of the marine turtles, and on the ecology of the beach is bound to be fairly disastrous and we are attempting, through various proposals made to the Governor of Sind (who is also Chairman of Sind Wildlife Management Board) and the KDA , to include certain clauses in the scheme which will safeguard as much as possible, the present status of the turtle. The ultimate aim is an attempt to declare the area of the high density nesting zones a Reserve.

Predators

The most serious predator of the turtle (discounting man) is the feral dog along Hawkesbay and Sandpit. Near the village a pack of 3-4 dogs can destroy every nest laid on a single night in the area around the enclosures, and it is not unusual to see a dog silently waiting beside a nesting turtle, to dig up her nest as soon as she finishes laying. They also prey on hatchlings at emergence. Fortunately, the dogs are limited in their range by proximity to human habitation, and are not found on the more remote beaches or on the 6 km beach just before Cape Monze.

The Ocypode crab is a widely recognised predator of turtle hatchlings and eggs and we have also observed this to be the case along our beaches. We have found Ocypode cursor within the nests, seen their holes, beginning from outside the protective meshes around each nest, and leading to the egg chamber. Although we have not yet acquired enough quantitative data to confirm the hypothesis, it is proposed that the increased numbers of Ocypode we observed in 1980 compared to 1979 and in 1981 compared to 1980 may be due to the fact that there is a constant food source within a relatively small area available to the crab, and this may have caused the population increase. It is disturbing, if true, that the technique of transplanting the eggs in one area to save them from human and canine predators, may in

Birds (Gulls, Crows and Pariah Kites) prey on hatchlings which have the misfortune to emerge during daylight hours. Predation by crows and kites stops short at the water line but that by Gulls continue into the water as much as one Km. out to sea.

Within the water there is the usual assortment of fish and sharks awaiting the newly emerged hatchlings but this aspect of predation has not been studied by us in any depth.

Injury and Mortality

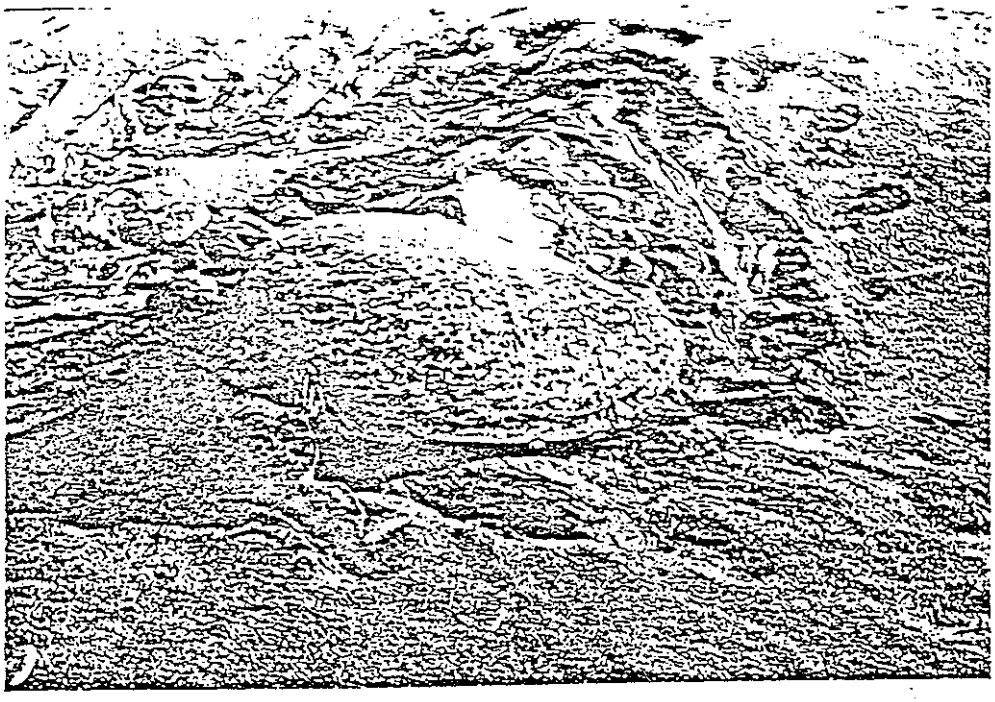
Not all injury of sea turtles leads to death. In fact it is not uncommon to see turtles with a flipper missing or part of the carapace gouged out (see photograph) probably by shark attack, nesting successfully on the beach. Other causes of injury could be the propellors of small ships or collision with rocks during the strong monsoon tides.

At certain times of year, particularly during the monsoon and post-monsoon period (which also coincides with peak nesting and may therefore only be reflective of the greater number of turtles in the area) there are a number of dead turtles washed up on to the beach. In some cases death appears due to shark attack, when the animal is obviously wounded and bleeding but at other times there is no discernible reason. Since we do not have access to laboratory facilities where a postmortem is possible, one can put forward the following possibilities for death :

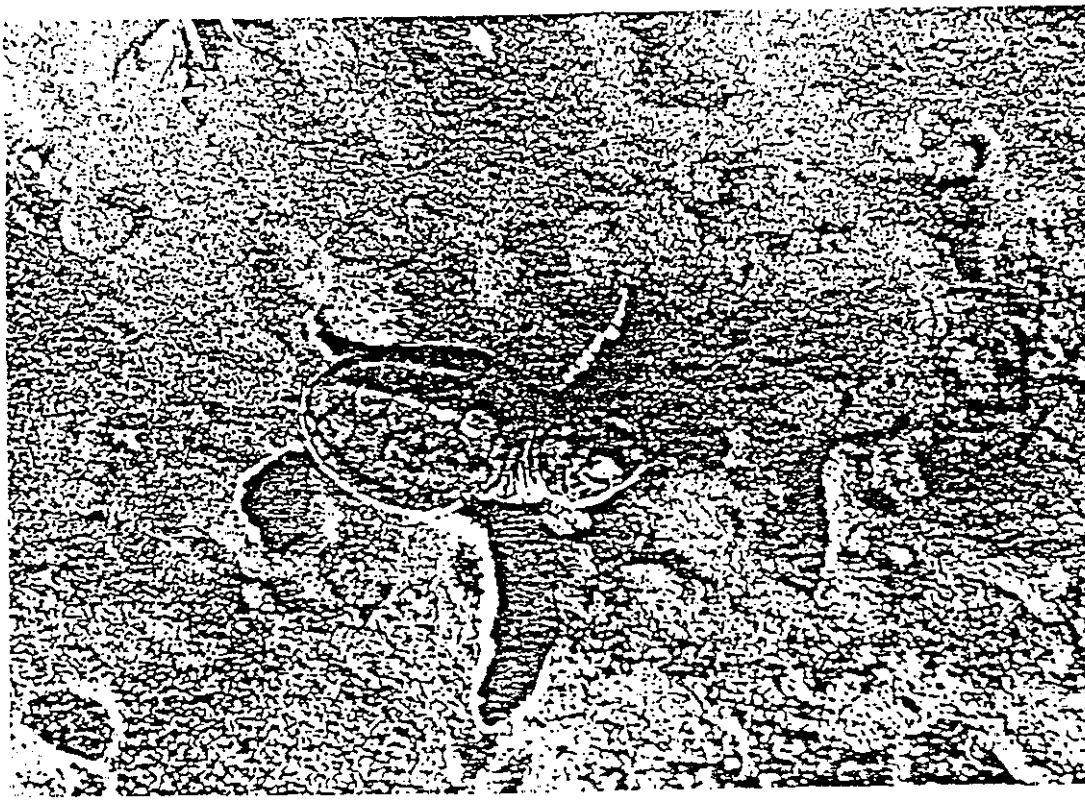
-Drowning in fishermen's nets as part of incidental catch,
-Poisoning by pollutants such as oil
-Disease

There is also the possibility that a turtle found dead along the beach may have been viciously injured by a poacher - but we have no eye-witness proof of such an occurrance.

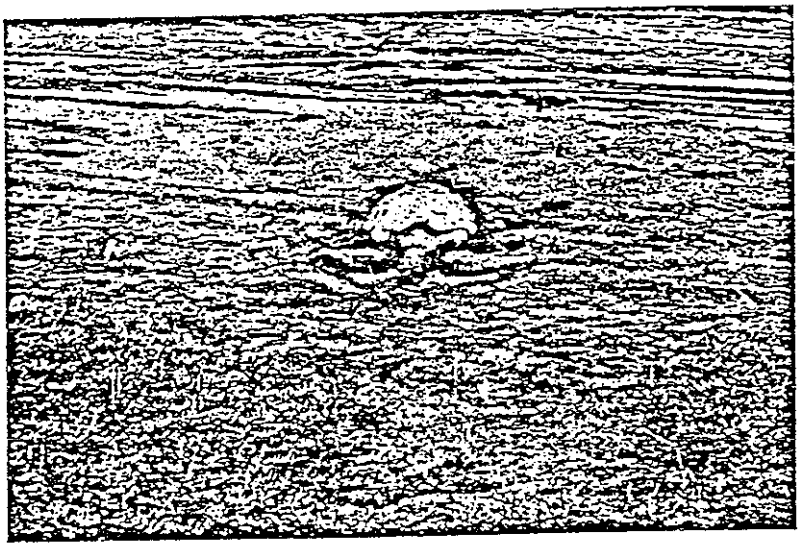
Another cause of death is the response to the false stimulus of artificial lighting from the city which causes both adults and hatchlings to orient towards the marshes and - unless found and rescued by us - certain death from dessication.



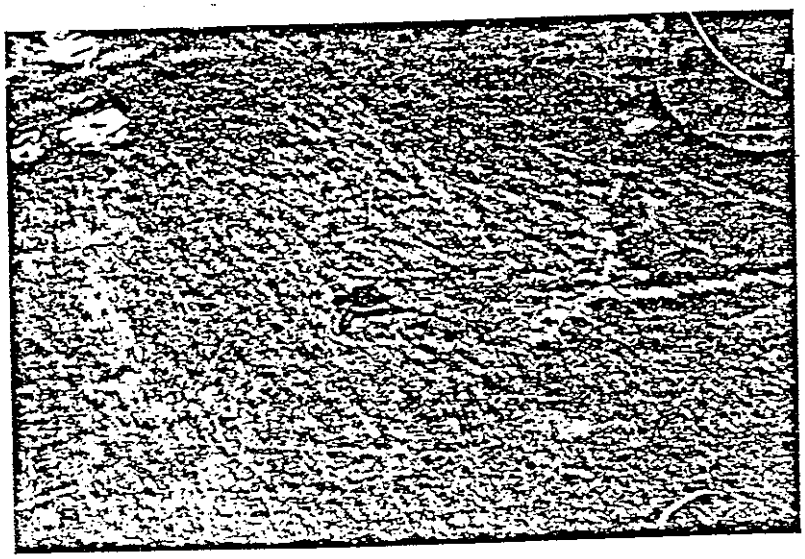
1. ADULT GREEN TURTLE (CHELONIA MYDAS)
NOTE BARNACLES ON CARAPACE PLASTRON MARGIN



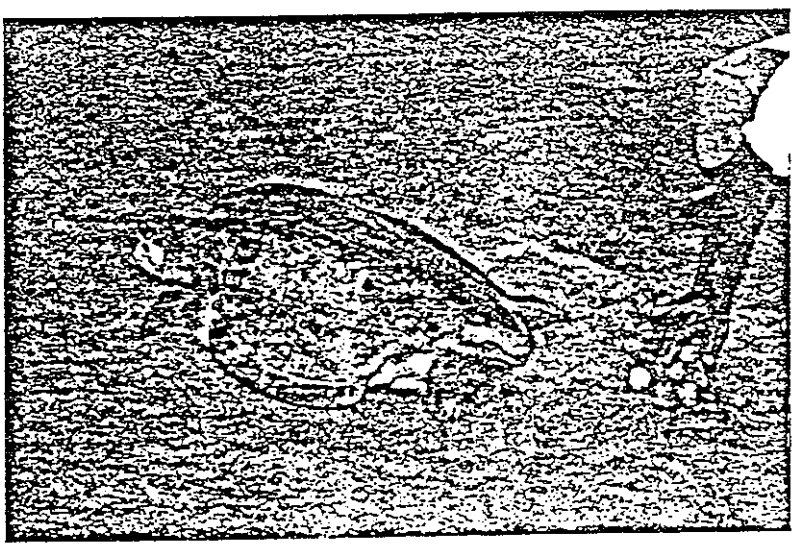
3. GREEN TURTLE TRACKS TOWARDS THE SEA



4. ADULT GREEN TURTLE STRANDED IN MARSH



6. EXCAVATING OLIVE RIDLEY EGGS FROM NEST HOLE



7. OLIVE RIDLEY (LEPIDOCHELYS OLIVACEA) AFTER LAYING. NOTE DEFORMED CARAPACE. POSSIBLY BY INJURY CAUSED BY SHARK ATTACK.

9. CHILD READY TO NAME AND RELEASE GREEN TURTLE HATCHLING

10. GREEN TURTLE BEING WEI

11. DUMBELL SHA
GREEN TURTL

SECTION - V (B)

B) RESEARCH

Distribution and Beach Selection

The results of the survey show that marine turtle (both green turtle and olive ridley) nest on most sandy coves and stretches of beach between Manora light house at the mouth of Karachi harbour, and the beginning of Sandspit beach, and along the coast up to the border of Sind - Baluchistan. The most suitable stretches of beach on Hawkesbay-Sandspit, as indicated by the greatest number of tracks and body pits, are the areas where we have constructed the protective enclosures (see map), but turtles nest along the entire 20 km. of beach as Sandspit runs into Hawkesbay. For 8 km. beyond Hakesbay, there are small sandy coves and rocky inlets. Occasional turtle (mostly Green Turtle) tracks are found along the sandy stretches, and sometimes there are body pits. Successful nesting and emergence can only take place at certain times of the year (October to February), when the sea is calm and the high tide does not submerge the entire beach.

Both Hawkesbay and Sandspit have open sandy offshore approaches and foreshores free of rock clutter. The beach platform is high enough to stay above the high tide line at all times of the year save the monsoon when it can be inundated by high tides. Vegetation is minimal, with just the occasional Ipomaea pescaprae creeper, and a few grasses in clumps.

The area behind the sand spit of 'Sandspit' is marshy and low-lying, with mangrove forest (Avicennia marina) which used to grow in profusion but has now been severely denuded by being grazed by camels and used for fodder. Turtles and hatchlings frequently lose direction and orient themselves towards the bright lights of the city of Karachi (lying north-east of the marsh) and so end up in the marsh and have to be rescued.

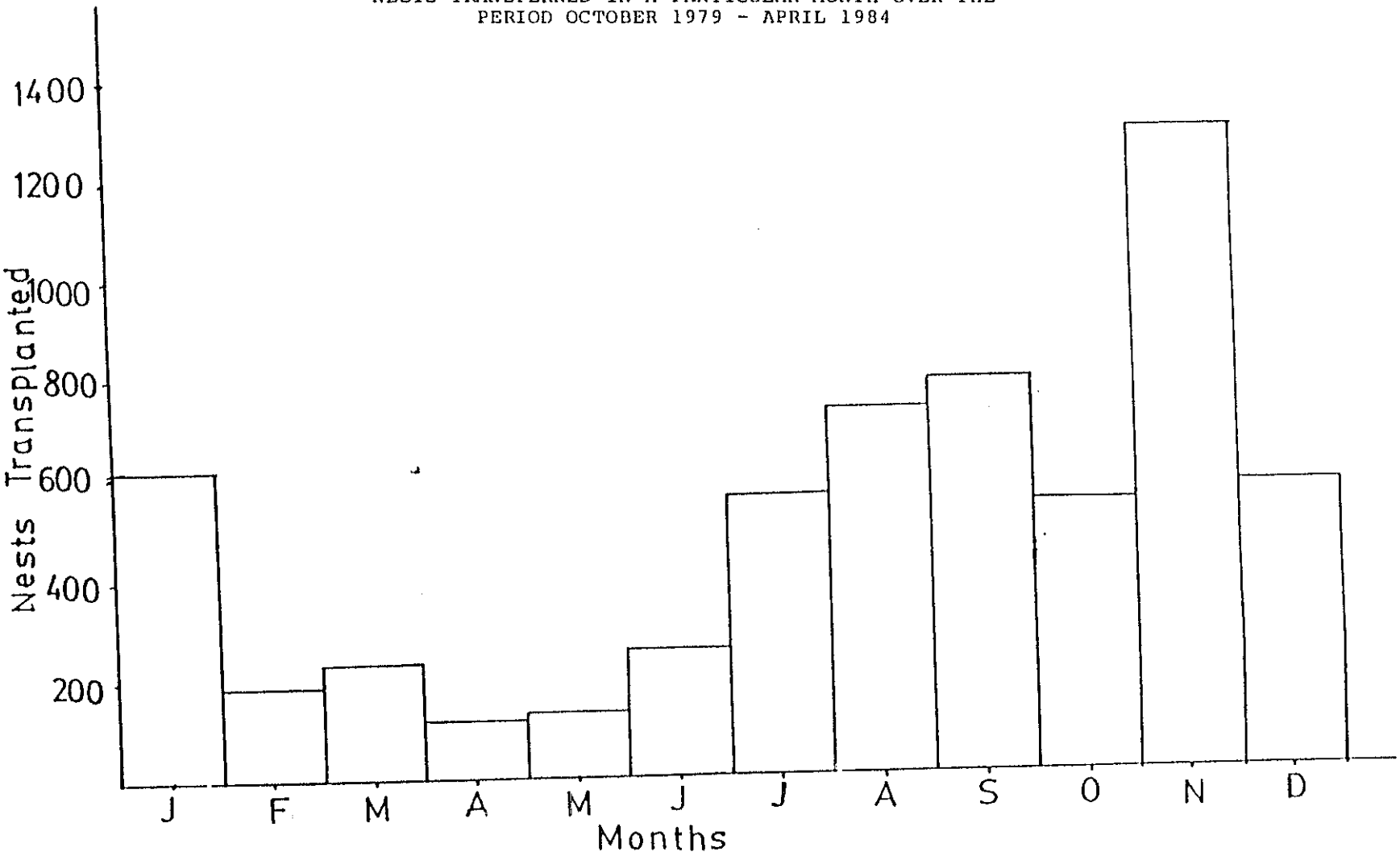
The 8 km. stretch after Hawkesbay has rocky offshore approaches, low beach platforms and in some cases, high cliffs rising behind a narrow sandy strip of beach, consequently, there are only occasional signs of nesting. The next 6 km. to Cape Monze forms a gently curving sandy bay with a sandy foreshore, sparse vegetation and a wide, gently sloping beach which stops short at the base of high cliffs. Except for the monsoon, when this beach is also almost entirely submerged, it is a favourite nesting place for both Green & Olive Ridley turtles right through the year.

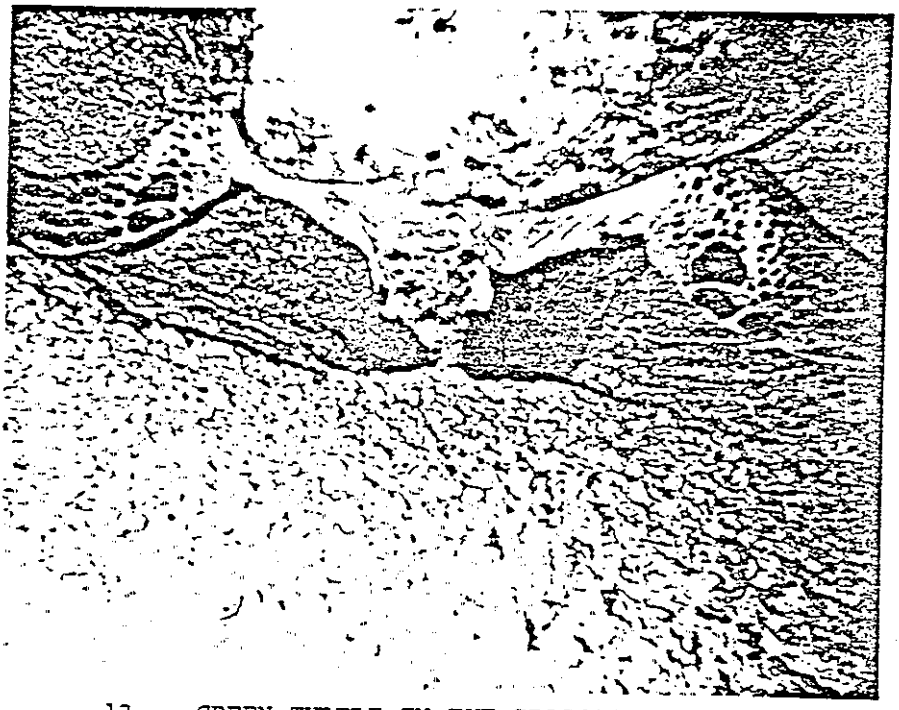
After Cape Monze, the coast again becomes rocky up to the provincial border, beyond which we have not surveyed. There are reports of turtles nesting along the Makran coast of Baluchistan, but these have not been verified by us.

Surveys by boat of the shoreline have confirmed the presence of turtles in the water in all months of the year except the monsoon. This is not to say that the turtles are not there, just that our boat is not equipped to navigate rough seas. It has not been possible to confirm the presence of Ridleys in the water at all times of the year, but Green turtles have been positively identified by divers as feeding on 'turtle grass' (Sargassum, Ulva) in the rocky coves and inlets. Sub-adult green turtles have also been caught in fishermen's nets strung out just beyond the breakers on both sandy nesting beaches and rocky outcrops

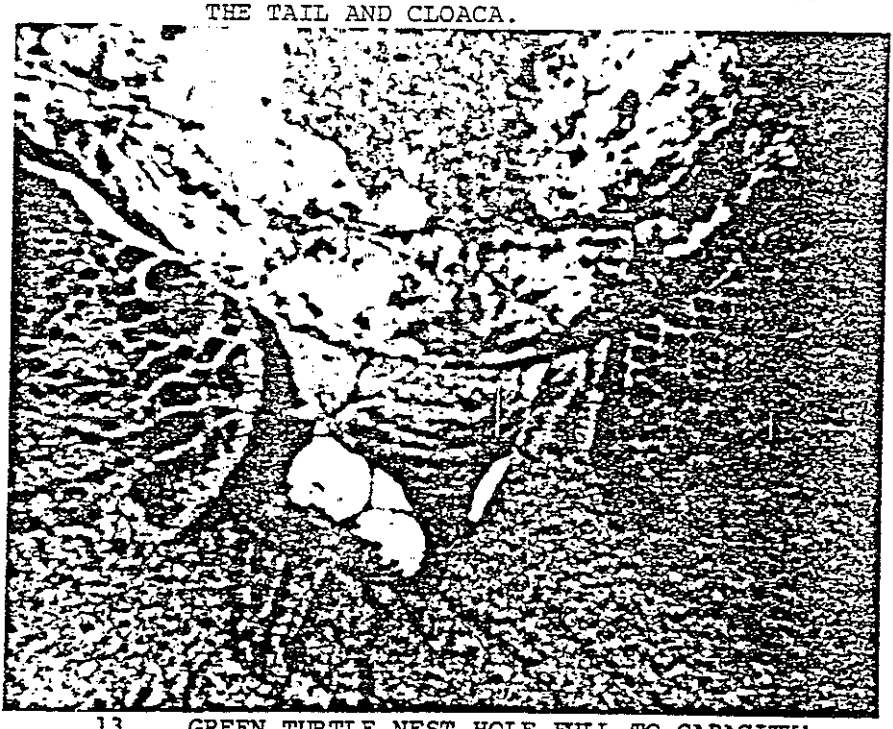
Fig.4

NESTING SEASON GREEN TURTLE (CHELONIA MYDAS)
RESULT OF TRANSPLANTATION OF NESTS INTO PROTECTED ENCLOSURES. EACH COLUMN REPRESENTS TOTAL NUMBER OF NESTS TRANSFERRED IN A PARTICULAR MONTH OVER THE PERIOD OCTOBER 1979 - APRIL 1984

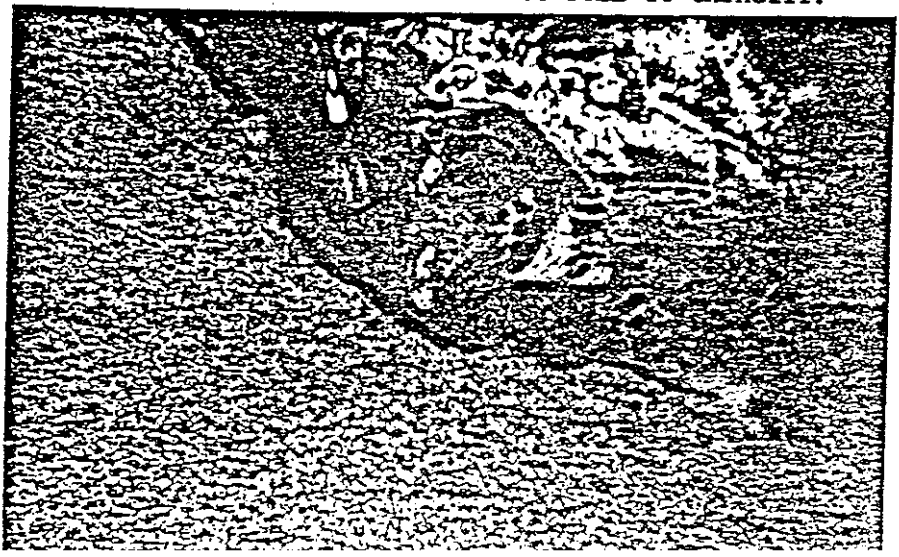


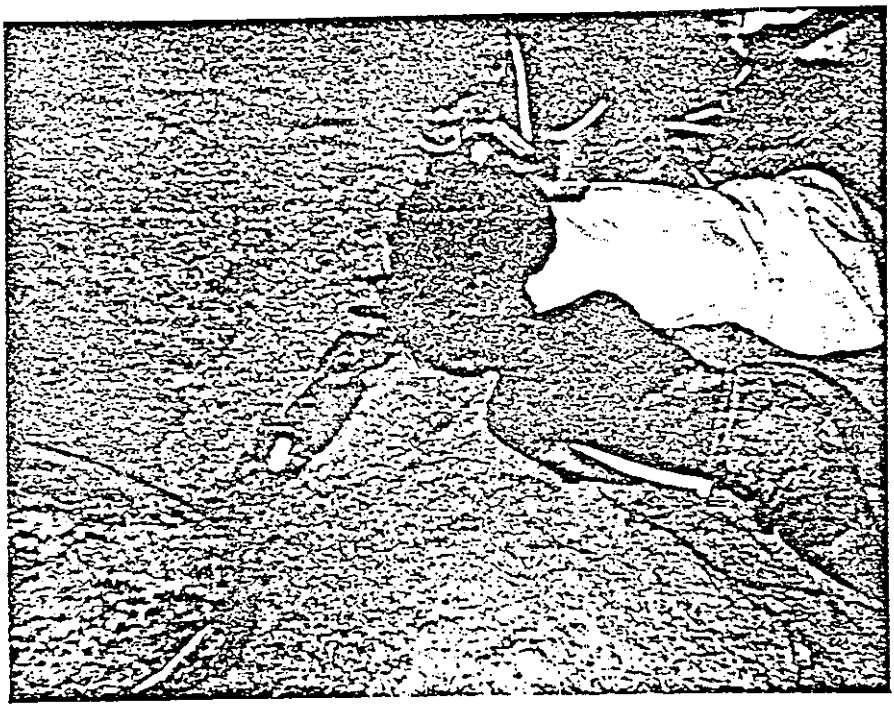


12. GREEN TURTLE IN THE PROCESS OF LAYING. HIND FLIPPERS HAVE BEEN MOVED TO EXPOSE THE TAIL AND CLOACA.



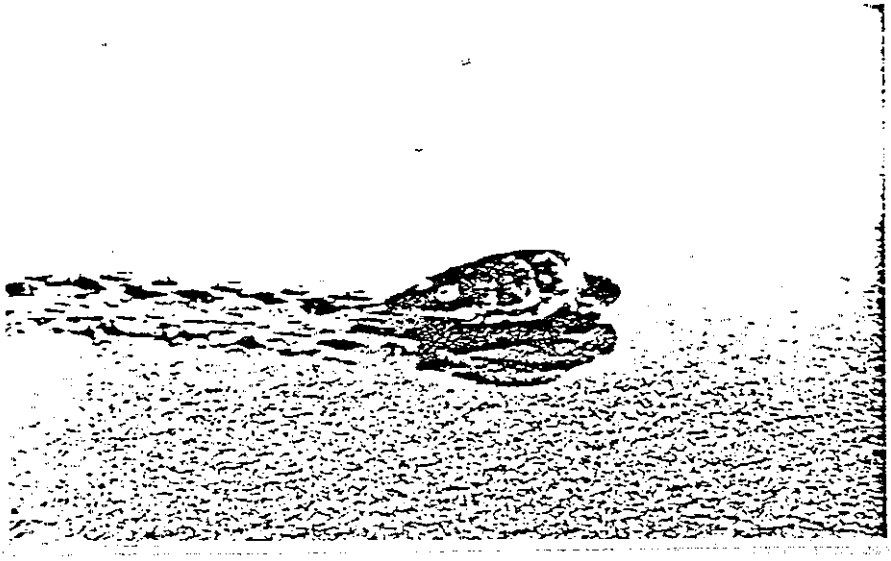
13. GREEN TURTLE NEST HOLE FULL TO CAPACITY!



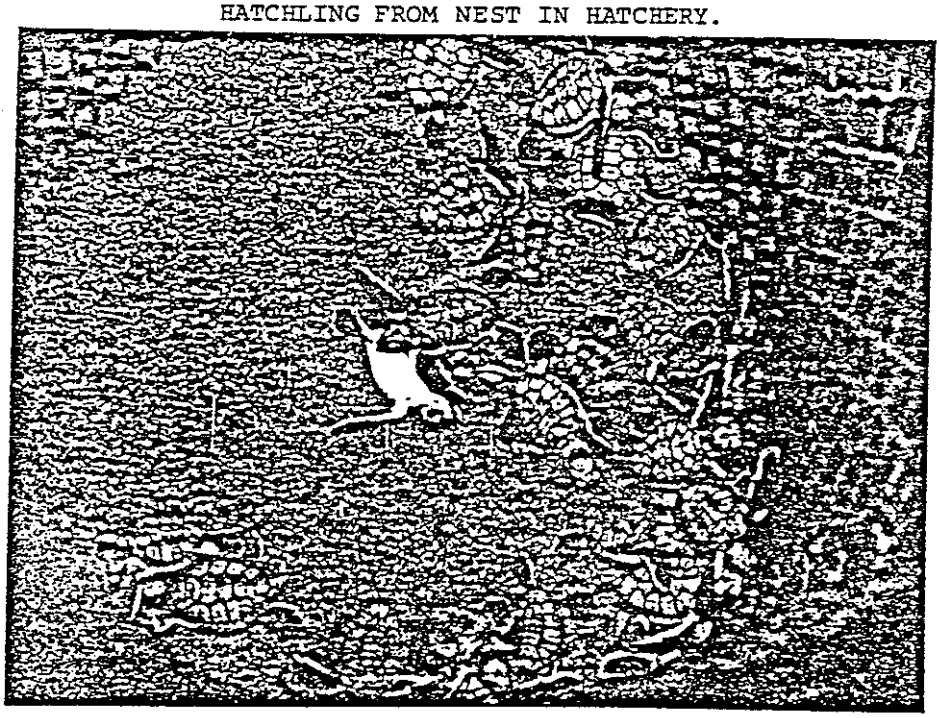


15. SCHOOLCHILDREN WATCHING A GREEN TURTLE LAY

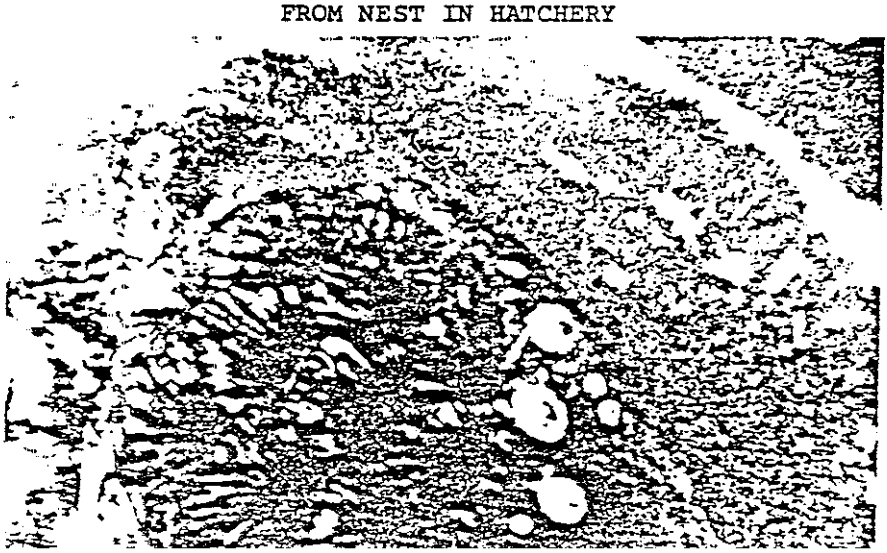
16. WATCHERS/GUARDIANS OF THE TURTLE BEACHES RESTRAINING A DOUBLE TAGGED GREEN TURTLE TO HAVE ITS PICTURE TAKEN!



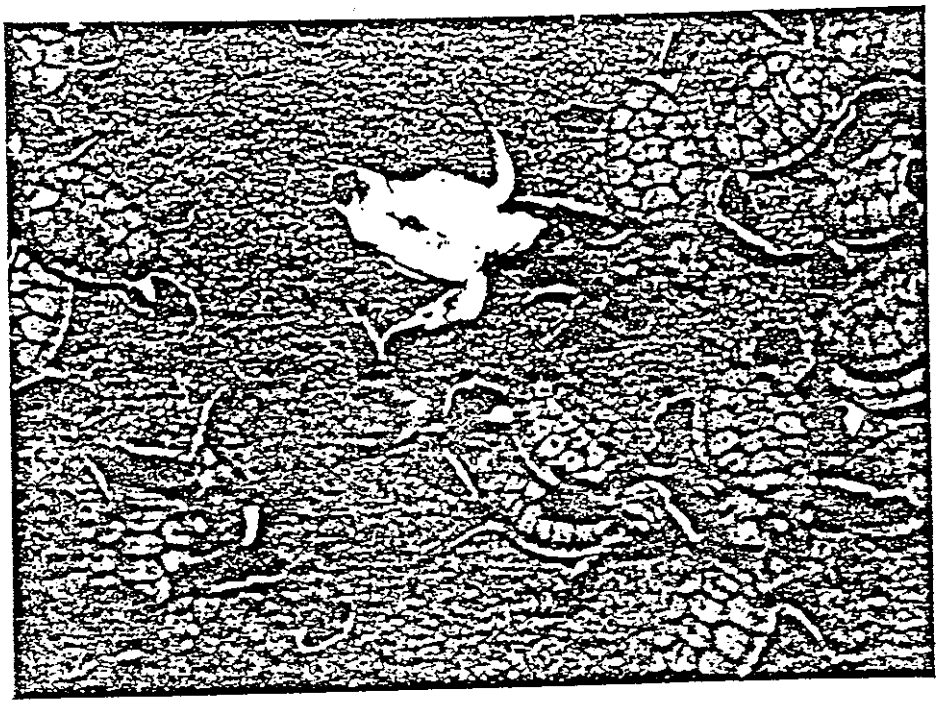
18. SCHOOLCHILDREN HOLDING NEWLY EMERGED HATCHLING FROM NEST IN HATCHERY.



19. GREEN TURTLE HATCHLINGS ON EMERGENCE FROM NEST IN HATCHERY



21. CO-INVESTIGATOR (F. FIRDOUS) WEIGHING GREEN TURTLE EGG



GREEN TURTLE HATCHLINGS ON EMERGENCE

Fig.5 HATCHING SEASON GREEN TURTLE (CHELONIA MYDAS) RESULT OF TRANSPLANTED NESTS WHICH HATCHED IN THE PROTECTED ENCLOSURES. EACH COLUMN REPRESENTS THE TOTAL NUMBER OF NESTS WHICH HATCHED IN A PARTICULAR MONTH OVER THE PERIOD OCT,1979-APR,1984

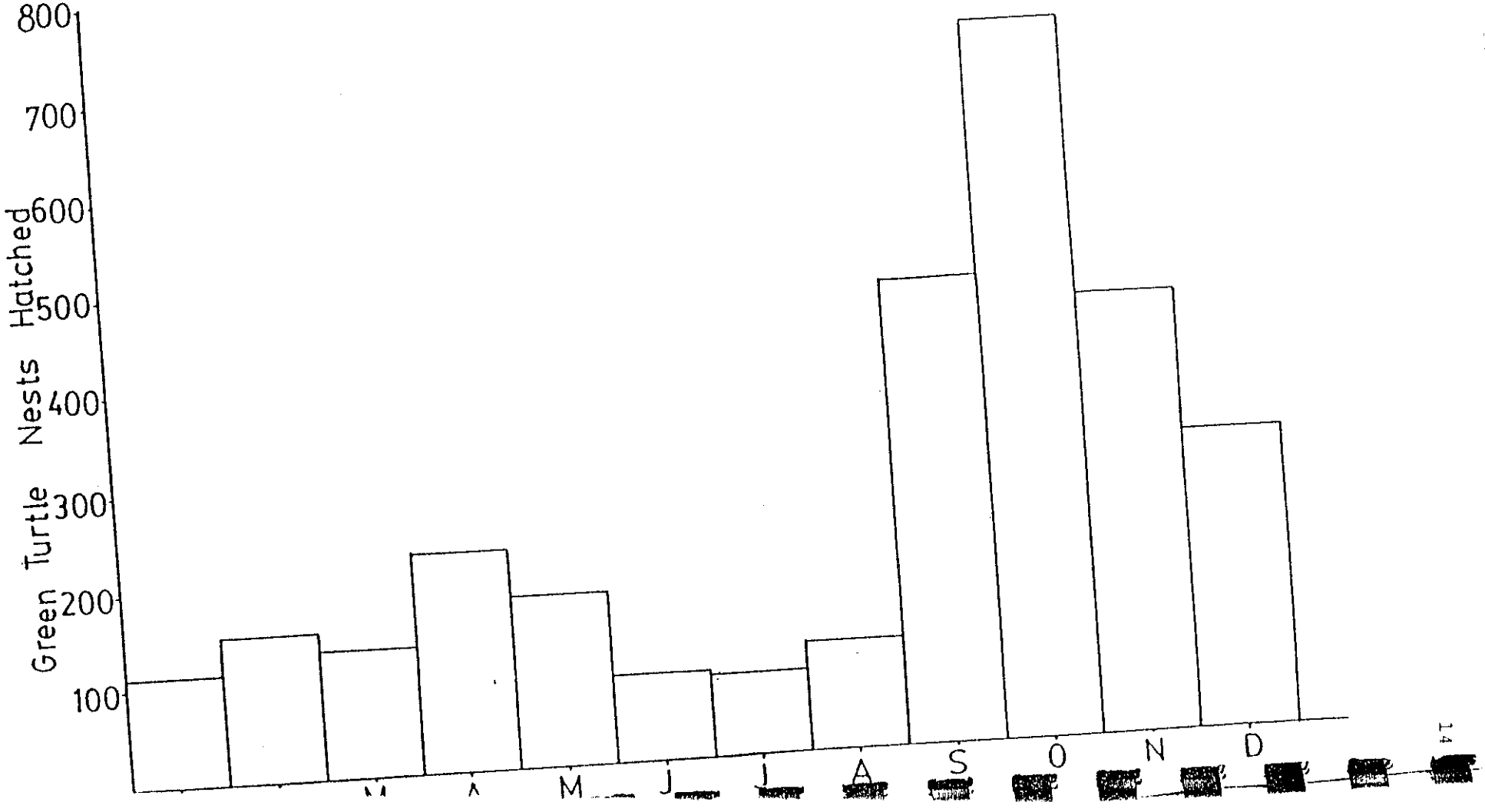


Fig.6 NESTING SEASON OLIVE RIDLEY (LEPIDOCHELYS OLIVACEA). RESULT OF TRANSPLANTATION OF NESTS IN TO PROTECTED ENCLOSURES. EACH COLUMN REPRESENTS THE TOTAL NUMBER OF NESTS TRANSFERRED IN A PARTICULAR MONTH OVER THE PERIOD OCTOBER 1979-APRIL 1984

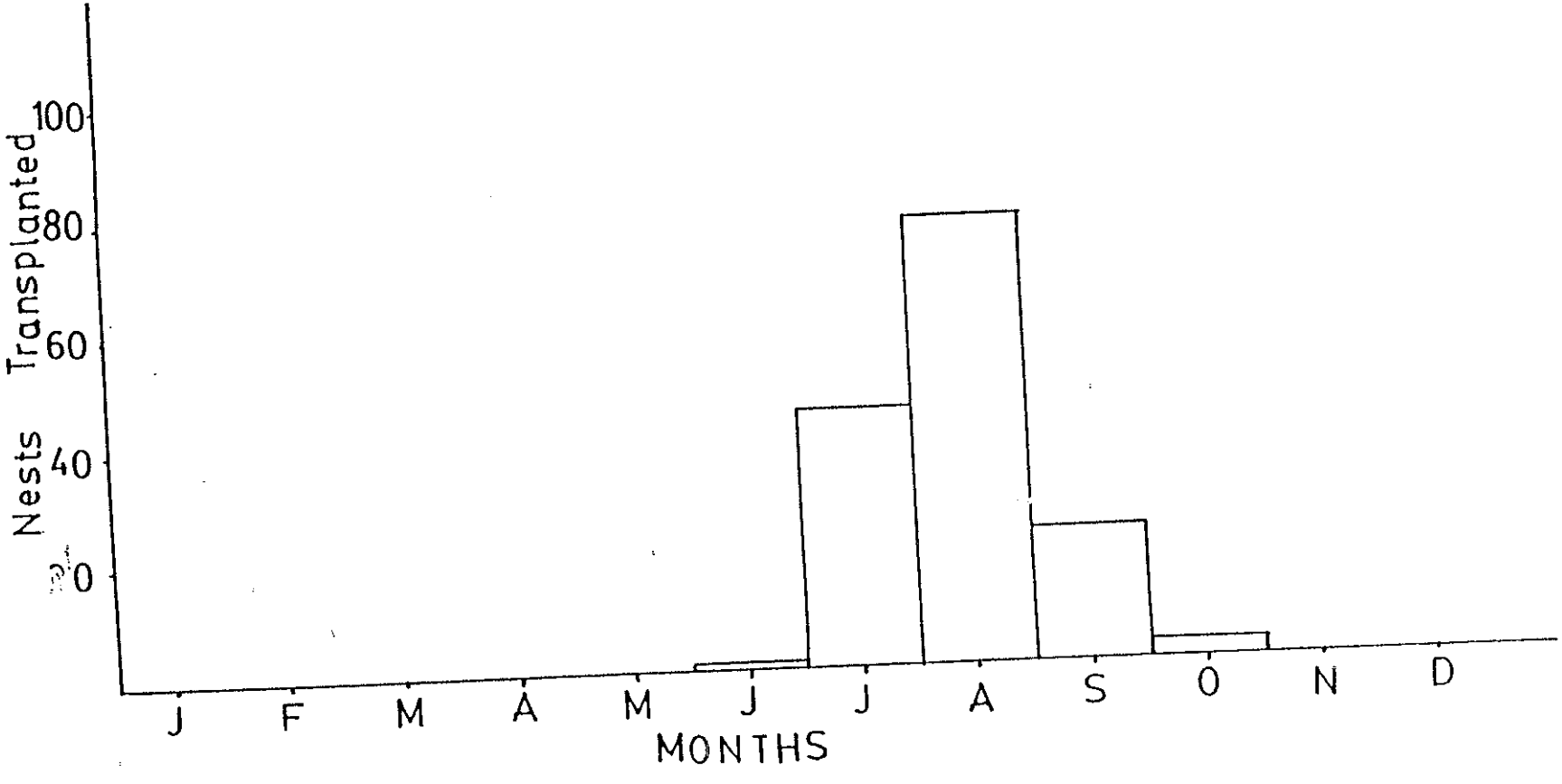
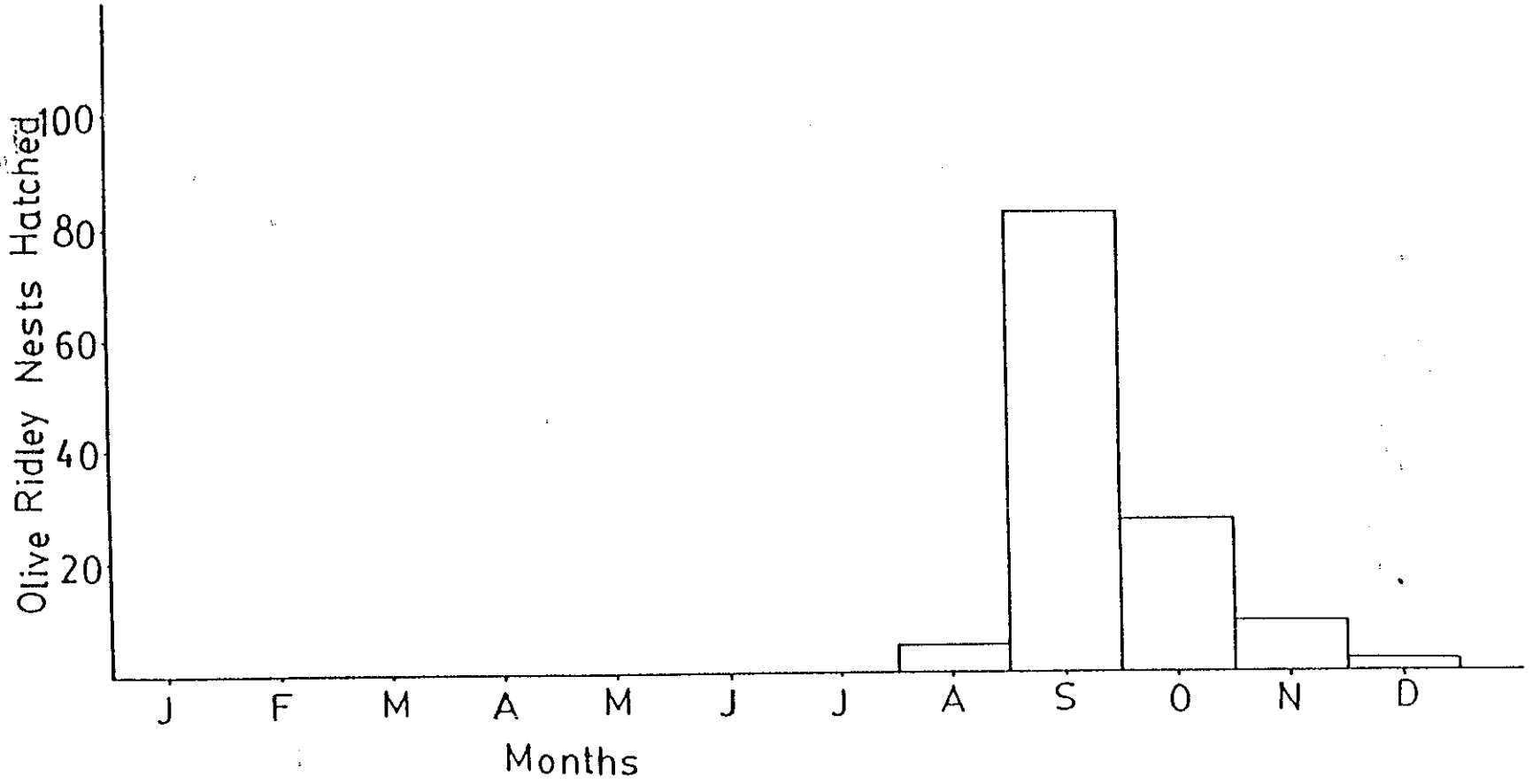


Fig.7 HATCHING SEASON OLIVE RIDLEY (LEPIDOCHELYS OLIVACEA) RESULT OF TRANSPLANTED NESTS WHICH HATCHED IN THE PROTECTED ENCLOSURES. EACH COLUMN REPRESENTS THE TOTAL NUMBER OF NESTS WHICH HATCHED IN A PARTICULAR MONTH OVER THE PERIOD OCT,1979-APR 1984



Nesting and Breeding Seasons

The results of nests transplanted and hatched over the four years period of the project are summarised for each species in the accompanying figures: 4,5,6 and 7

Green Turtle (Chelonia mydas)

Both nesting and hatching take place all through the year. The peak nesting is reached in the month of November, while peak hatching takes place in October. Although this data is obtained from nests and hatching in the protected enclosures, it corresponds with our observations of both aspects of breeding on the open beach in entirely natural conditions; i.e., that the greatest number of green turtles come up to lay in November, but since this is just before the 'winter' when high tides, rain and low temperatures are common, a great number of eggs perish. Thus it is nests/eggs laid in August, September and October which stand the greatest chance of survival as they incubate in ideal conditions of temperature and humidity, to hatch in September, October and November.

The presence of Green turtle hatching and nesting all through the year coupled with their feeding and continuous presence in coastal waters, apart from suggesting the strong possibility of a resident population, also makes the delineation of a distinct 'season', difficult. The second half of the year does however seem to be the best time for nesting and hatching.

Olive Ridley (Lepidochelys olivacea)

Unlike the Green Turtle, the Olive Ridley shows a distinct nesting season and is only seen in the waters and beaches off the coast during these months. Nesting coincides with the monsoon period, starting in June and ending post-monsoon in October. Hatching follows predictably, starting in August (for those eggs laid in June and July) and peters out in December (for the September & October nesters). Peak nesting is observed in August, while peak hatching is obtained in September.

Although the total number of live Ridleys observed is far lower than the Green Turtles, during their season, (which overlaps that of the Green Turtles), on certain nights, they outnumber the green turtles on the beach. Although the suggestion of an 'arribada' would be an exaggeration when compared to the numbers reported elsewhere, it certainly does appear that the olive ridleys display the same pattern of concentrated nesting on certain nights.

Description, Size, Weight & Colour

Description:

The Green Turtle (Chelonia mydas) adults and hatchlings are easily distinguishable by the four costal scutes on either side of the carapace, and the one claw on each front flipper. A closer look reveals the classic arrangement of prefrontals on the upper surface of the head.

The Olive Ridley (Lepidochelys olivacea) is in turn easily distinguishable from the green turtle, by its smaller size, five to six costal scutes and two claws on each front flipper. The arrangement of prefrontals on the upper surface of the head also follows the pattern described by Rebel (1974).

Size and Weight:

The sizes and weights of adults, sub-adults, juveniles and hatchlings green and olive ridley turtles are summarised in

couple of instances dead male green turtles have been found, but in such a state of decomposition as to make accurate measuring impossible.

In contrast to Hirth's (1971) observations, we found Green Turtle females laying at a carapace length below 80 cm and so classified them as adult. The mean carapace length (rounded out to the nearest figure) for egg laying Green turtle females was found to be 100 cm (O.C.), while for the Olive Ridley it worked out to 70 cm (O.C.). It is possible that the turtles of a size less than the mean were first time nesters, and in the case of the Green turtle, those below 80 cm (if Hirth (1971) is correct) were definitely so. However, it is difficult to be certain until such time as more data on the correlation of turtle growth and maturity with nesting becomes available

SIZE	GREEN TURTLE (Chelonia mydas)				
	Size of Sample	Length (cm) Average	Length (cm) Range	Breadth (cm) Average	Breadth (cm) Range
Adult (O.C.)	N= 198 animals	99.95	85.00-122.50	87.22	80.00-106.00
Adult (S.L.)	N= 166 animals	92.99	63.00-107.50	71.80	54.00-97.50
Juvenile (O.C.) & Sub-Adults	N= 5 animals	38.12	32.00-56.25	34.00	29.00-48.00
Hatchling (O.C.)	N= 82 animals (Taken at random (from different (nests	5.75	4.50-6.50	4.94	4.00-5.70
Egg (Circumference)	N= 72 Eggs (Taken at random (from different (clutches	15.22	13.00-16.50		
(Diameter)		4.84	4.14-5.25		

O.C. = 'Over the Curve' i.e. All measurements taken over the curved carapace using a tape measure.

S.L. = 'Straight Line' i.e. All measurements taken over the curved carapace using a caliper.

WEIGHT	GREEN TURTLE (Chelonia mydas)		
	Size of Sample	Weight (kg) Average	Weight (kg) Range
Adult	N=5	117.90	83.25 - 135.00
Juvenile	N=1	3.00	-
Hatchling	N=82	0.027	0.018----0.031
Egg	N=72	0.053	0.034----0.070

Table 1
=======

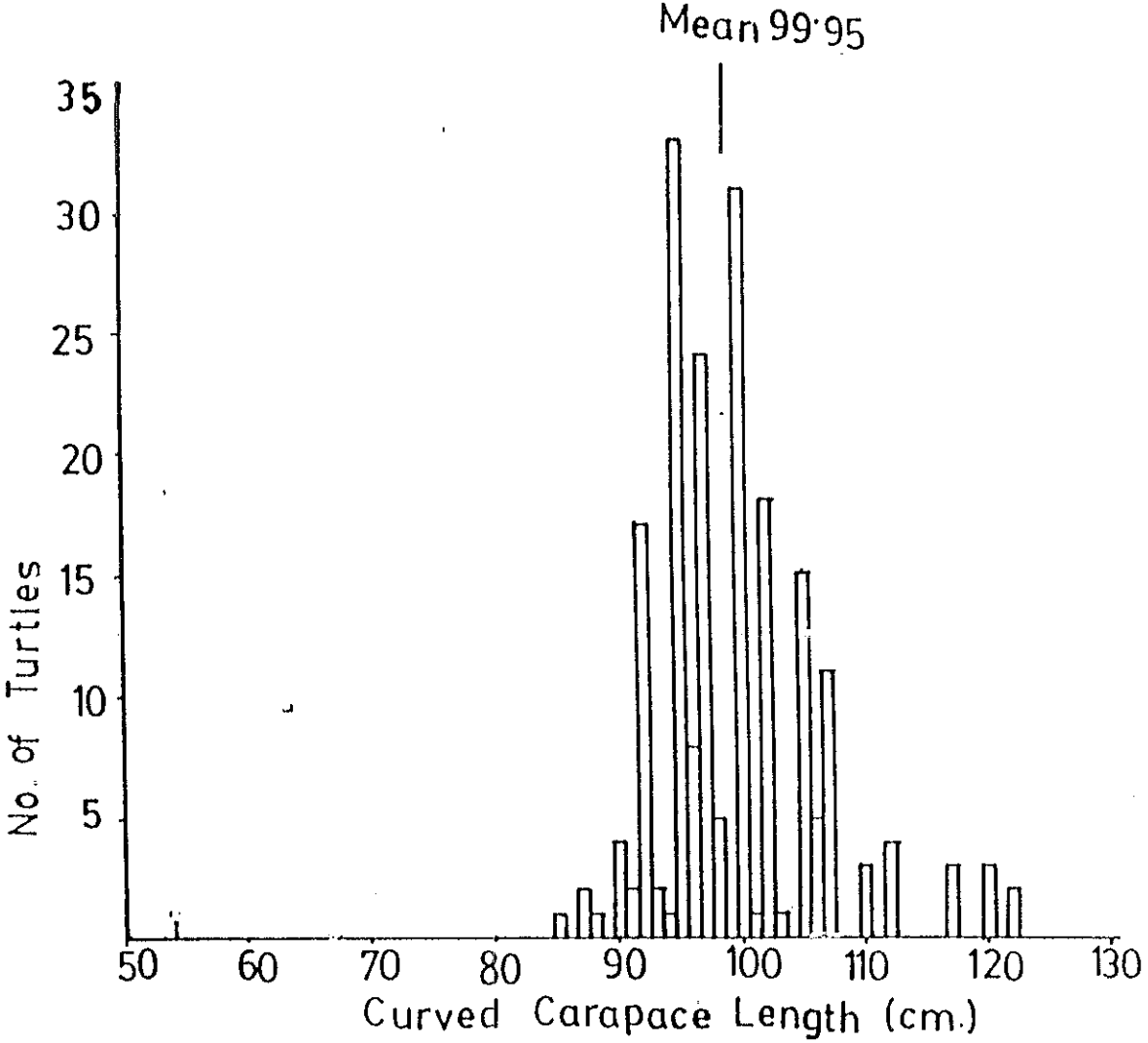


Fig. 8 SIZE (CURVED CARAPACE LENGTH) OF A SAMPLE OF GREEN TURTLES (CHELONIA MYDAS)

SIZE OLIVE RIDLEY (Lepidochelys olivacea)

	Size of Sample	Length (cm) Average	Length (cm) Range	Breadth (cm) Average	Breadth (cm) Range
Adult (O.C.)	N= 5 animals	69.70	52.50-80.00	70.20	55.00-82.50
Adult (S.L.)	N= 2 animals	65.00	60.00-70.00	63.50	60.00-67.00
Hatchlings (O.C.)	N=11 animals (Taken at random (from different nests	4.20	4.00-4.40	4.00	3.90-4.20
Egg (Circumference)	N=15 (random sampling)	12.90	12.50-13.00		
(Diameter)		4.10	3.98-4.14		

WEIGHT OLIVE RIDLEY (Lepidochelys olivacea)

	Size of Sample	Weight (kg) Average	Weight (kg) Range
Hatchling	N= 11	0.016	0.015 - 0.017
Egg	N= 15	0.036	0.030 - 0.040

Table 2

Colour:

The carapace colour of adult green turtles has been found to be a uniformly dark green with occasional blotches of olive and dark brown. The plastron is usually a creamy to yellowish white. Juveniles, sub-adults and hatchlings have a lighter more vibrant shade of green for the carapace and a cleaner, more pearly-white plastron.

The adult olive ridley has a dark, almost black carapace, with a chalky-white plastron. The hatchlings are grey, almost black dorsally when wet, with a yellow-white plastron.

On one occasion a creamy white (albino) green turtle hatchling was found.

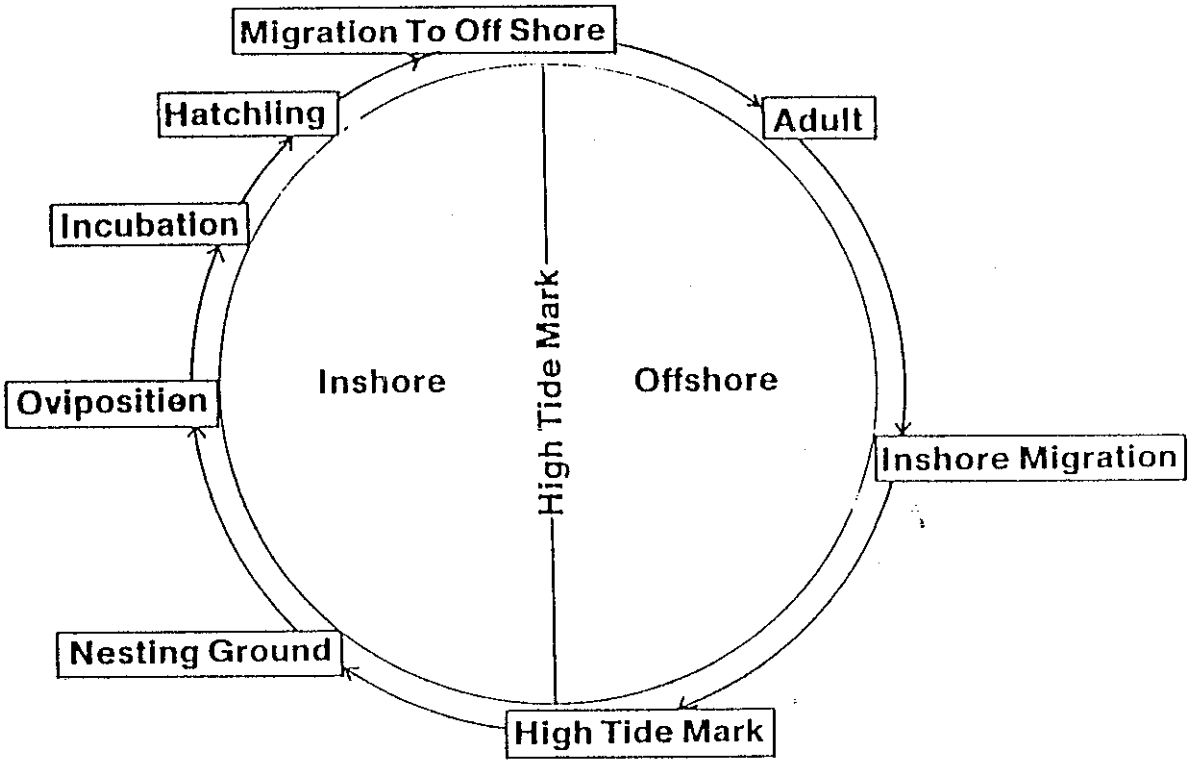
Food and Feeding

Turtles found washed up dead along our beaches have been dissected and the stomach contents examined to determine food sources. Seaweeds along the rocky parts of the shore line and washed up on to the sandy beaches have also been collected and identified. A list of our findings is given below:

Food contents of gut (Dissection of dead turtles)

1) Phytoplankton
   a) Dinophysis miles
   b) Dinophysis sp.
   c) Centroceros sp.
2) Helminths (only developmental stages of some species)
3) Molluscan shells (Broken condition)
4) Crabs (Broken pieces)
5) Red algae (Found in mouth)

Fig. 9 **THE LIFE CYCLE OF SEA TURTLES**



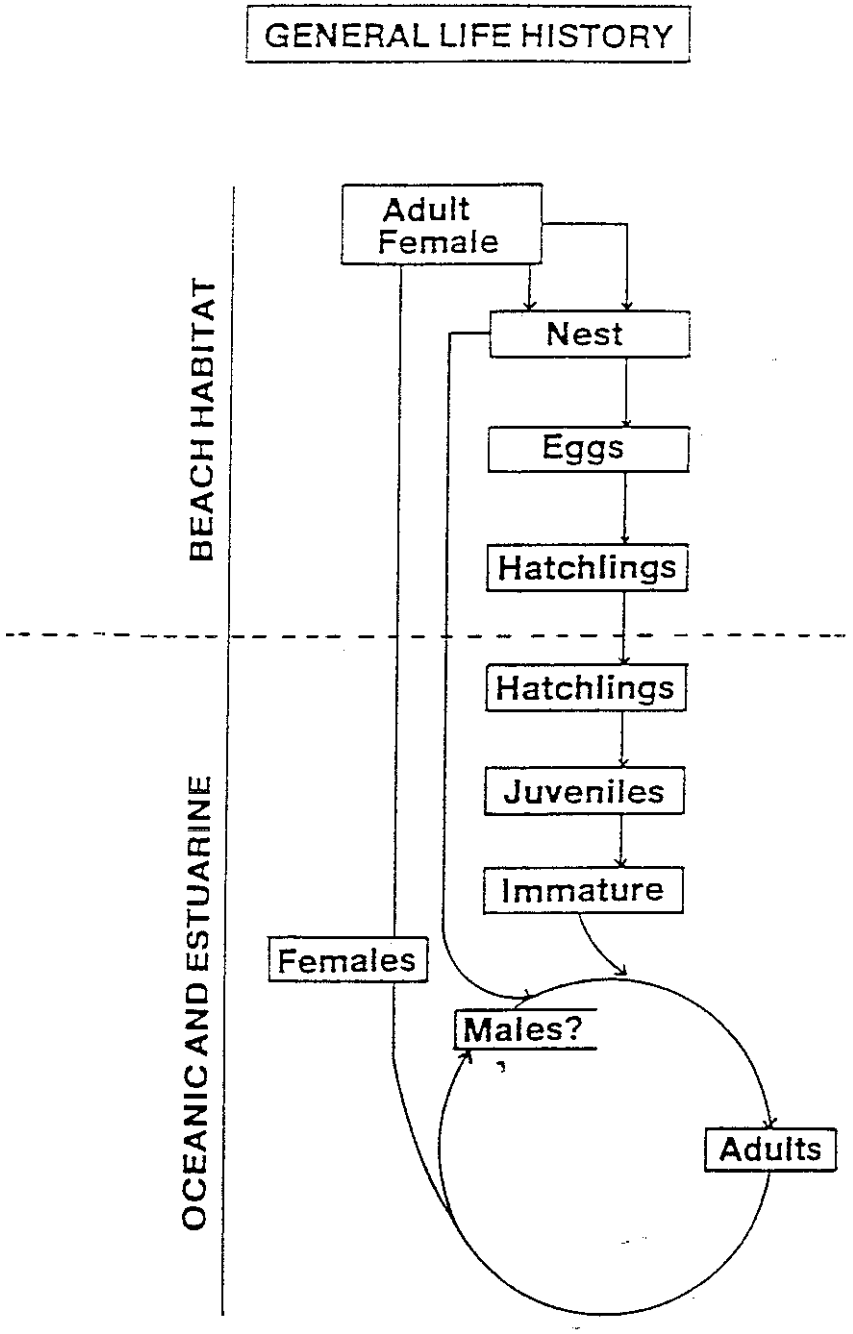


Fig.10

Ref: NOAA Technical Memorandum NMFS—SEFC—117
"Synopses of Data on the impact of Habitat Alteration on Sea Turtles Around the South eastern United States."

'Turtle food' found along the rocky coves and beaches of Hawkesbay and Sandspit.

1) Caulerpa (Green algae)
2) Sargassum (Brown algae)
3) Gracilaria (Red algae)
4) Geliduim (Red algae)
5) Crustacea
6) Sponges
7) Jellyfish
8) Molluscs

We also have eyewitness reports from divers that they have actually seen (and heard the crunching of) green turtles grazing on seaweed off rocks. Such reports coupled with the evidence of gut contents strongly suggest that suitable feeding grounds exist along our shoreline and that the green turtle population at any rate, is resident.

Mating

No mating activity has been observed with any degree of accuracy. However, it has been possible to observe turtles in the water just beyond the breakers, with binoculars, and from their positions and behaviour, there are indications that mating does take place off the Hawkesbay -Sandspit beach.

LIFE CYCLE OF THE MARINE TURTLE

Nesting:

The nesting behaviour of the green turtle can be divided into eleven stages (Carr and Ogren, 1960);

1) Stranding, testing of stranding site, and emergence from wave wash,
2) Selecting of course and crawling from surf to nest site,
3) Selecting of nest site,
4) Clearing of nest premises,
5) Excavating of body pit,
6) Excavating of nest hole,
7) Oviposition,
8) Filling, covering and packing of nest hole,
9) Filling of body pit and concealing of site of nesting.
10) Selecting of course and locomotion back to sea,
11) Re-entering of wave wash and traversal of the surf.

Our observations confirm the same sequence, which can take anywhere from three to five hours to complete. Emergence from the wave wash is always after dark, and in most cases coincides with the high tide. During the peak season, turtles are seen nesting on the beach as early as 8 pm, for the rest of the year however the hours between 10 pm and 2 am are usually favoured. In winter (December, January) the occasional turtle emerges in the hours just before sunrise (6 am to 7 am) and can be found continuing its attempt to nest on the beach well after sunrise, in broad daylight at 11 am. Although it has been reported we have never seen turtles actually laying eggs in daylight, but whether this is because they were disturbed by our clearly visible presence, or because the nest sites were themselves unsuitable (although those same sites are used successfully by other Green turtles throughout the year) is a matter for speculation. Dessication of the adult turtles is not such a problem during these months, [illegible] low and the sand moist due to fairly high

After selection of the nest site, the turtle scoops out the body pit using front and back flippers vigorously. The pit, which is roughly ovoid in shape, can be from 30 cm to 60 cm deep, and can take (with occasional pauses to rest) an hour or more to dig. A clear discharge from the eyes ('turtles tears') is seen to fulfil its probable function of keeping the eyes clear of sand and osmoregulation. Once excavation of the body pit is complete, the front flippers rest, and the back ones work alternately at digging out the nest hole. This assumes a round cylindrical shape, wider at the bottom, as deep as the back flipper is long, (about 45 cm). The flippers scoop out sand and simultaneously smooth out the walls of the egg chamber. The eggs are then dropped into the nest hole through the cloaca. Once laying is over, the nest hole and body pit are filled, again by the vigorous throwing back of sand by both sets of flippers. This action of sand being thrown back over the nest, moves the turtle forward, so that, by the time she is finished, and ready to return to the sea, she has actually excavated a depression in front of the original body pit, which is now completely full and shows no evidence of nesting. The false pit at a distance from the actual nest hole acts as camoflague, and may be an evolutionary survival adaptation.

The female turtle makes her way back to the sea, once nesting is complete. The head is raised occasionally as if 'smelling' the sea and sighting the horizon, and provided she is headed in the right direction, she reaches the sea, carving out the characteristic deep track, breathing deeply and with many seemingly tired, pauses. If however, she responds to the bright lights of the city of Karachi reflected in the water of the marshes, she orients over the spit and into the marsh, where, if not found by us in time and dragged out, certain death occurs.

Many nesting attempts are abandoned due to obvious factors such as disturbance, dogs, or encountering cement blocks and stones which form the foundations of beach huts, below the surface of the sand. In other instances, no obvious factor presents itself, and one must assume the unsuitability of nest site is due to the wrong sand particle size, humidity and similar reasons.

The females are most easily put off by disturbance at emergence from the water and ascending the beach. They are also very easily scared away at the beginning of nesting when the body pit is being dug. Once the nest hole is excavated and laying begins, they seem generally immune to torch light, noise, etc. In some cases however the turtle will be scared off even after the nest hole is ready, and at such times the eggs are dropped during her trek down to the sea, sometimes at the water's edge.

Some stages in the nesting sequence appear to be 'programmed' in a rigidly instinctive way. We have observed that when the female is moved forward and out of the main body pit, so that her eggs may be removed from the nest hole for transference to the hatchery, she continues her motions of throwing back sand with both sets of flippers as if she were still filling the body pit.

The sequence of nesting in the Olive Ridley is similar to that described by Zwinenberg (1976) and we have observed a marked difference between the very 'shy' Green Turtles and the far more 'daring' Olive Ridleys. The Ridleys do not seem to be as bothered by lights, dogs etc. and on one occasion, while we concentrated on the nesting of a Green Turtle, an Olive Ridley came up behind the principal investigator, who was on the edge of a Green Turtle nest hole, pushed her with the combined strength of moving turtle shell and flipper so that she practically fell into the nest, and seemingly totally oblivious to the commotion caused, went about digging her nest, hardly a foot away from the Green Turtle, and surrounded by excited observers!

The Olive Ridley has always been found nesting after dark, from 8 pm to the hours before sunrise, 4-5 am in summer. The nesting process can take anything from one to three hours and is therefore much shorter than that for a green turtle. The most obvious distinguishing feature of Olive Ridley nesting is the behaviour after laying is complete; that of pounding down the sand over the nest with side to side and up and down movements of the plastron. Nesting attempts are not so easily abandoned by disturbance, although the other 'natural' factors that influence nesting choices for turtles, affect the Olive Ridley.

Other features of nesting are similar to the green turtle except that the entire process is much quicker and far less 'thorough'. The body pit is also much shallower, about 15 cm, and the nest hole is as deep as the length of the rear flippers, about 40 cm. During laying, the turtle breathes heavily, sheds tears and occasionally raises her head with a great sigh. Covering up is carried out in an almost perfunctory manner when compared to the green turtle, and the olive ridley then moves towards the sea much more quickly, (provided it too, does not falsely orient towards the marsh) suggesting that its far less tedious laying process has left it greater reserves of energy - possibly of greater value in escaping predators, although the faster process of nesting leaves more vulnerable progeny.

Eggs:

Green turtle eggs are round and white and are dropped into the nest hole singly or in groups of two and three. They are covered with mucous which drips out over and after them. The actual process of laying takes around 15 min. On occasion, we have observed a hind flipper, after having scooped out the nest hole, being pressed against the wall of the hole, with the edge curved slightly upwards. When the eggs drop out of the cloaca, they fall first on the flipper, and then roll gently off into the hole. Eggs weigh an average of 53 gm (range 34 gms - 70 gms) each and have an average diameter of 48 mm (range 41.4 mm - 52.5 mm). Most eggs on laying are uniformly round and the shells firm and flexible enough to allow slight indentations without breaking. Sometimes however the shells are very soft and thin, and split open on contact, presumably indicating inadequate calcification. The occasional miniature and dumbell shaped egg is also observed in a clutch and these only contain albumin, never yolk.

Our observations confirm those of Blanck and Sawyer (1981) that early embryonic development is 'indicated by the appearance of a white circle which enlarges during incubation until the egg is entirely white'. Only fertile eggs are found to have this ring, infertile eggs remain a creamy beige colour. We have found that fertile eggs develop harder shells and are a bright chalky white colour, while infertile eggs remain the creamy beige colour with softer shells.

The average number of eggs per clutch observed for the green turtle over four years (for all months of the year) is 88 (range 9-173). The distribution of the number of eggs/nest is given in Fig. for one month, August, in the season of 1982 when the mean shifts to 95, reflective of larger clutches in optimum conditions.

Not all eggs in a clutch gestate successfully. The possible reasons for failure are discussed in the section on Hatching Success. It is clear from other studies that even in natural conditions, not all eggs in a clutch hatch, and that a number of natural features such as infertility, or temperature, humidity, pollution, internest predators (crabs, lizards), and microbial contamination all cause arrested development and subsequent mortality.

Fig.11

DISTRIBUTION OF THE NUMBER OF EGGS OF GREEN TURTLE (CHELONIA MYDAS) LAID PER NEST IN AUGUST 1982 (PEAK MONTH OF THE SEASON)

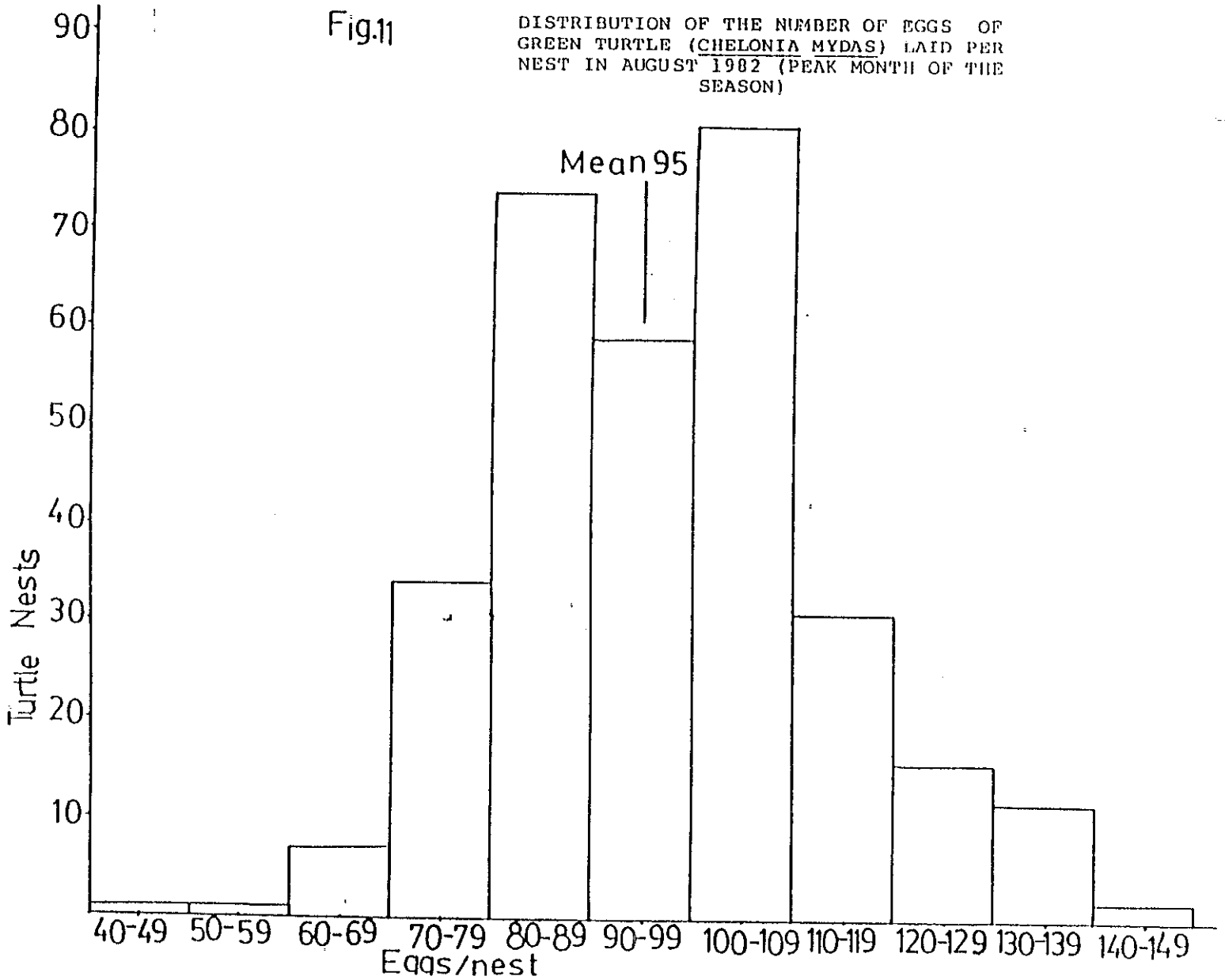


Fig.12 DISTRIBUTION OF THE NUMBER OF EGGS OF OLIVE RIDLEY (LEPIDOCHELYS OLIVACEA) LAID PER NEST IN AUGUST 1982 (PEAK MONTH OF THE SEASON

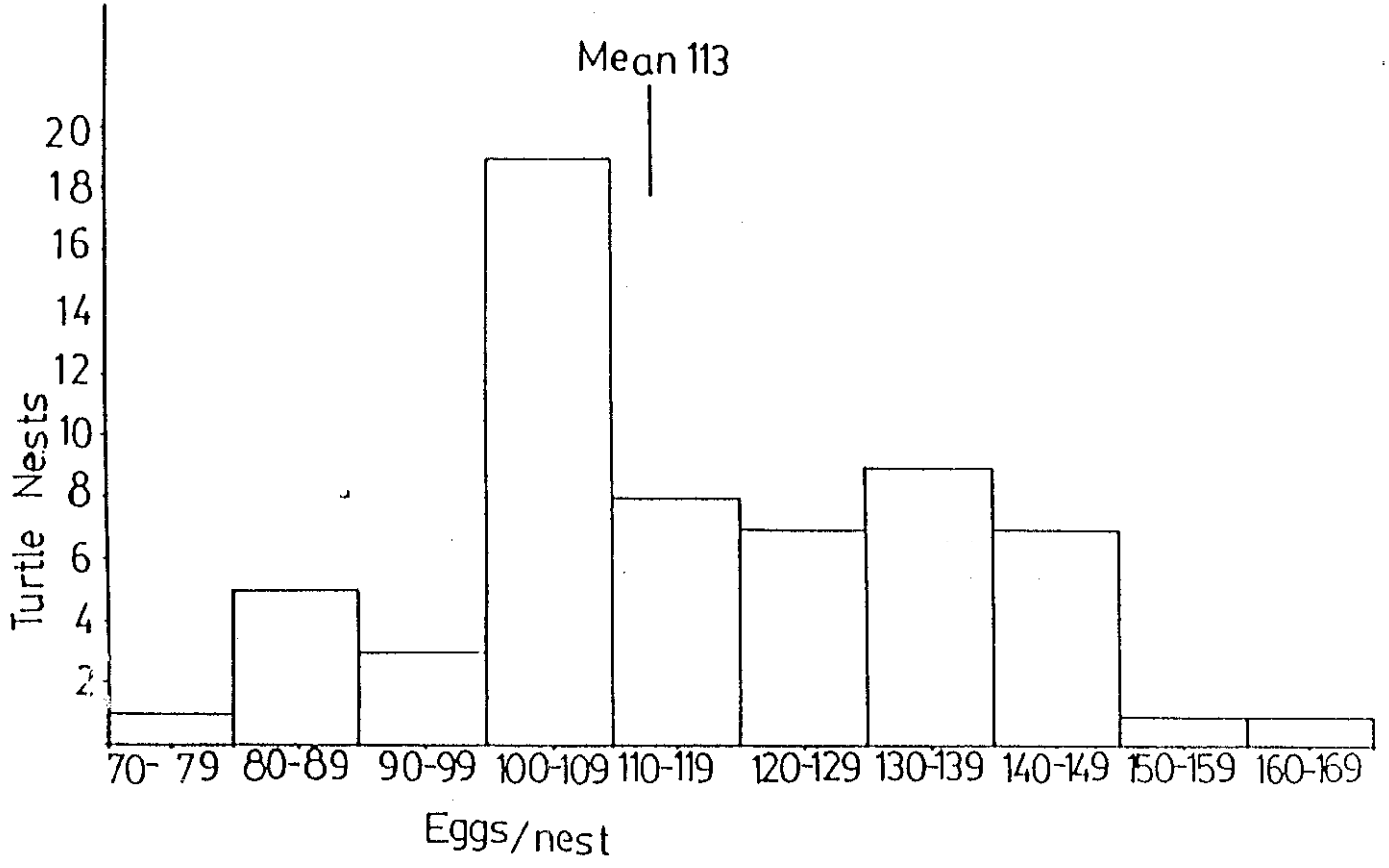


Fig.13 AVERAGE INCUBATION PERIOD OF GREEN TURTLE (CHELONIA MYDAS) EGGS TRANSPLANTED FROM OCTOBER, 1979 - APRIL, 1984.

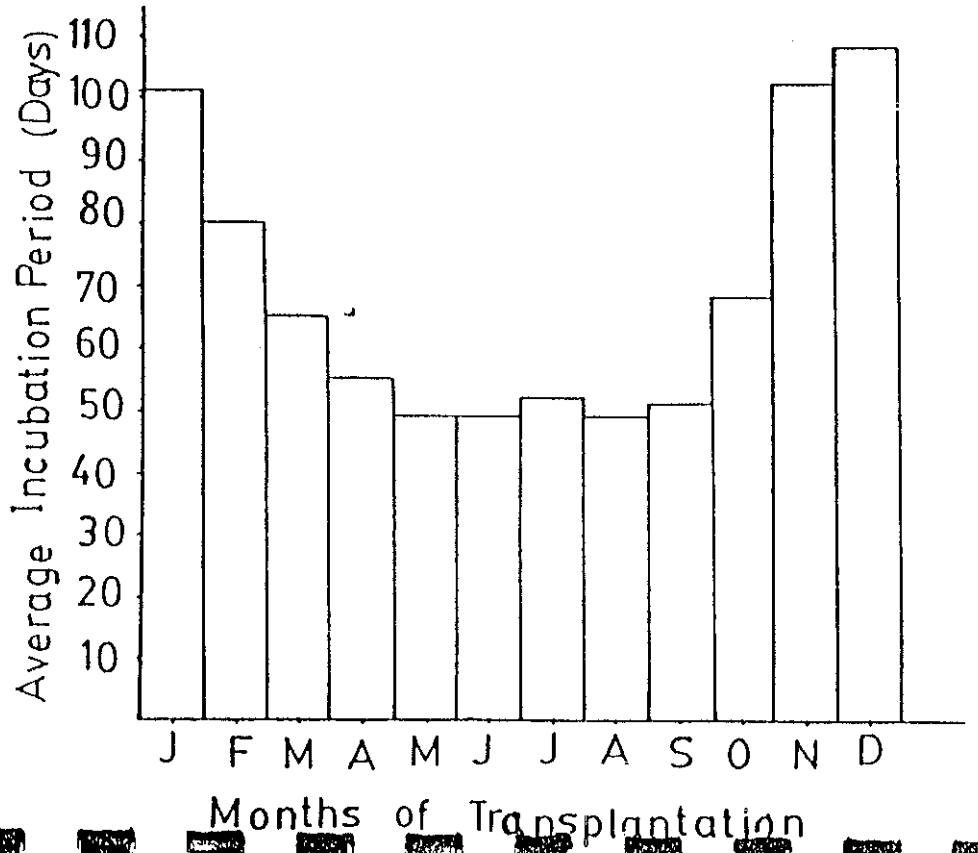
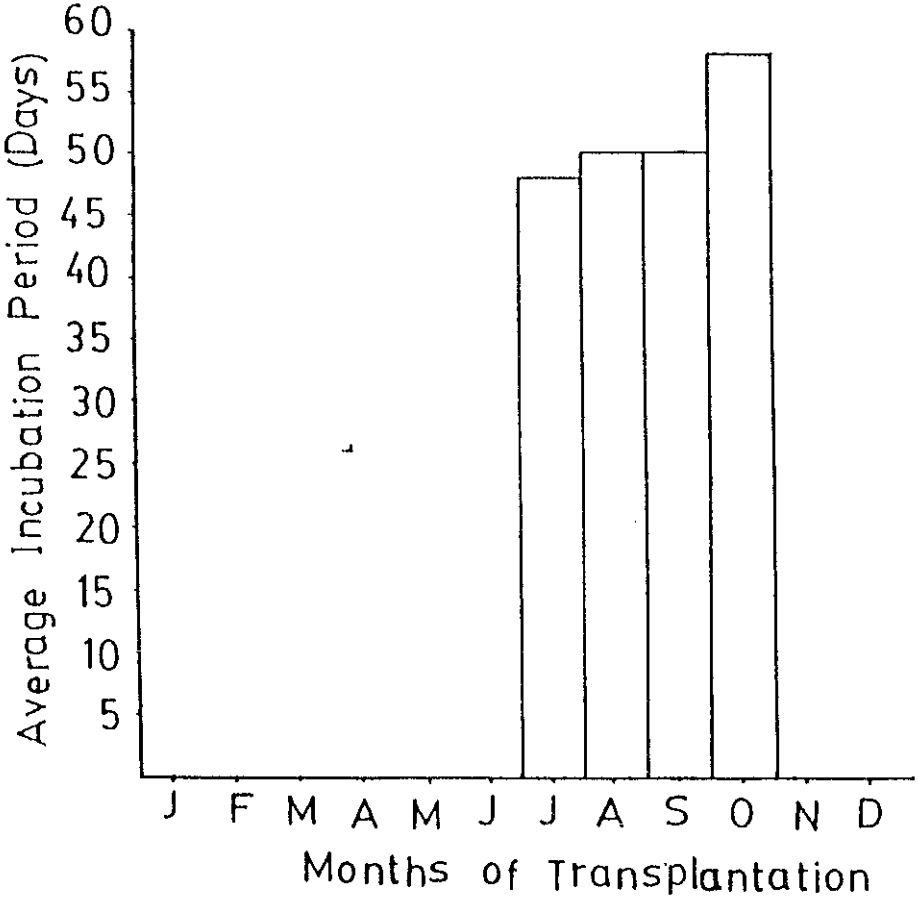


Fig.14 AVERAGE INCUBATION PERIOD OF OLIVE RIDLEY (LEPIDOCHELYS OLIVACEA) EGGS TRANSPLANTED FROM OCTOBER, 1979 - APRIL, 1984.



Our procedure for transference of eggs, which originally involved removing the eggs to a basket and then reburying them in a nest hole in the hatchery at the same depth as the original hole, has now been modified in view of J.Mortimer's suggestions (Report to WWF/IUCN 1984), and eggs are now caught in a cloth net held below the cloaca, as they are laid, and then transferred to the hatchery so that they do not get covered with sand during the process of transference. If one of the causes of low hatch rate has been the fact that sand coating the eggs interferes with gas exchange and so suffocates some embryos, the improved technique should yield higher hatch rates.

Every nest that is transferred and reburied in the hatchery is excavated after hatching has occurred. The number of days before this is done is determined by the incubation period of that particular month (see Fig.13,14). The eggs (unhatched) and shells (hatched) are counted, and figures tallied with those of hatchling emergence. Unhatched eggs are opened at random, and notes made of the various stages of development. We have observed the entire gestational range within a clutch starting from infertile eggs to the different steps in development, to hatchlings dead in the process of pipping, in the nest chamber and in the sand above it. These stages have also been investigated for natural nests and the same range of arrested development observed.

Once a clutch has been excavated and the observations recorded, rotten eggs are thrown into the sea where they are soon swept away by the tide. The nest hole is then left exposed to the sun and wind for 2-3 days or longer (depending on the season - shorter in peak season when the turnover of clutches hatching and being buried is higher), so that it is allowed to 'disinfect' from microbial and other contamination in the light and heat of the sun.

Olive ridley eggs are similar in appearance to those of the green turtle but smaller and lighter. Eggs weigh an average of 36 gms each (ranging 30-40 gms) and have an average diameter of 41 mm (range 39.8 - 41.4 mm). Laying takes place rapidly and the hind flippers are spread firmly onto the sand beside the nest hole during laying, Mucous covers the eggs as they fall out of the cloaca in lots of one, two and three.

The average number of eggs per clutch was found to be 116 (range 60-186). The distribution of a sample of eggs per clutch is given in Fig. 12 for one month (August) of the peak of the season in 1982.

Observations of mortality within transferred clutches are as for the green turtle, and the procedure of transferrence,etc. is the same.

Incubation Period:

Reports in the literature (Zwinenberg, 1975) state that the incubation period for a clutch of green turtle eggs varies between 48-70 days. We have observed an average of 69 days for transplanted nests within the hatchery, with a range of 22-166 days. Observations for natural nests also correspond with these figures. The incubation period varies largely due to climate, season and temperature, being shortest during the summer (May-August) 49 days and longest in the winter (December-January) 108 days. Fig 13 shows the accumulated data for four years where the average incubation period of nests buried in a particular month is shown for the entire year.

The average incubation period for an olive ridley clutch has been found to be 51 days with a range of 42-69 days. Shultz (1975) reports that undisturbed nests in Surinam hatched after 46-62 days, while replanted nests needed an incubation period of 45-72 days. Overall however, reburied and wild nests proved to have the same incubation time. Good weather (hot and dry) invariably

Table 3

INCUBATION TEMPERATURE PROFILE OF A CLUTCH OF GREEN TURTLE EGGS WITHIN THE ENCLOSURE.

(OCTOBER, 1981)

Day	Ambient Temperature (°C)	Intra-clutch Temperature (°C)	
0	29.00	28.00	
1	29.00	32.00	
7	29.00	33.00	
12 (noon)	35.00	29.50	
12 (midnight)	29.00	30.00	
13	30.00	30.00	
21	31.00	29.00	
25	30.00	28.00	
32	30.50	29.00	
54	29.00	27.00	
61	30.00	24.50	(Hatching & (Emergence

****

Table 4

GREEN TURTLE INTERNESTING INTERVALS

(Tagged on, and return to Hawkesbay - Sandspit)

Tag No.	Date of Tagging	Recovery	Interval (Days)
0025	25. 1.83 NL	25. 3.83 NL	59
		28. 3.83 NL	62
		29. 3.83 L	63
0052	27. 6.83 NL	28. 6.83 L	2 hrs
0058	28. 6.83 NL	9. 7.83 L	11
0066	9. 7.83 NL	13. 8.83 L	35
0104	9.10.83 NL	22.11.83 NL	44
0122	6.11.83 L	27. 1.84 NL	82
		28. 1.84 L	83
0132	8.11.83 NL	24.11.83 NL	16
0135	8.11.83	5.12.83 NL	27
0150	29.11.83 L	15. 2.84 L	78
0161	15.12.83 L	2. 2.84 L	49
0166	3. 1.84 NL	1. 2.84 L	29
		Average	49 days

NL - Not laid

L - Laid

shows data for four years summarised as the average incubation period of eggs laid in individual months of the season. It is shortest in July (48 days) and longest in October (58 days).

Temperature:

Temperature affects eggs and hatching in a number of ways. Lower ambient temperatures increase incubation time, higher temperatures decrease it. Ambient temperature in turn affects the temperature within the nest which can determine the sex of the hatchlings (Morreale et. al., 1982, Mrosovsky et. al. 1980). We have been keenly aware during the running of this project of the dominant role that temperature plays as a controlling factor in the development of sea turtle eggs, and made various attempts in the early stages of the project to find suitable equipment. We did eventually get a Cole Palmer Thermistor-Thermometer which stopped functioning after a few attempts. It was replaced after a while, and since then have done a few recordings but do not have enough data to state conclusively the effect of intranest or sand temperature on hatching at Hawkesbay-Sandspit. Since there is no vegetation of the shading sort on the beach and the main nesting beach runs in a north-south direction, it is exposed to the sun all through the day and very few areas are in shadow (caused by the beach huts) for long. Therefore the ambient and sand temperatures of the hatcheries are likely to be the same as for undisturbed nests along the open beach as their location is in the same area. An incubation temperature profile showing selected readings from a clutch of green turtle eggs in the hatchery is presented in Table 3 . Since we have not tried sexing hatchlings from a clutch we do not know how these temperatures may have affected the gender of the emergent hatchlings, but they do appear to follow the intranest incubation temperature pattern reported by other workers (Limpus et al. 1983), where the optimum temperature range for good hatching success is 25° degree - 32° degree Centigrade. At lower temperatures (25°C) male hatchlings result, at high temperatures (30° - 32° C) female hatchlings. Intermediate temperatures (27.5° C) produce a mixed sex ratio.

It is not possible to state when the onset of metabolic heating occurred since we do not have sand temperatures for the same clutch, but we are now in the process of collecting data with properly instituted controls.

Mortality and arested development of sea turtle eggs within the cluth, particularly during the winter is likely to be partly temperature related, and probably occurs when sand temperatures drop below the minimum lethal temperature for incubation, 24° C. It is possible too that very high sand, temperatures in the hottest months of the year, May and June are responsible for mortality (particularly for eggs in the upper layers of a clutch), if they go beyond the upper lethal unit of 34° C. (Limpus et al. 1983).

Hatchlings:

When emergence out of the nest is about to occur, a crater like depression forms on the surface of the sand above the nest, indicative of activity and movement in the clutch below. This usually occurs at night, giving the hatchlings the advantage of the cover of darkness to escape most predators such as gulls, crows etc. It also eliminates the danger of dessication by the direct heat of the sun and the radiated heat of surface sand.

The movements of hatchlings can be divided into the following stages (Carr and Ogren, 1960):

(1) From nest to surface; (2) From nest to wave-wet sand
(3) Across wave-wet sand (4) Through wave-wash
(5) Through breakers and (6) Travel by hatchlings and immature stages.

We have been able to study phases 2-4, but have not had the

Most hatchlings on emergence head straight to sea. If however, the clutch has been laid over the rise of the spit of Sandspit (Fig. 2) on the side of the marsh, the bright city lights reflecting off the water of the marsh are a sure beacon to disaster as the sea is then no longer visible and hatchlings head to certain death on the beach road (where they are crushed by vehicles) as they cross over into the mangrove marsh with its sticky mud, predators and dense foliage.

Such occurrances usually occur during peak season and at such times the most reliable way of rescuing the hatchlings is to stand still on the road running between spit and marsh with a torch or lantern shining brightly on to the surface of the road. Hatchlings who are already into the marsh have been seen to struggle back to the beam, when they are gathered into a basket and taken over the spit to the beach where they can orient accurately to the sea. Another favourite method of finding lost hatchlings is to park the jeep on the road and leave the headlights shining, the hatchlings soon come scrambling into the light from nests and the marsh.

Those hatchlings that emerge from transplanted nests are removed from them as they hatch, identified, counted and weighed, and checked for deformities. They are then carried to just before the wave wet sand and released. Under normal conditions, they scramble seawards after a few seconds of orientation. At this stage we check for predators especially the ghost crab and dogs. If there are many visitors to the beach shining torches, or with lanterns lighting up beach huts, the occasional hatchling will go round in circles and then orient to the brightest light, sometimes coming back out of the wave wash to trek up the beach. At such times one of us goes into the water up to the first breakers and stands there with a torch beam reflecting on to the water. It is usually adequate to ensure that the hatchlings orient back to the water.

Green turtle hatchlings on Hawkesbay-Sandspit have been found to have an average carapace length of 57.5 mm (range 45-65 mm) and an average width of 49.4 mm (range 40-57 mm), with an average weight of 27 gms (range 18-31 gms). Olive ridley hatchlings have an average carapace length of 42 mm (range 40-44 mm) and width of 40 mm (range 39-42 mm), with an average weight of 16 gms (range 15-17 gms).

Hatchlings can emerge from a nest all in one night, or over a period of 3-4 days. During the day if one burrows down with ones hand into the nest which is in the process of hatching, one can frequently feel live healthy hatchlings lying still below the surface layers of the sand. Mrosovsky (1968) concluded that thermal inhibition of activity is a major factor in limiting the emergence of hatchling green turtles to nocturnal hours, as activity is slowed down when sand temperatures rise above 28.5°C. Thus hatchlings lie quiescent under the surface until a drop in temperature during the evening triggers activity and emergence.

The hatchlings which emerge from a nest which is unaffected by cold, rain or high tides are active and quite obviously 'healthy' and 'normal'. Those that emerge from nests affected by any of the above factors are usually sluggish, sometimes abnormal (curved and deformed carapace and plastron) and do not emerge out of the nest independently but have to be dug out and released. Sometimes one or two quite active normal hatchlings are dug out of a nest where the rest of the eggs have rotted, and one assumes that the reason they did not emerge is because it would be difficult for a single hatchling to burrow through the weight of the sand above. There is evidence to support this in the fact that sometimes quite normal looking single dead hatchlings are found only a few inches below the surface of the sand with fully depleted embryo sacs.

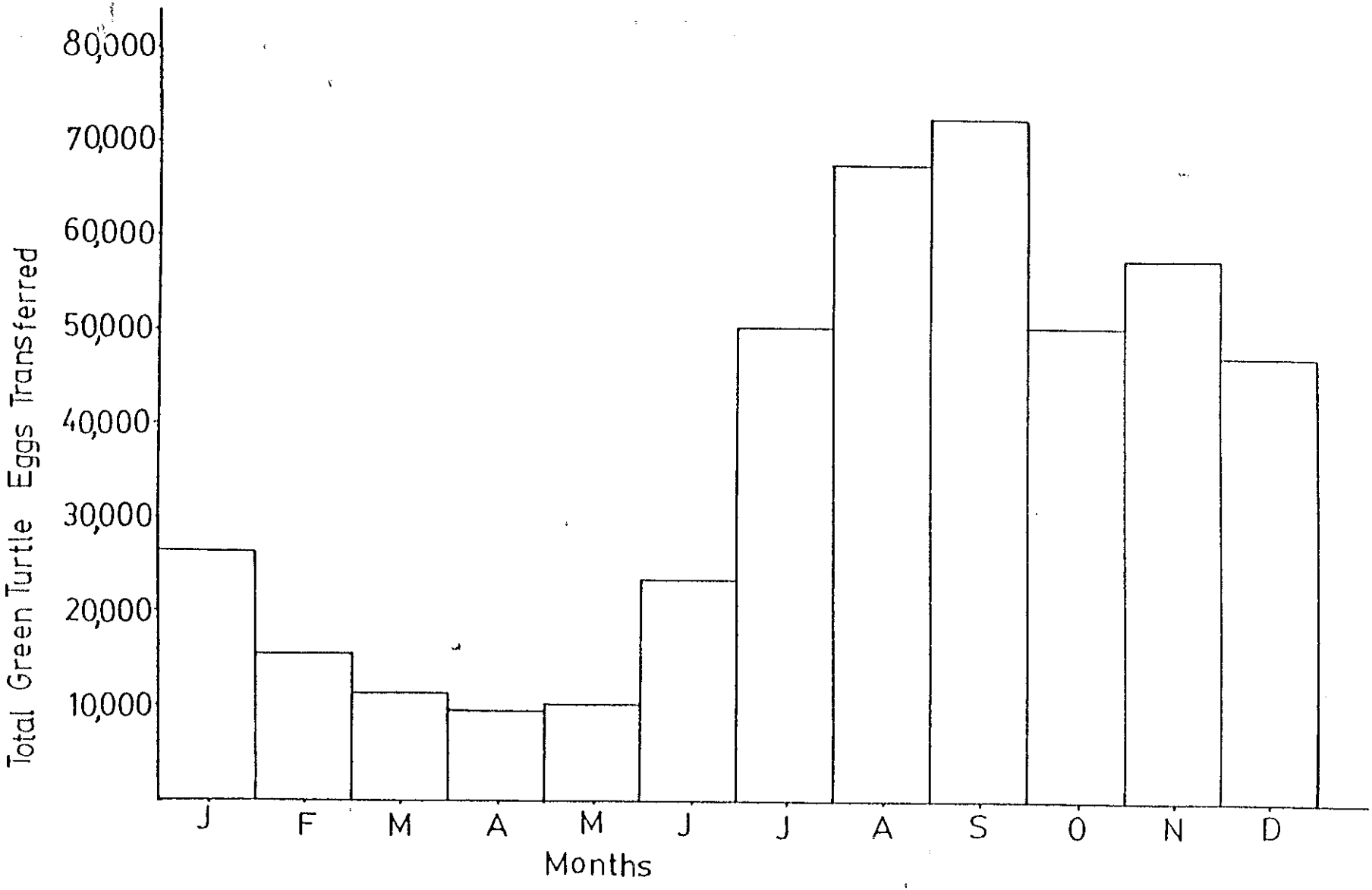


Fig.15 TOTAL NUMBER OF GREEN TURTLE (CHELONIA MYDAS) EGGS TRANSFERRED TO THE PROTECTED ENCLOSURES PER MONTH OVER THE PERIOD OCTOBER, 1979 - APRIL, 1984.

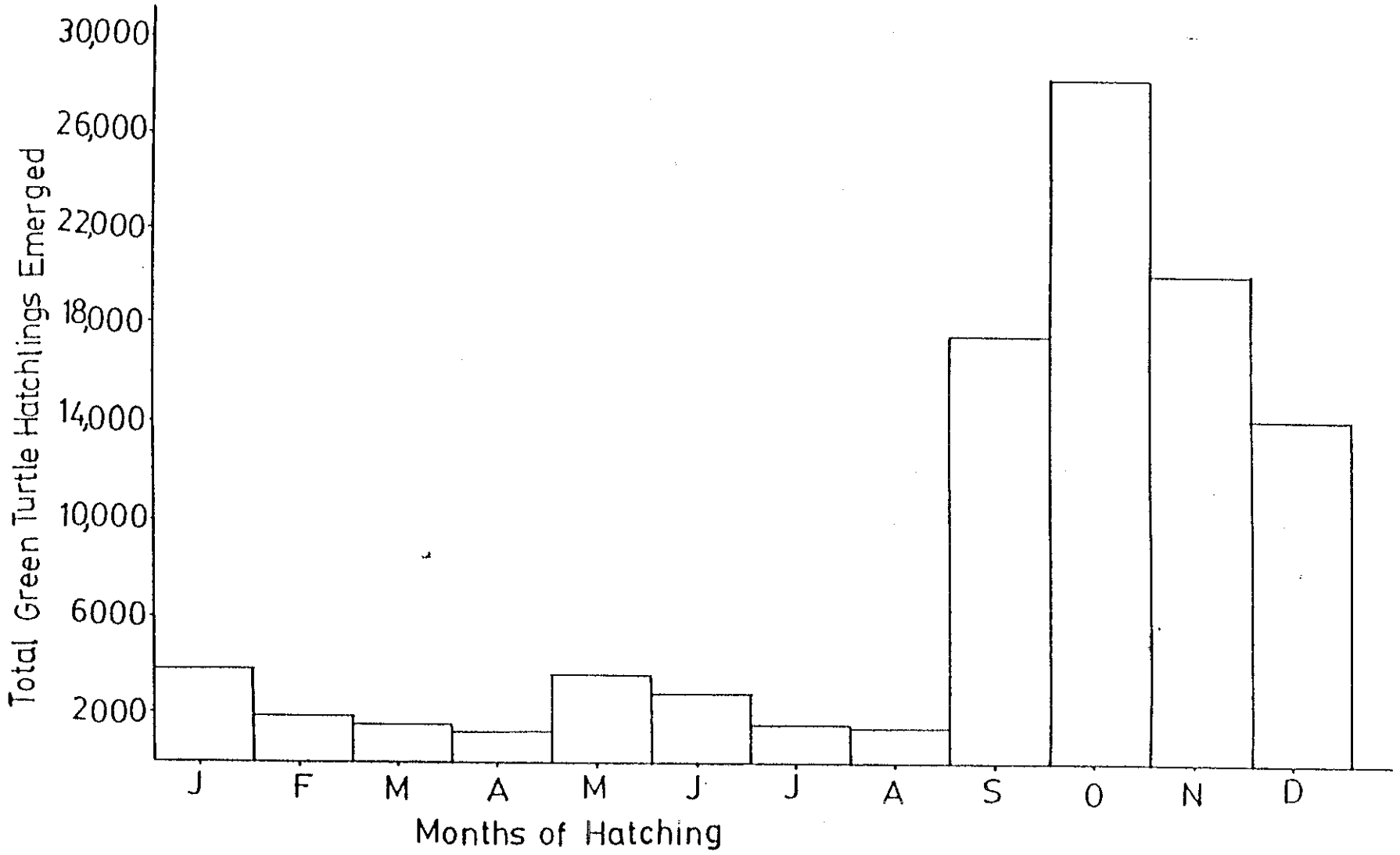


Fig.16 TOTAL NUMBER OF GREEN TURTLE (CHELONIA MYDAS) HATCHLINGS TO EMERGE FROM NESTS IN PROTECTED ENCLOSURES PER MONTH OVER THE PERIOD OCTOBER, 1979 - APRIL, 1984.

Fig.17 TOTAL NUMBER OF OLIVE RIDLEY (LEPIDOCHELYS OLIVACEA) EGGS TRANSFERRED TO THE PROTECTED ENCLOSURES PER MONTH OVER THE PERIOD OCTOBER, 1979 - APRIL, 1984

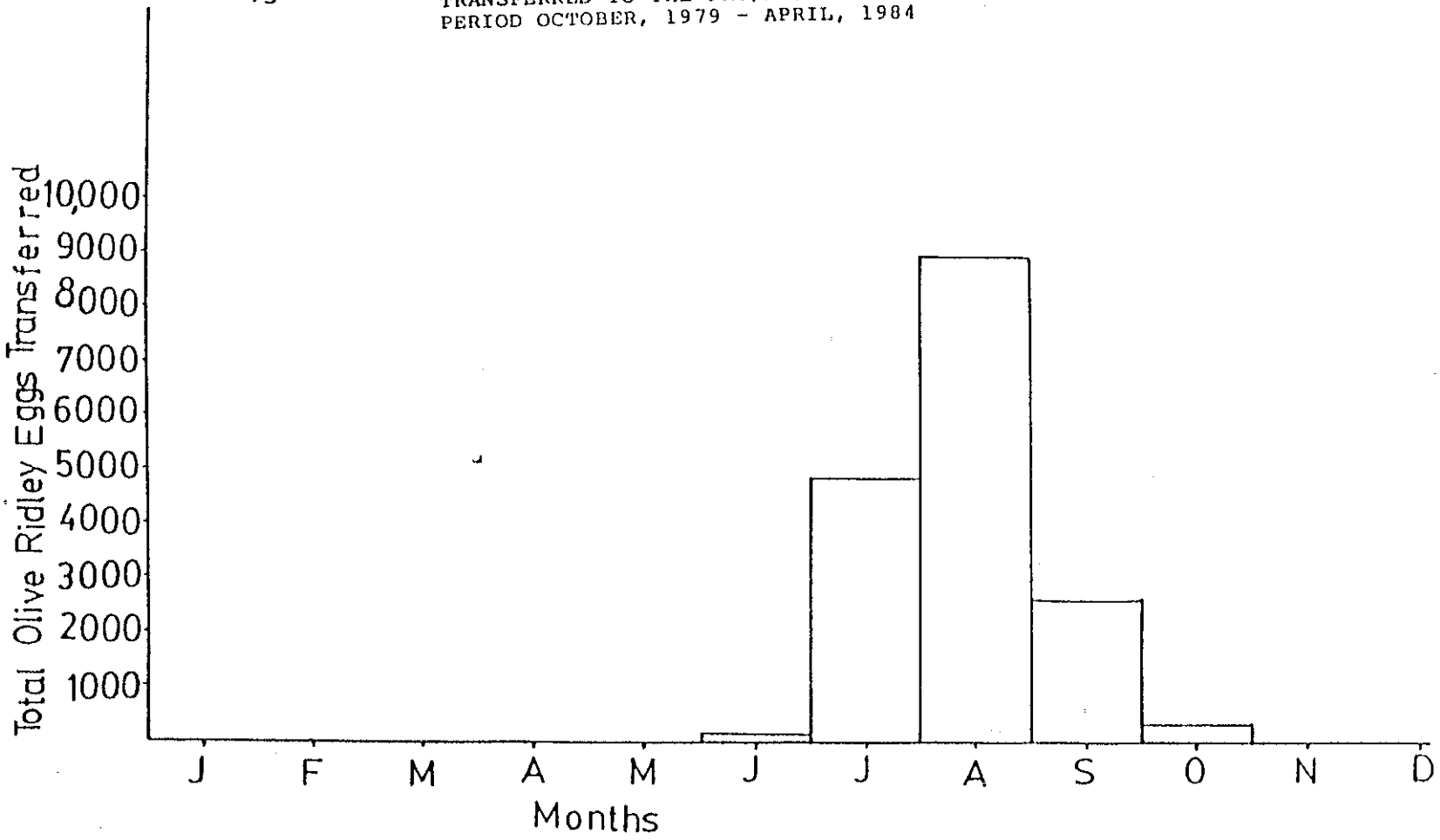
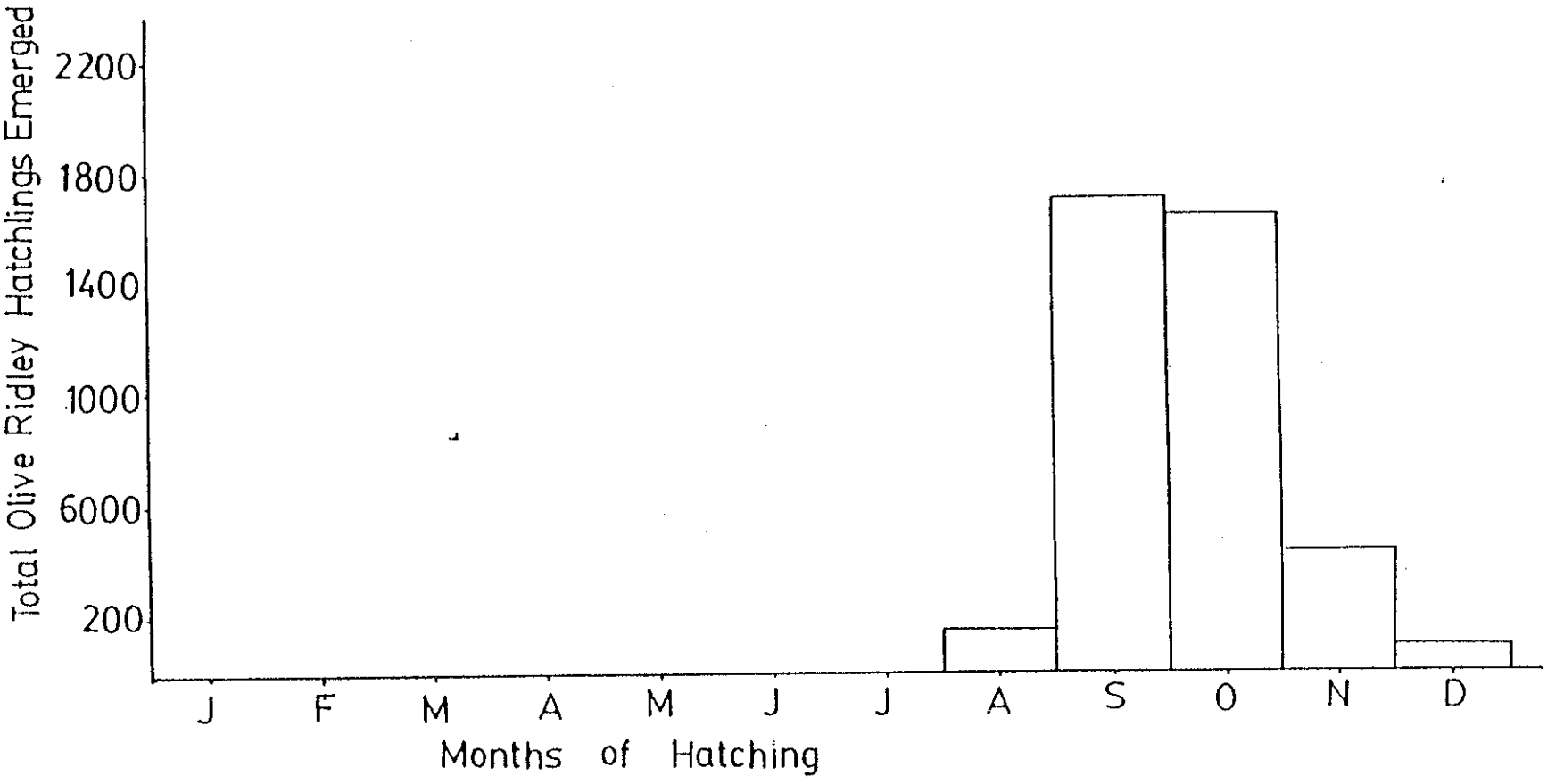


Fig.18 TOTAL NUMBER OF OLIVE RIDLEY (LEPIDOCHELYS OLIVACEA) HATCHLINGS TO EMERGE FROM NESTS IN PROTECTED ENCLOSURES PER MONTH OVER THE PERIOD OCTOBER, 1979 - APRIL, 1984.



On one occasion a live, otherwise normal and healthy albino green turtle hatchling was found. When unhatched eggs are opened and dead embryos examined, there are frequent abnormalities. In other cases when the hatchlings emerge alive from the eggs, but do not emerge to the surface, the most frequent abnormality is a curved carapace and inwardly indented plastron. These hatchlings are released to the sea but cannot swim properly and tend to stay on the surface of the water, unable to dive below the breakers, and so are carried back on to the beach where they are usually picked off by crows or gulls.

Once the hatchlings enter the sea we have no record of their activities or the events of the 'lost year'. We have no evidence of sargassum rafts of the sort reported (Carr & Meylan, 1980), but sargassum drift weed is found washed up onto the beaches.

Hatching Success

The hatchery programme started at the beginning of the project, on the assumption that it was one way of protecting the eggs and hatchlings from feral dogs and man until such time as predators could be identified and the legal protection afforded to the turtles, implemented. In so far as these objectives are concerned, it has been a success. A record of predators has been made and a considerable amount of data on the breeding of turtles has been acquired. In addition, it provides a focus for protection which is understood by the local workers and together with beach patrols continues to raise considerable awareness in visitors to the beach as to the turtles' plight. The hatcheries are also a most valuable teaching tool as far as explaining conservation to school-children (and adults) go, since it is easy to predict approximately when hatching will take place so that field trips can be planned to coincide, and the children actually participate in removing hatchlings from the wire-mesh enclosure around the nest, and releasing them to the ocean. From feedback received, this is the stage of the life cycle which makes the maximum impact on children.

Together with the advantages, however, one has also to assess the scientific aspects of a hatchery programme, viz., hatch rates and the possibility that the process of transference affects natural sex ratios and other aspects of breeding morphology yet unknown.

In the case of the green turtle, the total figures for eggs transferred and hatchlings released are diagrammatically presente in Fig.15,16and as can be seen, hatching success coincides with peak season nesting, the greatest number of hatchlings emerging when the conditions of temperature and humidity are at optimum levels. The overall hatch rate over the entire year, for the four years of the project is 22%. It is highest for eggs buried in September (43%), (this is post monsoon and so nests are not swamped and drowned by high tides, and hatch before the winter rains and cold temperatures destroy them) and lowest for those buried in December (3%), when hatching takes place in January, February and March, the coldest months of the year with high winter tides.

Individual nests have shown variations from these overall figures, and hatch rates have sometimes been as high as 98% and at other times as low as 0.7% - discounting of course nests that did not hatch at all. In certain years (e.g., 1980) the months of August and September showed hatch rates as high as 66% and 74%

A small study (which is presently being expanded) was also undertaken to compare natural undisturbed nests and their hatch rates. Of fifteen nests studied two were totally and three partially destroyed by dogs, while one was excavated and destroyed by a subsequently nesting turtle. In six nests hatching took place with an average hatch rate of 60% (range 4%-98%).

Figures 17 and 18 are presented for total eggs transferred and hatchlings released for the olive ridley. Again eggs transferred in September and October show the best hatch rates (31% and 38%). The overall hatch rate is 28% with individual nests showing a maximum of 93% and minimum of 1%. These figures can be compared with those obtained by Cornelius et. al (1983) in which a hatch rate between 0.2% to 1.2% were obtained in natural conditions for the olive ridley.

While every attempt is made in the transference of nests to keep conditions as natural as possible, there are a number of factors which may be introduced and contribute to higher mortality and a lower hatch rate than in the wild.

-Eggs are removed from the nest hole after the female has finished laying, and in most cases, when the motions of filling the nest pit have begun. Consequently, most eggs get coated by sand. As pointed out by Mortimer (1984), this might interfere with gas exchange through pores in the eggshell, resulting in suffocation of the embryo, since in a natural nest only the outermost eggs touching the walls of the egg chamber come into contact with the sand - eggs in the interior are clean. We have now modified our technique of collection, and collect the eggs in a cloth net as they are laid, preventing them from getting coated with sand.

-It is possible that the sand in the hatcheries gets contaminated by the microbes associated with decomposition of the eggs and this affects subsequent nests. The site of the hatcheries has been changed twice since the project began, as when the fencing corrodes, another site parallel to the old with completely fresh sand is chosen.

-When nests are excavated, they are left exposed to the sun and air for 3-4 days at a stretch in an attempt to 'disinfect' them. However, this does have the disadvantages of drying out the nest and therefore affecting the moisture content of the sand. If such an equilibirium is upset and the internal environment of the 'transferred' nest is different from the natural, it is possible that such an introduced factor affects the overall hatch rate.

-There is always the likelihood that the emergent hatchlings are being undercounted. This is possible since the wire mesh at the base of the nest corrodes very fast, and although mended as soon as we notice it, the occasional hatchlings have been known to escape as is evidenced by tracks leading away from such nests.

In view of the factors stated above, one is faced with two alternatives: Either to stop the hatchery programme, or to continue with further safeguards built in. To halt the programme and still extend the same measure of protection would require far more field personnel than are presently available, and would not save nests which are bound to be dug up by dogs or which are below the high tide mark. Therefore, it would appear more appropriate from both the practical and conservation point of view to continue the programme selecting only those nests for transference that are most vulnerable to destruction, putting more emphasis on the protection of natural nests. Data from natural nest hatch rates if showing a significance difference from the transferred, would also influence the eventual strategy.

Tagging:

Since the tags did not actually reach the project until early 1982, the tagging programme got off to a late start. There were then limitations in that the number of trained assistants is small and so tagging progress is slowly. 150 turtles have so far been tagged. We started by single tagging, but now double tag.

The internesting intervals of a sample of green turtles is given in Table 4 It is difficult to state as other workers have done that there is a definite seasonal internesting interval, as individual turtles are seen to come up three to four times over a three month period but that period can be at any time during the year. Our average internesting interval (49 days) also appears to be quite long compared to that found by other workers, but it is possible that a tagged turtle came up and nested on some section of the beach unobserved by us, during the intervals recorded.

We have not had any recoveries in the sense of tags being returned from places other than along Hawkesbay-Sandspit. This could be reflective of the small number of turtles tagged, or alternatively may point yet again to a resident population of green turtles.

Data for the olive ridley is too sparse to be of significance.

Population:

There are a number of methods for censusing population size, most of which we were unaware of until very recently. In this project the one constant parameter known is the number of turtles whose egg clutches were transferred to the hatcheries per year/season. This figure is known for the project area of 5 km where the protected enclosures are constructed. It is likely that it is a conservative count as there are bound to have been many turtles who came up and nested while we were working in the hatcheries. We are now using the method of counting tracks (riding camel back) on the beach at regular intervals, so as to gain a greater degree of accuracy.

Taking as our starting point our count of the number of turtles nesting on the 5 km stretch, it is possible to work out a rough estimate of population size. From our observations the number of turtles coming up to nest along the beach is highest in this 5 km stretch, but by no mean confined to it, and the entire Hawkesbay-Sandspit beach of 20 km is turtle nesting ground. Therefore, with a count of 1500 green turtles per year for 5 km, we can estimate roughly 6000 green turtles nesting on Hawkesbay-Sandspit each year. If the male-female population ratio is1:1 as found by certain researchers (P.Ross pers. comm.), then we arrive at a figure of 12,000. We have found approximately the samenumber each year over the period 1981, 1982 and 1983. Assuming that the cycle of nesting of 2-3 year intervals found by other workers (Hughes, 1982) is applicable to the green turtles of Hawkesbay, then over three years we have recorded between twelve to eighteen thousand different female greens nesting on the beaches, which, at a 1:1 ratio would suggest a population of twentyfour to thirtysix thousand green turtles in our coastal waters.

It is possible that a number of female greens (in the absence of a tag) were counted twice or thrice each time they lay a clutch in the same year, but offset against this possible overcount is the factor of not counting the nesters along the rest of the coast and the 6 km beach (see map of project area). This figure also does not take into consideration the population abng the Baluchistan Coast.

Lest there be the temptation to consider, on the basis of this figure, the possibility of commercial exploitation, it must be strongly stressed that this figure is very approximate, and cannot be treated as accurate until verified by more reliable scientific methods. One has also to consider that the green turtles may be part of a larger population feeding along different coasts where they are already exploited and coming together on Hawkesbay to nest.

Alternatively, the population may be a resident one feeding and nesting along the coast of Sind and Baluchistan, since juveniles and sub-adults have also been found. Until such time as we have more data and tag returns indicate the migratory or resident pattern of the green turtles, the population needs to remain under strict protection.

The olive ridley has a definite nesting season (June to October) and is in all likelihood a migratory species as it has never been reported feeding or caught in any of its growth stages in fishermen's nets at other times of the year. Possible feeding grounds could be in the south-east at the islands of the Rann of Kutch, or Sri Lanka, both of which report olive ridley populations. Westwards lie the coasts of Baluchistan, Iran and Oman, all of which report nesting turtles, and in Oman the olive ridley has been identified.

The olive ridley population, calculated in the same manner as the green turtle, works out to approximately 200 per year on the 20 km stretch. Considering the same male:female ratio of 1:1, we arrive at a yearly figure of 400. Since the same number have occurred over three years and they have been found to have 2-3 year nesting cycles, (Hughes 1982) one can estimate a population of eight hundred to twelve hundred olive ridleys. This is fairly low and it is possible that the bulk of the ridley population may be nesting in Baluchistan, and it is only the stragglers that come up to Hawkesbay to lay. Alternatively this population may be the remnants of a larger population which is being exploited at its rookery and feeding grounds, and if so we expect the numbers will drop even further over the years.

TURTLES IN CAPTIVITY

The Karachi aquarium periodically takes hatchlings from the beach and attempts to raise them to maturity in their tanks. One female hatchling of Chelonia mydas (according to their reports) had been raised to the age of three years. It measured 35 cm length x 29 cm width curved carapace measurements. However, shortly after we had seen it, this specimen died. Our enquiries to the aquarium staff have indicated that the mortality rate of hatchlings reared in their tanks is very high and we suspect it is largely due to disease which results from ineffective clearing of the tanks and recycled water.

BEACH FLORA AND FAUNA

The following flora and fauna have been found along our beaches. Some flora is recognised as 'turtle food' while predators of turtle eggs and hatchlings are represented in the fauna.

Flora and Fauna found on the beaches of Hawkesbay and Sandspit

1) Flora

A. ANGIO-SPERMS (Flowering plants)

1. Ipomaea pescaprae (roots penetrate turtle nest and eggs)
2. Cassia holosericea
3. Cressa cretica
4. Launaea nudicaulis
5. Aerva pseudo-tomentosa
6. Aelurapus lagopoides

B. CHLOROPHYTA (Green algae)

1. Ulva fasciata
2. Caulerna recemosa
3. C. scalpelliformis
4. Codium latum
5. C. flabellatum
6. C. ivengarid

C. PHAEOPHYTA (Brown algae)

1. Colpomenia sinuosa
2. Dictyopteris sp.
3. Dictyota dicholtoma
4. Ivengaria stilata
5. Spatoglossum schroideri

D. RHODOPHYTA (Red algae)

1. Champia salicornoides
2. Hypnia musciformes
3. Hypnea cervicornis
4. Gracilaria sp.
5. Galaxaura cylindrica
6. Galaxaura sp.
7. Nemalion schramni
8. Champia parvula
9. Eucheuma isiforme
10. Halymenia agardhi
11. Halymenia sp.
12. Amphiroa anceps
13. Scinia indica
14. Laurencia obtusa

II) Fauna

A. CRUSTACEANS

1. Uca lacteus (Fiddler crab found in the marsh)
2. Ocypode cursor (Ghost crab, found in the nests as a predator)
3. Chelonobia testudinaria (Barnacle, attached on the carapace as a commensal)

B. MOLLUSCS

1. Gastropodes (Very small live specimens of a few species and some empty shells)
2. Bivalves

C. AVES (Birds)

1. Larcus canus (Common Gull, New Gull, both predators of hatchlings)
2. Phoenicopterus ruber (Greater Flamingo)

E. MAMMALS

1. Hedge Hog (only skin found)
2. Dolphins (in schools, in water close to the shore)
3. Feral dogs (predators of eggs and hatchlings)
4. Goats.
5. Camels

VISIT TO OMAN

At the suggestion of WWF/IUCN, a visit by the two investigators, to the Marine Turtle Conservation Project in Oman was arranged. During the week spent in Oman, both the rookeries at Ras-al-Had and on Masirah island were visited. All four species of sea turtle as reported by Ross (1979) were seen, and nesting and tagging were observed. It was the first opportunity afforded to the investigators to see live specimens of the Loggerhead (Caretta caretta), and Hawksbill (Eretmochelys imbricata) and to see results of an extensive tagging programme. In view of the fact that the Baluchistan coast (where turtles are known to nest) of Pakistan is only a few hundred miles away from Oman, the results of tag returns over the next few years might possibly indicate the likelihood of a common population of olive ridleys and perhaps even the green turtle.

A Report of the trip (with recommendations) and an article on the visit (see enclosures) was written and published in the leading English language daily newspaper 'Dawn'.

SECTION - V (C)

C) EDUCATION

It becomes increasingly apparent during the course of running a conservation project such as this, that the biological aspects of species conservation are only one, albeit vitally important, part of the problem. When the main threat to a species is man or his attendant needs (as it is in most cases), then educating people and tackling their socio-economic needs within the framework of preservation of the species becomes an integral part of any conservation programme.

Public Education was a planned part of this project from its inception. During its duration however, it became more and more of a high priority need as a small amount of time and effort spent on raising awareness had a multiplier effect and brought an enthusiastic and positive response at all levels to conservation generally and the marine turtles in particular.

The methods used to educate and raise awareness were varied and some worked better than others. They are discussed below :

The Media

The working relationship with the media was a mutually beneficial one. They were always looking for a 'good story' and the turtles and the project invariably aroused interest partly because of most people's familiarity with the beaches, and mainly through its novelty value.

We, in turn, benefitted from the publicity as it made visitors to the beach aware of our work and the threatened status of the turtles, and also encouraged people who were unaware of the marine turtles' existence, to contact us and visit the project. Another important spin off was to actually educate members of the media and to establish a liaison with sympathetic journalists, reporters, advertising agencies and editors, who gave the right kind of coverage to issues on wildlife whenever needed.

a) Newspapers / Magazines:

A number of articles on marine turtles, this project and wildlife conservation, accompanied by photographs have appeared in most of the large circulation English and Urdu newspapers and magazines in the country. On occasion the articles were written by the investigators, and at other times by journalists who took the material from us or wrote after visiting the project.

Copies of all articles to appear in the press have been sent with previous Progress Reports to IUCN, and those that appeared in 1983/84 accompany this Report.

b) Films / Television:

Films on the project were made both by the Ministry of Information and Pakistan Television (PTV). Those made by the Ministry are for distribution in the cinemas of the province of Sind, as a documentary 'short' before the main feature film. Those made by PTV in English, Urdu and Sindhi, form part of full length films on wildlife, and of news programmes which give a weekly round up interesting events. All these films have been transfered on to video-cassette and are therefore available to accompany talks given at schools etc. and also for people to borrow.

We have also attempted to acquire films on wildlife of other parts of the world and use them

c) Hoardings:

On certain strategic parts of the road leading to the beach there are hoardings showing a marine turtle (see photographs accompanying previous reports) with the text informing people that these are an endangered species and that poachers are liable to prosecution.

At each enclosure, there is also an information board and a 'cutout' hoarding in the shape of a turtle, explaining the purpose of the hatcheries and the plight of the turtles.

d) Stamps:

Over the last few years, the Pakistan Post Office, in response to the prompting by Sind Wildlife Management Board (SWMB), has printed a series of stamps on the Wildlife of Pakistan. One of the series depicts the green turtle, and the text for the brochure accompanying the cover on the first day of issue, was supplied by us (see Progress Report II, 1981).

e) Stickers:

We have found that attractive stickers are a foolproof way of raising funds and passing a 'message' on to educate people. Accordingly, in 1981, with funds provided by SWMB, a sticker showing a turtle with the message 'Face to face with extinction. Save the Marine Turtle' was printed in English and Urdu. The advertising agency through whom it was designed and published only charged the cost of the paper, so 60% of the minimum sale price of the sticker (Re 1.00 ≈ $ 0.07) goes back to SWMB who use it towards funding the project. This sticker has proved very popular and sells well.

Following a lecture given on the project and marine turtles to the youth branch of the Rotary Club in Karachi, they adopted the marine turtle as one of their 'causes' and had stickers printed to raise funds for the project.

f) Lectures / Seminars:

Lectures on the status of marine turtles, the biology of the green turtle and the olive ridley, on conservation and on this project have been given in a variety of forums. On one end of the scale is the talk given to 6 and 7 year olds at primary schools, where the talk is a 'lead in' to a field trip to the beach to see the turtles nest and release hatchlings, followed by a film. On the other are papers read at seminars and science conferences, explaining the importance of conserving the turtles. Somewhere in between, come the general interest lecture given to clubs, societies and similar institutions.

What follows is a list of all the various bodies addressed by either or both investigators during the project. In some cases, talks were given more than once at a single forum.

Lectures & Talks

1. Pakistan Forest Institute, Peshawar.
2. Goethe Institute, Karachi
3. Jaycees Club, Karachi.
4. Rotary Club, Karachi
5. Rotract Club, Karachi
6. Women's International Club, Karachi
7. Junior Grammar School, Karachi
8. Pakistan American Cultural Centre, Karachi
9. Government Girls Secondary School, Pakistan Air Force Base, Masroor, Karachi
10. Federal Urdu Science College, Karachi in 20th National Urdu Science Conference.
11. Islamia University, Bahawalpur in 21st National Urdu

The response in almost all cases was positive and enthusiastic and some of the toughest question came from the six year olds! Feedback from the schools included essays on the turtle, some of which have been reproduced in various magazines. (See enclosures)

An additional bonus of these talks was a steadily growing band of enthusiasts who volunteered to help us on the beach, and who, once aware of the need to leave the turtles to nest undisturbed, made sure other picnickers and tourists did not harass them.

g) Turtle Tours / Visitors:

We have informed tourist organisations etc. of the existence of the project, and offer to take anyone on a guided "Turtle Tour". There has been a steady response from schools, individuals and institutions, and in this way we reach a fairly wide audience. We try to have hatchlings ready for release, as children are particularly impressed by being given a hatchling to hold, name and then release, and see it scamper towards the sea.

Apart from organised tours, a number of foreigners have visited the project, a complete list of visitors is given in Appendix III.

h) Coast Guards:

The Coast Guards who regularly patrol the beaches, have also been approached, and their Director General, 'educated'. In consequence a directive has been issued, and their beach patrols keep an eye out for poachers or tourists who might harass turtles.

i) Exhibitions / Competitions:

As part of the Conservation of Wildlife and Natural Resources, Education Programme funded by WWFP, (See Appendix II) an exhibition of Wildlife photographs was organised from March 5 to 7th at the Pakistan American Cultural Centre, Karachi. The specific aim of this exhibition was to educate and create mass awareness about the threatened status of Wildlife in Pakistan, by reaching a cross section of the public through the visual media.

The displays in the exhibition fell into broadly three categories: Photographs, Films and the entries to a Photographic Competition on the theme 'The Natural World of the Outdoors'. In addition, there were eye catching displays such as cartoon posters with 'messages' to children specifically, as to the need for conserving wildlife and a live show - a tank with newly emerged marine turtle hatchlings which generated a lot of interest. There was also a sales desk where material such as brochures, stickers, posters and books published by WWFP and SWMB were on sale. Admission to the exhibition was by means of a sticker displaying an endangered species, costing Re 1.

Some excellent photographs were displayed as part of the main body of the exhibition, which were voluntarily contributed by the following individuals; Mr T.J.Roberts, Khan Mohammad Khan, Syed Asad Ali, Dr M.H.Rizvi, Mr A.Lee, Mr Rohail Nan and Mr Feroz Turab; all of them accomplished outdoor photographers. Each was presented with a copy of the SWMB publication on the Blind Dolphins of the Indus as a token of appreciation.

The photographs were divided into various sections, depending on the wildlife they displayed. Therefore, 'Kirthar National Park' showed ibex and urial, 'Creatures of the Sea' showed dolphins and turtles, 'Inhabitants of the Wetlands' showed the birds of Haleji and 'Birds of Prey' showed a Goshawk, Tawny Eagle and Palas Fishing Eagle.

Films on wildlife conservation on Sind and other parts of the globe displayed on a TV with the aid of a VCR were run continuously, which drew large crowds of school children and grown ups alike.

The competition had a fair number of entries, and prizes in the form of cash and cups donated for the purpose by the Sports Directorate of the Government of Sind and a shield as part of the first prize donated by Dr M.H.Rizvi, were awarded. In addition all the participants were given the brochure published by SWMB. First prize was won by Dr Mubashir Hasan with his picture of the Coppersmith bird, Second prize by Dr Naveed Shah with his Sind ibex photograph and Third prize by Mr S.M.Shahid, showing crows flying over the Safari Park.

In making this exhibition a success a number of persons contributed their time and efforts on a voluntary basis. Mr Iqbal Mir of Prestige Advertising arranged free advertising space in various leading English language newspapers, while the Creative Department of Pakistan Herald Publications helped with its entire staff to organise the exhibition from the inception, which included the supervision of the composition of the photos for displays, to the actual placing of the mounted final product on the walls of the exhibition hall. Other individuals and institutions helped by arranging to produce the materials needed at cost price, e.g., the stickers from Oscar Advertising, and the composing, enlarging and mounting of photographs by Turab Studios, Agfa Studios and Fotofun Studios.

The exhibition was inaugurated by the Chief Secretary, Government of Sind, Mr Sami Qureshi who was shown around by the Sind Secretary Forests and Wildlife, Mr Hameed Ahmed, and the President of the WWFP, Syed Babar Ali. The Chief Secretary expressed his appreciation and promised to assist the cause of conservation in whichever way he could. Syed Babar Ali in his address expressed the hope that exhibition should be only the first of a series which could tour Sind and thus educate people in the smaller cities and rural areas, where the wildlife is found. Mr Hameed Ahmad assured his department's total cooperation to implement these suggestions and thanked all those people who had organised the exhibition.

A special effort had been made to contact schools and inform them about the exhibition, and as a result, over 50% of the attendance was by school children of varying ages. Over the two and a half day period, approximately 1000 persons visited the exhibition.

The reaction by the Press was generally favourable. The exhibition received coverage on KTV in both Urdu and Sindhi. A number of newspapers and magazines also carried favourable reviews.

The pictures that formed the main displays are now at the WWFP office in Karachi, awaiting the organisation of another exhibition in another city so as to make this a continuing show, and slowly build up an impressive photographic catalogue of the wildlife of Pakistan.

SECTION - VI

RECOMMENDATIONS AND THEIR IMPLEMENTATION IN THE PROGRAMME.

Recommendations for improvements in and expansion of the project are made by the personnel of the same agency as has responsibility for their implementation, Th Sind Wildlife Management Board, Department of Forests & Wildlife, Government of Sind, Pakistan. Therefore all the recommendations which follow are already being acted on, some more successfully than others, and future reports will evalute the usefulness of each.

-The marine turtle conservation project should be an open ended programme, which although planned on a five yearly basis as per financial considerations, should not envisage a cut-off point, in recognition of the fact that the marine turtle will always be a species under threat, if not by direct exploitation, then by the very fact that its habitat competes with human development needs. This is particularly true of the population in our study which nests so close to one of the fastest expanding cities in Asia.

-A reserve for the marine turtles needs to be set up. It is possible that this may be problematical on Hawkesbay-Sandspit as it is one of the only recreational areas for the city, but if the protection afforded by the project and the hatcheries covers this area, then a reserve could be declared on other nesting beaches, possibly the 6 km beach.

-The education programme needs to be expanded still further, for the most powerful protection for the species will be strong public opinion in favour of its continued existence. An awareness of the necessity for conservation needs to filter through at all levels, and a tie-up with the National Conservation Strategy may be the best means of achieving this.

-The tagging programme needs to expand considerably before significant results and the value of tag data becomes apparent. For this, volunteers and better trained field staff are needed.

-An attempt should be made to work out a collaboration scheme with institutions like Karachi University or the Pakistan Council of Scientific and Industrial Research (PCSIR), for the running of research projects, where personel of this project would have access to their laboratory facilities.

-Any schemes for development of Hawkesbay-Sandspit should be screened and vetted for possible effects on the turtles and their habitat. Schemes that adversely affect either or both should be modified or rejected.

-The hatchery programme should be pared down to the transference of only those nests which are certain to be destroyed e.g., those right next to the village where dogs are most numerous, or those laid in the zone which gets covered by the high tide, etc. Wherever possible the emphasis should be on the protection of nests, eggs and hatchlings in their natural condition in the wild state.

SECTION - VII

FUTURE OF THE CONSERVATION PROGRAMME

Any conservation project undertaken to protect marine turtles has to consider the life-cycle and biology of the reptile when an estimation of the length of time such a project will run is made. Thus, in view of the fact that adults protected and tagged and hatchlings released during these three years of the Project will need to be monitored for at least another five years and preferably longer, before the success of our conservation efforts can be accurately stated, it was tacitly acknowledged by SWMB that when funding from WWF/IUCN ceased, an effort would be made to continue by using our own resources.

Accordingly, at the end of 1982 an approach was made to the two likely sources of further funding, The WWFP, and the Planning and Development, and Finance Departments, Government of Sind.

The proposal submitted to WWFP is as follows :

"The Marine Turtle Conservation Project actually began as a small pilot project in 1979 with the joint collaboration of Sind Wildlife Management Board and World Wildlife Fund Pakistan. In July 1980 it received formal approval from WWF/IUCN and this became the third collaborating agency proving funds for two consultancies, equipment and books etc.

The funding period for WWF/IUCN ends in June 1983. World Wildlife Fund (Pakistan) has so far made no further financial commitment to the project beyond June 1982. The Sind Wildlife Management Board has in its latest meeting held on 25th October 1982, presided over by the Governor/Chairman decided in principle to extend the project for another five years i.e., to July 1989, provided funding can be made available through the Government of Sind and international agencies. To this end a PCI scheme has been prepared.

It is essential that an international agency like WWFP commits itself in some financial measure to the continuation of this project, as this will make it far easier to get approval of funding from the Government in the PCI scheme.

The Marine Turtle Conservation Project fulfills in a large measure all the objectives of the WWFP and although many of the reasons for its continuity are self-evident, they are enumerated below :

1. This project started out as a pilot project. It has now arrived at the stage where enough research has been done and data collected for the planning of a full scale, long term conservation project of expanded scope and depth.
2. Although funding from WWF/IUCN was actually received in July 1980 all the equipment necessary for research did not arrive until late 1981. As a result it was only in 1982 that the project has really begun to gain momentum, and to stop in July 1983 would mean ending at a point when the maximum amount of progress is being made.
3. We are only now beginning to consolidate the gains in conservation, in terms of public awareness and the stopping of poachers. To cease efforts at this stage and remove our presence from the beaches would mean a recurrence of poaching and a complete negation of three years of time, effort and money. If these three years of the project are to have any genuine meaning they must do so in the planning of a long term conser-

4. Such public awareness that has been generated by the project has always been positive and enthusiastic. If the project were to end now, it would create cynicism in the public mind and would not in any way create a good PR image for any further projects by WWFP or WWF/IUCN.

5. One of the soundest and most pursuasive scientific reasons for the continuation of this project is the biology and life cycle of the animal being studied. The Marine Turtle has a very long life span (60-80 years) and very little is known of most of this period. We can only be sure of its biology and behaviour when it comes up on land to nest or when it hatches; and this is but a few short hours during its reproductive and birth phases. Thus our very subject demands a great deal of time to study it from hatchling to adult (in itself a minimum period of 8-15 years) and then post-maturity to death.

6. Even being able to determine such aspects of turtle biology as migration and breeding is dependent on our tagging programme which has only recently begun and which will take two to three years before the first data begins to come in.

It is requested, in view of all the reasons given above that WWFP consider their annual contribution to the Marine Turtle Conservation Project to be in the region of one lakh rupees."

After consideration the WWFP comitted first Rs 50,000/- to the Project and then smaller sums on an ad-hoc basis, as requested by us, for maintainence and repair of the enclosures, and for miscellaneous expenditure in the 'bridging over' period between the end of the Project financed by WWF/IUCN and release of funds to SWMB for the 'new' project.

As has been mentioned in the proposal, the Chairman of SWMB had already decided in principle to extend the period of the Project for another five years. A request for funding (Appendix I) was then submitted to the relevant ministries. Final sanction and release of funds came through in November 1983. During the period July-November both Investigators worked on the Project in an honorary capacity without being paid while the field staff and vehicle were maintained by SWMB, and the project continued to function as well as it could in the circumstances.

Since then we continue to run things as before, and expand in the scope of our investigations, implement the recommendations of Section VI, and work on the Education Programme (Appendix II) for which the funding requested has been sanctioned, and the first exhibition of wildlife photographs and films, held (See Section V-c).

SECTION - VIII

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