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A GUIDE FOR TAGGING OF SEA TURTLES IN THE SOUTHEAST ASIAN REGION

Marine Fishery Resources Development and Management Department
Southeast Asian Fisheries Development Center

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Marine Fishery Resources Development and Management Department
Southeast Asian Fisheries Development Center
Taman Perikanan Chendering
21080 Kuala Terengganu
MALAYSIA

Tel: (609) 6175940, 6171543: Fax: (609) 6175136, 6174042
E-mail: mfrdmd@mfrdmd.org.my
http://www.mfrdmd.org.my/

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A GUIDE FOR TAGGING OF SEA TURTLES IN THE SOUTHEAST ASIAN REGION

By

Ahmad Ali
Ku Kassim Ku Yaacob
Zulkifli Talib
Mahyam Mohd. Isa
Solahuddin A. Razak

Marine Fishery Resources Development and Management Department
Southeast Asian Fisheries Development Center
2006

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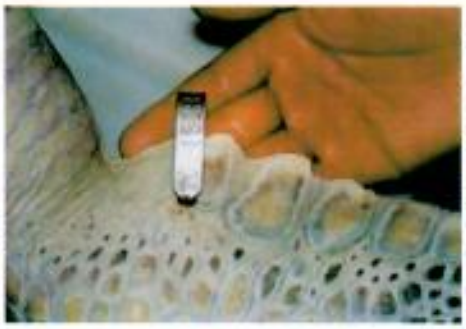


PREFACE

Sea turtle tagging activities have been practiced in the Southeast Asian region since 1950's. Researchers in this region have been using various designs of tags made from Monel, titanium, plastic, Inconel as well as PIT tags. The first record of sea turtle tagging in the region was reported in Malaysia in 1953 on the green turtle's population in Sarawak. Thailand started its tagging activities in 1970's, the Philippines (1982); Indonesia (1980's); Vietnam (1998); Brunei Darussalam (2000); Myanmar (2001) and Cambodia in 2002. Various government agencies, universities and NGOs in this region have been involved in these activities but information on their tagging activities was not well documented. Until now, the information on the number of sea turtles which have been tagged according to species from each country is still scanty.

Without proper planning, training, scientific knowledge and experiences, tagging program will be futile and will not contribute significantly to managers who are directly or indirectly involved in sea turtle conservation and management.

The success from sea turtle tagging program in terms of tag retention and maintaining recognition of a turtle can vary depending on a multiple of factors such as type of tag used, where and how it is applied, species and size class, geographical location, skill of workers tagging, as well as number of tags applied to each turtle.

This book provides some important information based on local experiences as well as information and knowledge gathered from other regions. Researchers, managers or workers can use this book as a reference and a guide to conduct tagging activities in their countries in order to collect a credible tagging data.

Through the proper collecting, organizing, processing and presentation, all the data collected in this region from various tagging projects will become more meaningful for the successful management and conservation of sea turtle populations. To achieve this credible result, high quality tagging data are needed from all SEAFDEC Member Countries involved in any turtle conservation and management project.

Ahmad Ali
Project Coordinator
Japanese Trust Fund I

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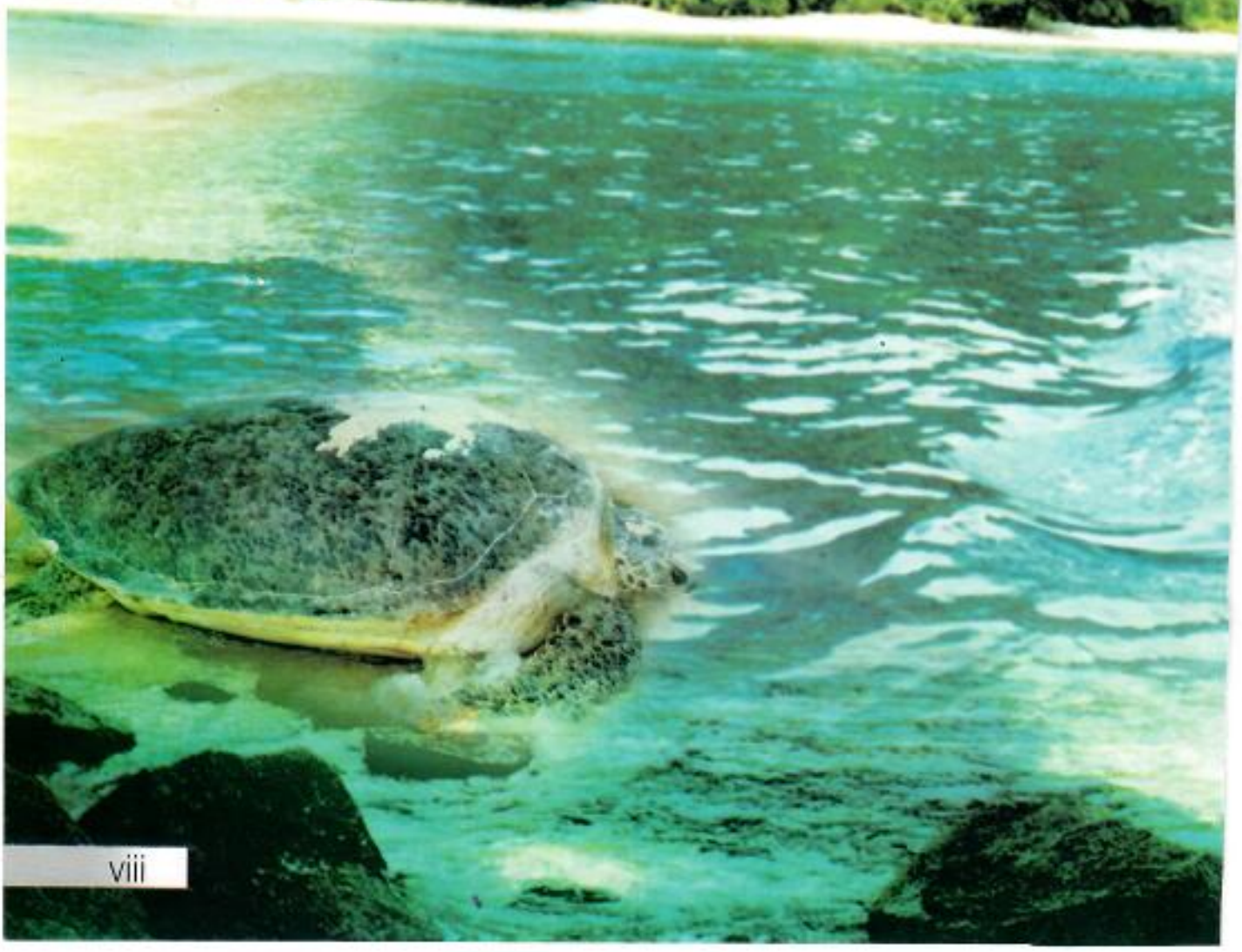


INTRODUCTION

Sea turtles are highly migratory animals and are known to inhabit waters of the Southeast Asian region regardless of geographical and political boundaries. They are able to migrate up to several thousand kilometers from feeding grounds to nesting areas and back.

Based on various sources of information it was estimated that more than 100,000 nesting sea turtles, mostly greens, have been tagged by various organizations in this region. Malaysia is the major country which has managed to tag more than 90,000 nesters since 1953 mostly greens, hawksbills and leatherbacks. The state of Sabah in Malaysia which is located in northern Borneo has tagged 76,849 nesters mostly greens, at Turtle Islands since 1970 (Paul Basintal, 2005; *pers. com.*). Other countries such as the Philippines tagged more than 15,000 nesters mostly greens and followed by Indonesia with more than 5,000 nesters of green turtle. Thailand has tagged a few thousand nesting turtles in its major rookeries. Vietnam has already tagged more than 1,300 nesters since the project started in 1998. Myanmar and Brunei Darussalam have also tagged a few hundred nesters in their major rookeries.

This guide is prepared primarily to assist the sea turtle workers in the Southeast Asian Fisheries Development Center (SEAFDEC) Member Countries, namely Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam with proper tagging techniques and standardized tagging activities in their countries.

REGIONAL SEA TURTLES TAGGING PROGRAM

A Regional Sea Turtles Tagging Program in the Southeast Asian region was initiated by the Southeast Asian Fisheries Development Center (SEAFDEC) in 1998. The objectives of this program are:

- to enhance public awareness about sea turtles tagging program,
- to standardize a tagging work, and
- to improve data collection and analysis through production and distribution of turtle identification sheets and tag recovery flyers, publication and distribution of tagging manual and procurement or development of computer program for tagging data entry and analysis.

Under this program, it is expected that most of the nesting sea turtles in major rookeries in this region will be tagged. The migration, reproduction, growth and mortality of the sea turtles will be better understood. After certain period of conducting tagging activities, it is possible to estimate population size of certain species. Information gained from this study will be used for proper management of sea turtles in the region.

Tagging program has been implemented intensively in all SEAFDEC Member Countries except the Lao PDR and Singapore. Since 1998, SEAFDEC Member Countries have implemented a standard tagging procedure. From 1998-2002, a total of 11,300 units of Inconel tag had been distributed by SEAFDEC-MFRDMD to Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam.

A new type of tag, i.e. the Passive Integrated Transponder (PIT) tags or microchip tags are becoming popular and many scientists are now using these tags to supplement flipper tags. PIT tagging activities were initiated in 2003 for the region and each SEAFDEC Member Country namely Malaysia, Thailand, Indonesia, Myanmar and the Philippines was provided with 25 PIT tags, plunger applicators and a PIT tag reader. In order to have a comprehensive tag and recovery data, PIT tags are used to supplement existing flipper tagging.

IMPORTANCE OF TAGGING

Different types of tag and applicator used in tagging sea turtles in the world

Tag is one of the simplest yet most important tools in the sea turtle research as it enables scientists to identify individual sea turtle. Much information can be gathered from tagging studies. These include:

- migration and geographical ranges,
- how often and how accurately a female returns to her nesting beach,
- how often and how many eggs she lays in a season,
- how accurately she returns to her home feeding site,
- growth rate,
- change in population numbers,
- location of their foraging habitats,
- stranding and/or incidental capture in fishing gears,
- health status.

Tagging of sea turtles as defined in this book refers to the external attachment, usually to the flippers, of a metal, plastic or Inconel tag inscribed with numbers and words and, the insertion of microchips into the body that can be detected with an electronic device.

In many cases, a commitment of systematic tagging for many years may be necessary to achieve certain objectives. However, in some instances the tagging of even a few turtles, particularly at nesting beaches where tagging has never been conducted, can yield valuable insight into migrations and the locations of resident foraging areas (Balazs, 1999).

A: Beach patrolling includes recording all relevant information

B: Tagging of a turtle

C: Care of tagging equipm

ESTABLISHING OF A TAGGING PROGRAM

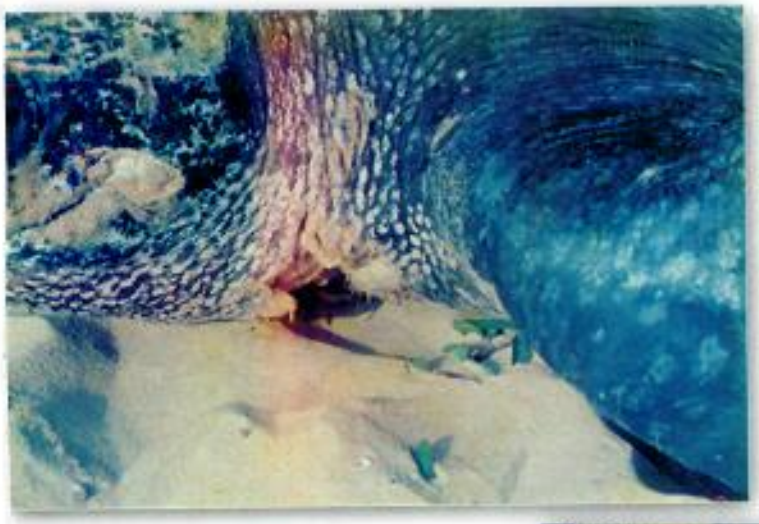
Tagging activities are very expensive to implement and depend on a well-trained and reliable workers. At an established of tagging activity in any rookeries, authorities should place permanent or temporary staff for beach patrolling, tagging the turtles as well as recording all information as listed in the tagging data sheet. A training course should be conducted for the staff to show them the correct tagging procedures. The common duties of the staff are shown in Plates A to M.

D: Storage of tagging data

E: Record all relevant information as listed in tagging data sheet

F: Record the position of nest

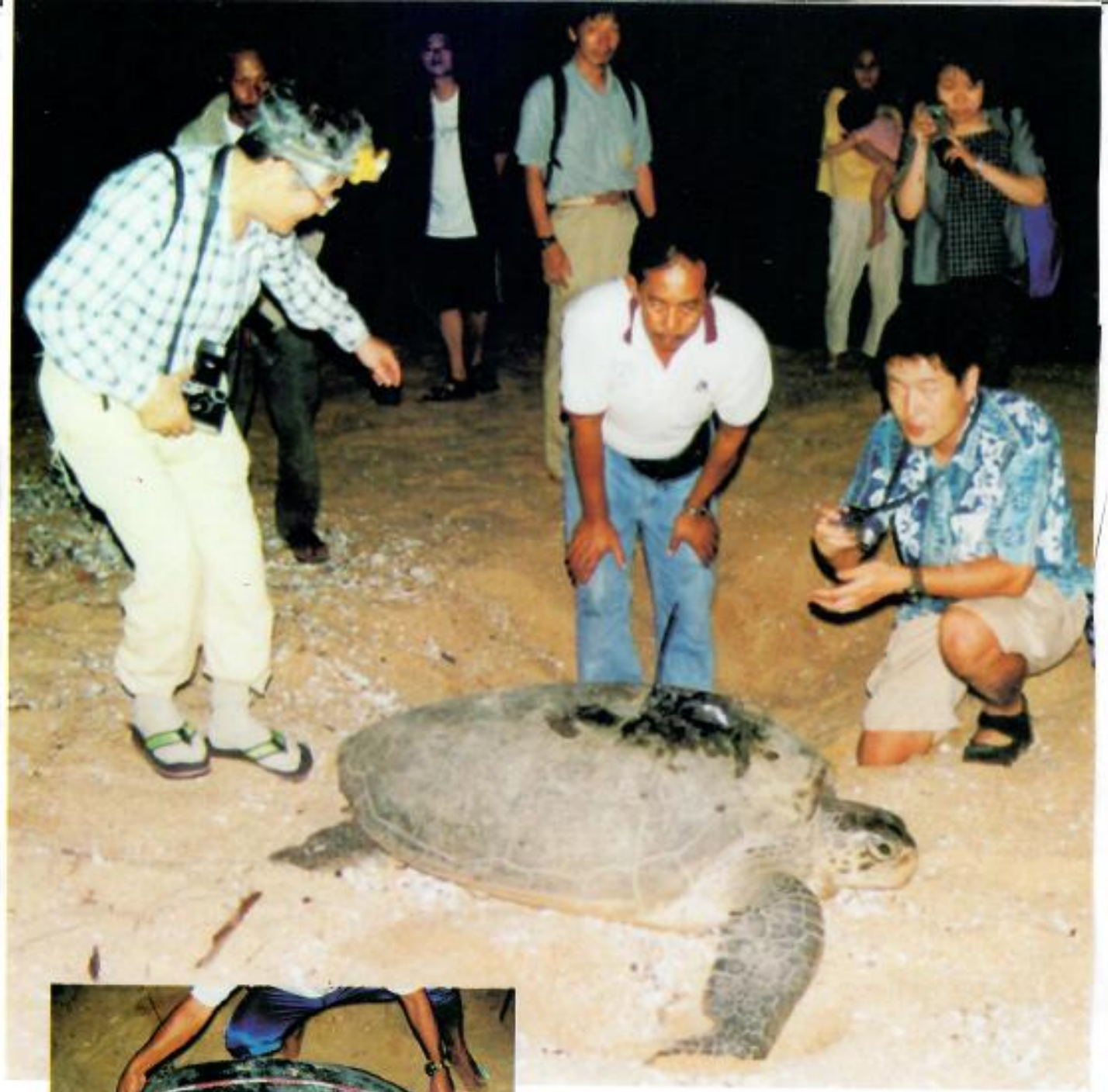
G: Involvement in other research activities such as satellite telemetry study



H: Give treatment and report of injured turtle

J: Check the carapace for any obtruding barnacles and remove them from the carapace without discomforting the turtle

I: Collecting of tissue sample for DNA analysis



K: Control of a crowd

L: Record the turtle curve carapace length

M: Record the curve carapace width

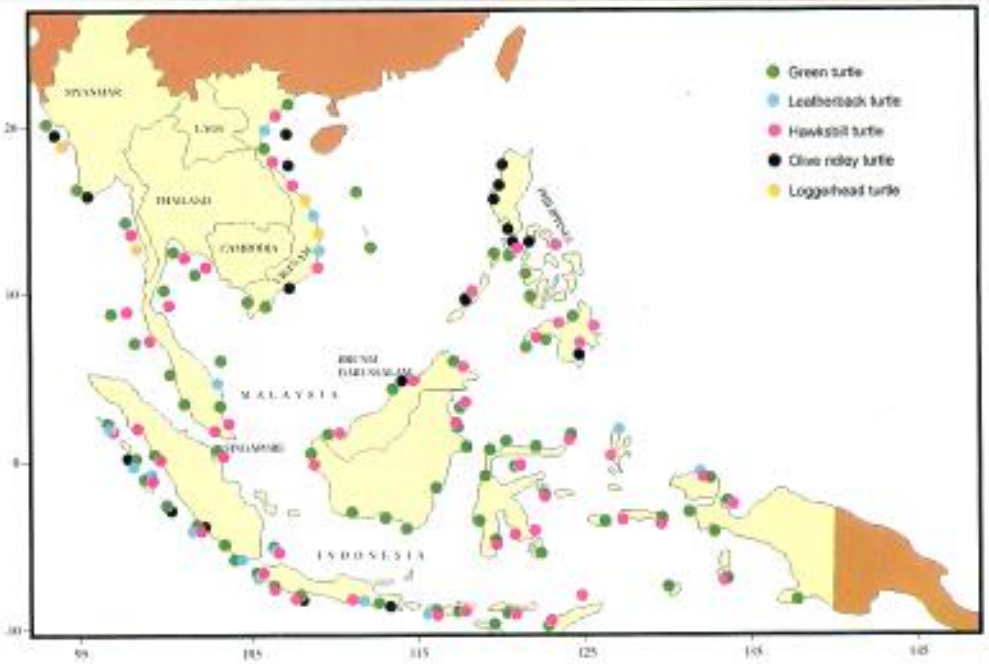


Figure 1: *Distribution of sea turtle species in the Southeast Asian region*

TARGET SPECIES

Six of seven species of living sea turtles in the world are confirmed to nest or inhabit the Southeast Asian waters, namely leatherback (*Dermochelys coriacea*), green turtle (*Chelonia mydas*), olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and flatback turtle (*Natator depressus*) (Kamarruddin, 1993; Soehartono, 1993; Palma, 1993; Chantrapornyl, 1993; Sukarno et al., 1993; Chantrapornyl, 1996 and Kamarruddin et al., 1996). All these six species are commonly found in ASEAN waters except for the flatback which is found in eastern Indonesia. The flatbacks are known to nest in Australia but the foraging areas are in the Indonesian waters. The occurrences of sea turtle nesting in the Southeast Asian nations are shown in Table 1. Indonesia has the most species of sea turtle compared with other countries in the region.

Table 1: *The occurrences of sea turtles in the Southeast Asian countries*

Country	Leatherback	Green	Hawksbill	Loggerhead	Olive Ridley	Flatback
Brunei Darussalam	x	x	x			
Cambodia	x	x	x	x	x	
Indonesia	x	x	x	x	x	x
Malaysia	x	x	x		x	
Myanmar	x	x	x	x	x	
Philippines	x	x	x	x	x	
Thailand	x	x	x	x	x	
Vietnam	x	x	x	x	x	

SPECIES IDENTIFICATION

Green turtle

Olive ridley turtle

Hawksbill turtle

Leatherback turtle

Loggerhead turtle

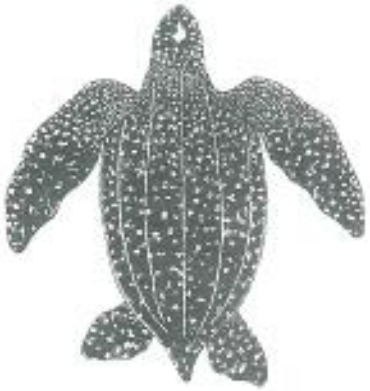
Flatback turtle
(Photo courtesy of C.J.Limpus)

KEY TO IDENTIFICATION OF ADULT/SUBADULT

The sea turtle species can be quickly and easily identified through a number of key morphological characteristics and scale information as shown in Figure 2.

This key is designed to identify subadult or adult sea turtle spotted briefly at the beach during nesting season or stranded.

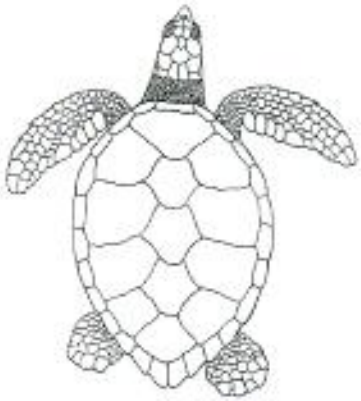
- longitudinal ridges on carapace



Leatherback turtle

- 4 pairs of costal scutes

- 2 pairs of prefrontal scales
- scutes overlapping



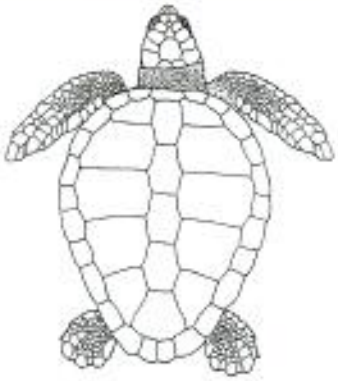
Hawksbill turtle

Figure 2: *Key to identify subadult or adult sea turtle at the beach during nesting season (Illustration from Pritchard and Mortimer, 1999)*

ITLE IDENTIFICATION KEY

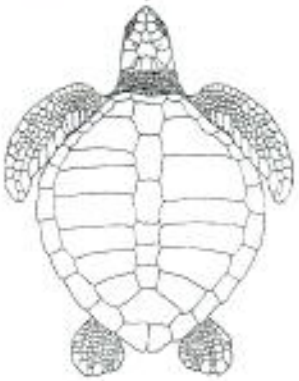
- no longitudinal ridges on carapace
- carapace with large scutes

- 5 pairs of costal scutes
- carapace longer than wide
- no inframarginal pores in plastron



Loggerhead turtle

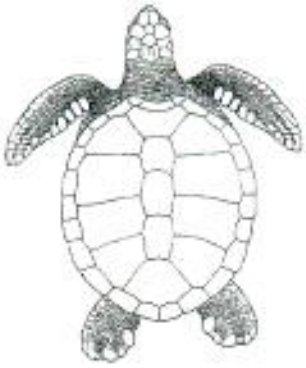
- 6 pairs or more costal scutes
- carapace approximately circular
- inframarginal pores present



Olive ridley turtle

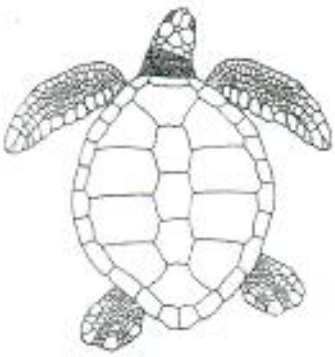
- 1 pair of prefrontal scales
- scutes not overlapping

- carapace low dome with upturned edges
- head broadly triangular and relatively flattened



Flatback turtle

- carapace high dome



Green turtle

TAGGING OF ADULT FEMALES

Under SEAFDEC Sea Turtles Program, tagging activities will be focused mainly on adult female turtles, which are encountered in nesting habitats during nesting season. Adult males are easily distinguished as having a long tail, which extends well beyond the carapace. However, care must be taken, as some large male subadults and juveniles may not have developed long tails and could therefore be mistaken for females. In foraging habitats, only adult males can be reliably identified by their long tail. All other individuals encountered could be adult females, subadult females or subadult males (that have not yet developed their long tail).

Adult males of olive ridley turtle (above) and hawksbill turtle (left) showing muscular tail which extends well beyond the margin of the carapace

COVERAGE AREA

The areas covered by standardized tagging activities in the Southeast Asian region include coastal areas of eight countries in the Southeast Asian region namely Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Vietnam. ISO codes and subarea codes are utilized to identify information gathered from the different countries within the region and within each country as shown in Table 2.

Table 2: ISO codes for the countries in the Southeast Asian region

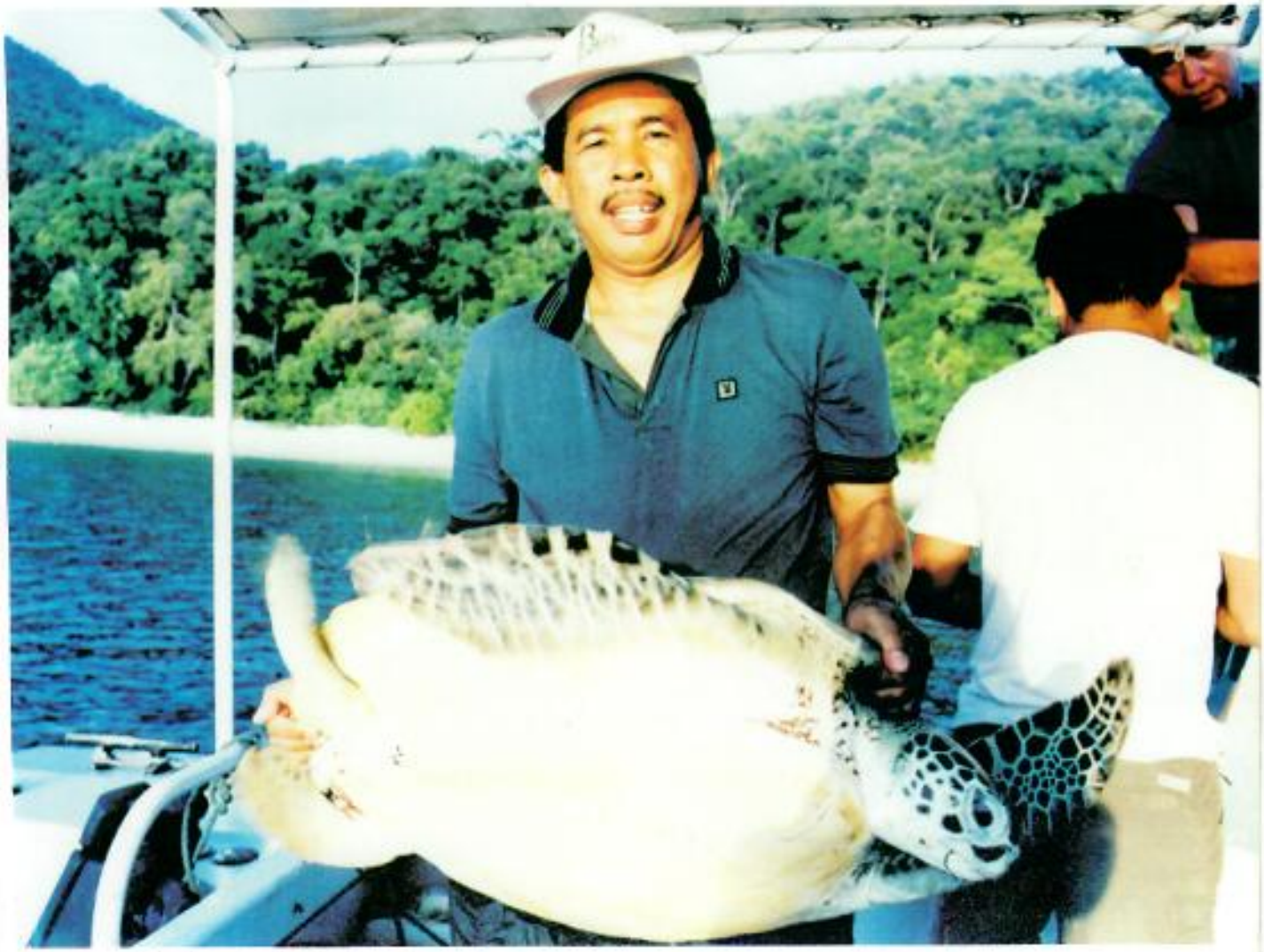
	Country and Subarea	ISO Code
1.	BRUNEI DARUSSALAM	BN
2.	INDONESIA	
	West Sumatra	ID
	South Java	ID
	Malacca Strait, Sumatra	ID
	East Sumatra	ID
	North Java	ID
	Bali, Nusa Tenggara	ID
	Kalimantan	ID
	Sulawesi	ID
	Maluku and Irian Jaya	ID
3.	CAMBODIA	KH
4.	MALAYSIA	
	Peninsular Malaysia-East Coast	MY
	Peninsular Malaysia-West Coast	MY
	Sabah	MY (S)
	Sarawak	MY (SA)
5.	MYANMAR	MM
6.	PHILIPPINES	
	Luzon	PH
	Visayas	PH
	Mindanao	PH
7.	THAILAND	
	Gulf of Thailand	TH
	Indian Ocean	TH (P)
8.	VIETNAM	
	North Vietnam	VN (N)
	Central Vietnam	VN (C)
	South Vietnam	VN (S)

TAGGING AT NESTING HABITAT

This program will focus mainly on the tagging of female turtles at nesting beaches in major turtle rookeries, as these habitats are generally easily accessible. If possible, tagging should be conducted at all turtle rookeries. However, taking into consideration of manpower, time and resource constraints, priority should be given to rookeries with highest density of turtle nestings.

Tagging at a nesting beach

TAGGING AT FORAGING HABITAT, HEADSTARTING PROGRAM, INCIDENTAL CATCH AND OTHERS



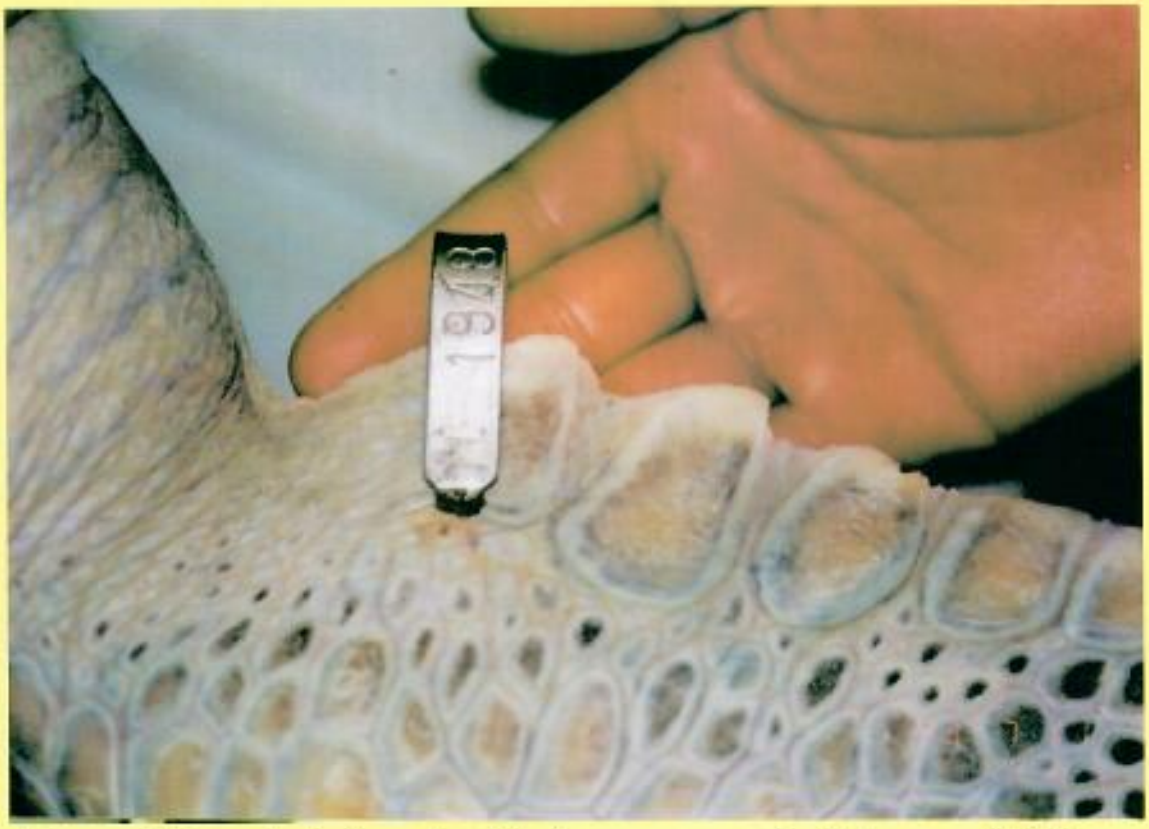
Tagging turtle by hand capture

Tagging can be made on turtles left in the intertidal area during low tide, or on those caught by nets or from headstarting programs. Tags can also be applied if sea turtles are found in areas identified as foraging habitats.

Tagging turtles incidentally cought by fishing gear

(Photo courtesy of Mr. Pich Sereywath)

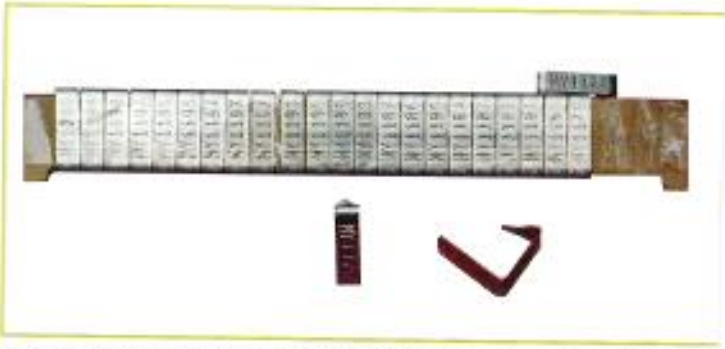
A tag being applied on turtle from headstarting programs



A tag applied on turtle from headstarting programs should be more flexible than that of for adults

TAGS AND TAGGING EQUIPMENT

External Applied Tags



Inconel tag used in SEAFDEC Member Countries

There are several types of flipper tags available in the market. The tags provided by SEAFDEC-MFRDMD to Member Countries are Inconel self-piercing metal tags sized 681. This metal tag is easy to use. When the applicator is squeezed, the sharp point of the tag pierces through the flipper and passes into a hole in the opposite end of tag, where it bends over and locks into place. Inconel and titanium tags are equally resistant to corrosion in sea water. Inconel tags have shown no visible signs of corrosion after being attached for 21 years to an adult green turtle in captivity at Sea Life Park Hawaii (Balazs, 1999). Each tag will be identified by a serial number and the name of the relevant institution.

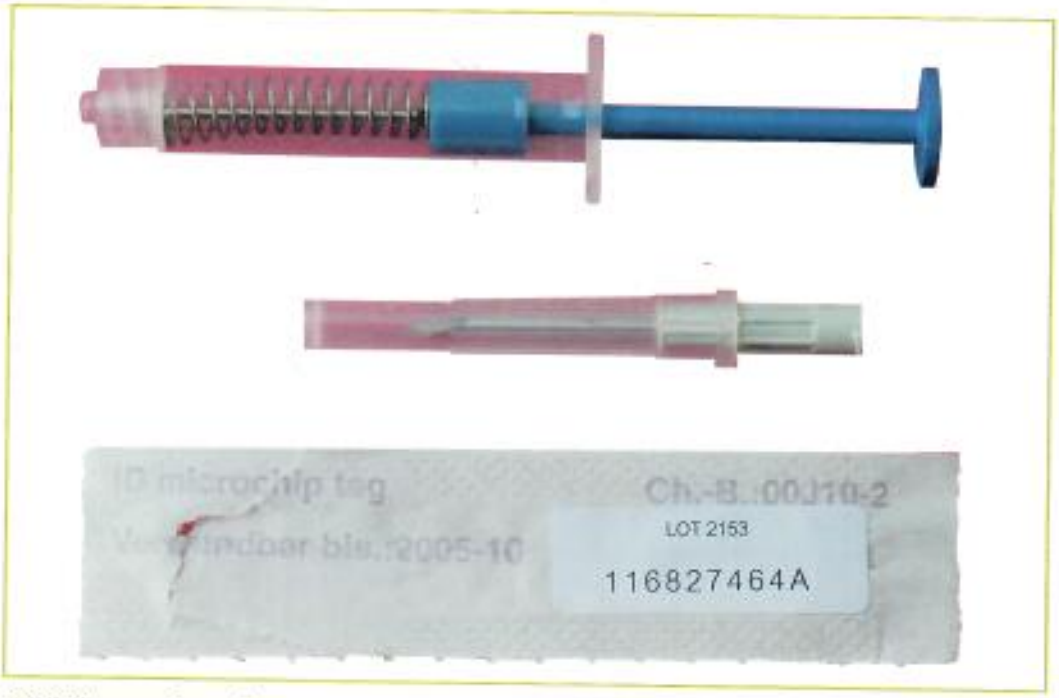
- Tag serial number is printed on the top face of the tag. It consists of two or three capitalized letter of ISO country codes, followed by numbers. The ISO country codes and serial numbers for each country are as shown in Table 3.

- Name of institution and permanent address are printed on reverse face of the tag. The institution's name is usually abbreviated.

Table 3: Country codes, number of tags and serial numbers of Inconel tags sized 681 provided by SEAFDEC-MFRDMD to Member Countries from 1998-2002

Country	Country Code	No of Tag Sent	Serial Number
BRUNEI DARUSSALAM	BN	300	BN0001 to BN0300
CAMBODIA	KH	300	KH0001-KH0300
INDONESIA	ID	2,000	ID0001-ID2000
MALAYSIA	MY		
Peninsular Malaysia		2,000	MY0001-MY2000
Sabah		1,000	MY(S)0001-MY(S)1000
Sarawak		1,000	MY(SA)0001-MY(SA)1000
MYANMAR	MM	1,000	MM0001-MM1000
PHILIPPINES	PH	2,000	PH001-PH2000
THAILAND	TH	1,100	
Andaman Sea			TH(P) 0001-TH(P)1000
Gulf of Thailand			TH0001-TH0100
VIETNAM	VN		
North Vietnam		200	VN(N)0001-VN(N)0200
South Vietnam		200	VN(S)0001-VN(S)0200
Central Vietnam		200	VN(C)0001-VN(C)0200

NOTE: If there is any new tagging program planned to be conducted in this region, responsible officer(s) should find out what tag numbers have been used in the region in order to avoid duplication.



PIT Tag and a plunger used in SEAFDEC Member Countries

Passive Integrated Transponder Tags (PIT Tags)

Passive Integrated Transponder or PIT tags are small inert microprocessors sealed in glass that can transmit a unique identification number to a hand-held reader when the reader briefly activates the tag with a low frequency radio signal at a close range. This is a relatively new innovation in sea turtle research. PIT tags have the advantage of being encased in glass and positioned inside the turtle tissue where loss or damage over time from abrasion, breakage, corrosion or tearing should be virtually non-existent. PIT tags therefore offer the promise for reliably retaining the identification of individual sea turtles for decades, something that is not considered possible with externally applied tags. PIT tags used on sea turtles range from 11.5 x 2.1 mm to 20.0 x 3.2 mm. Large PIT tags can be read from a greater distance than the smaller one (Balazs, 1999). The SEAFDEC Member Countries used pre-sterilized PIT tags with a disposal injector model Ch.-B.:00J10-2 and a reader model Power TracKer II (All Weather Extended Range Multi Tag Reader) manufactured in USA.

A PIT Tags' reader used in SEAFDEC Member Countries

Inconel tag applicator (right) and PIT tags' plunger (left)

Tag Applicators

Metal tags require a special applicator for proper attachment. When the applicator is squeezed, the sharp point of the tag pierces the flipper and passes through into a hole in the opposite end of the tag where it bends over and locks into place.

NOTE: It is important to note that no other instrument shall be used to apply the tags other that the specially designed tag applicators.

Tag applicator should be checked and cleaned on regular basis to avoid rusting

Caring of Tagging Equipment

All applicators should be checked and cleaned regularly and discarded when they cease to function properly. Tags should be kept in a dry room to avoid rusting. During storage, the applicators should be greased. PIT tags and readers should be kept in a cool and dry environment. Batteries of readers should be taken out at the end of nesting season to avoid being oxidized.

Metal tags must be cleaned in warm soapy water prior to usage to remove lubricating oil or other residue resulting from the manufacturing process. Soaking the tags in alcohol as a final step may also be advisable to disinfect and prevent transmission of disease to the turtle.

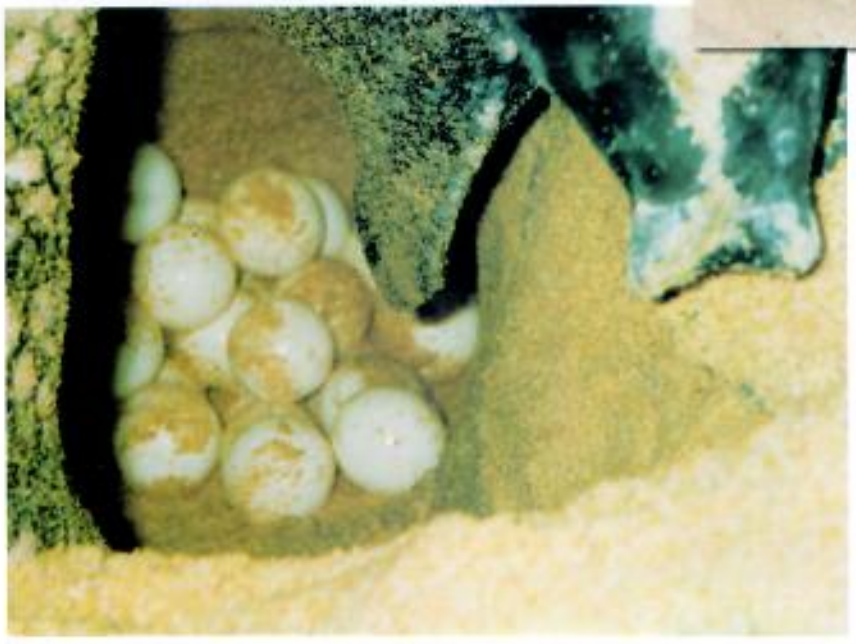
TAGGING PROCEDURES

When To Tag?

Since tagging activities are expensive to implement, some countries cannot afford to continue their tagging activities for the whole season. In this case intensive tagging activities should be conducted continuously for at least 3 months during the peak nesting season of major rookeries. All efforts should be focused to tag 100% nesters in order to gather information of adult females for every nesting season.

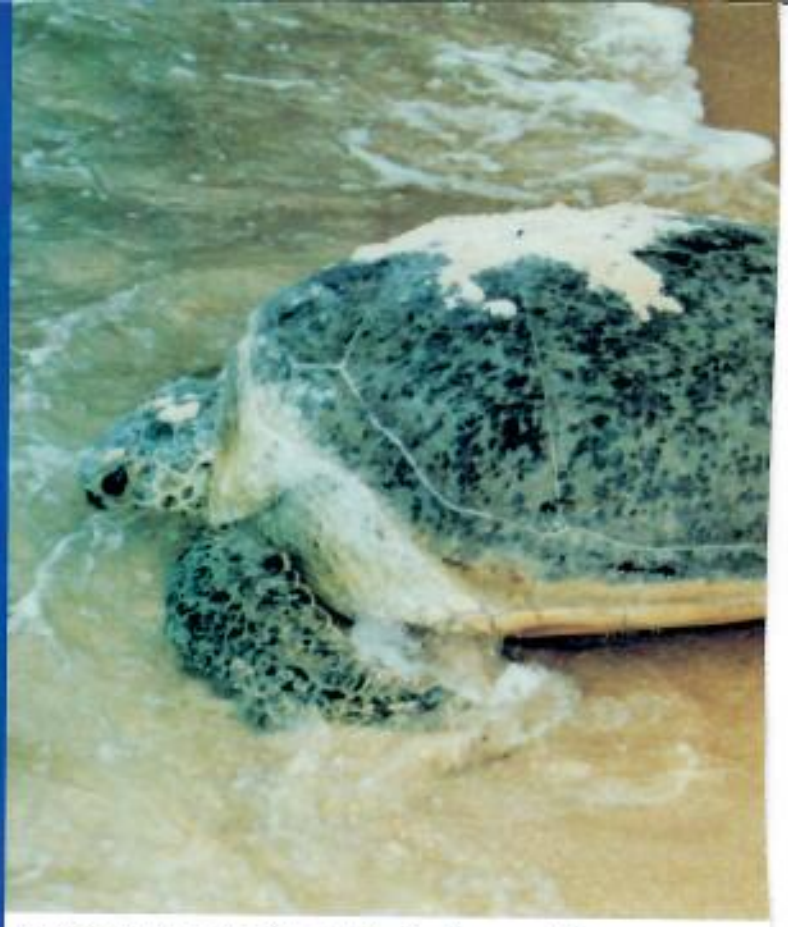
The decision of when to tag also relates mainly to nesting females. When conducting tagging studies that involve beach patrolling, care must be taken not to disturb the nesting process. If a female is encountered emerging from the water, wait motionless for her to crawl onto the dunes before continuing beach patrol. She should be allowed to lay her eggs before tagging take place. Nesting sea turtles are easily disturbed by lighting and movement on the beach. Therefore, dark clothes are recommended to be worn and the use of torchlight is to be minimized. When a nesting female is encountered the following rules from Plate A to E must be obeyed:

A: Always approach the turtle from behind in a crouching position



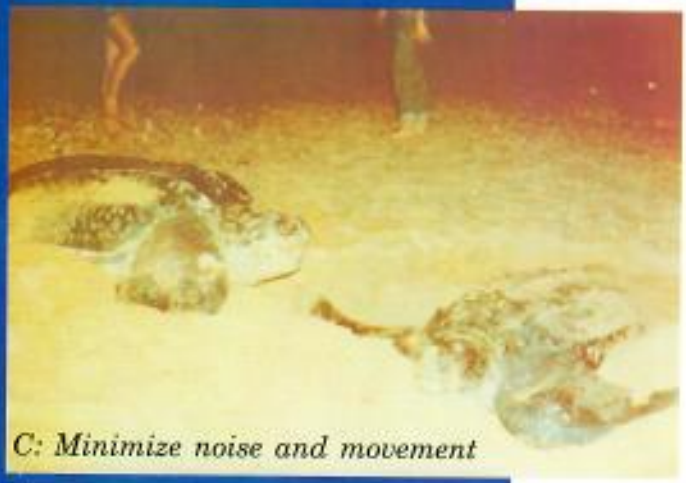
B: No use of torchlight until oviposition is complete

Some researchers feel the best time to tag is immediately after egg deposition when back-filling of the egg chamber starts with the hind flippers. If tagging is done prior to this time, some turtles will prematurely return to the sea but will usually emerge again to nest on a subsequent night. Tags can also be applied when nesting female turtles are on their way to the sea. In this case, a worker can place himself in front of the turtle and use both hands to cover the turtle's eyes with strong downward pressure to stop it from moving, while the other worker can apply the tags. Turtles should never be turned onto their backs.



D: Tags can also be applied when nesting female turtle is on her way to the sea

E: Turtle can be tagged at any time after oviposition



C: Minimize noise and movement

Tag applicator should be checked and cleaned on regular basis to avoid rusting

Caring of Tagging Equipment

All applicators should be checked and cleaned regularly and discarded when they cease to function properly. Tags should be kept in a dry room to avoid rusting. During storage, the applicators should be greased. PIT tags and readers should be kept in a cool and dry environment. Batteries of readers should be taken out at the end of nesting season to avoid being oxidized.

Metal tags must be cleaned in warm soapy water prior to usage to remove lubricating oil or other residue resulting from the manufacturing process. Soaking the tags in alcohol as a final step may also be advisable to disinfect and prevent transmission of disease to the turtle.

Who Will Tag?

There is an element of risk to inexperienced workers when tagging large turtles on a nesting beach. Powerful, fast and unexpected swings of the front flippers can inflict painful blows. Tag applicators which is not gripped firmly may be turned into a hazardous projectile as a result of violent flippers movements. Sand on nesting beach can be flung by flippers with incredible force creating a danger to the worker's eyes if caution is not exercised. All workers should wear durable shoes to protect against foot injury from nesting turtle that suddenly decide to crawl while being tagged. The sharp point of a metal tag and the injector needle of a PIT tag are also hazardous and may cause injury.

Difficulties in applying Inconel tags may result in the incomplete sealing of the tag's point or the point is prematurely bent before passing through the hole. PIT tags can sometimes move within body tissue or lost if not carefully inserted.

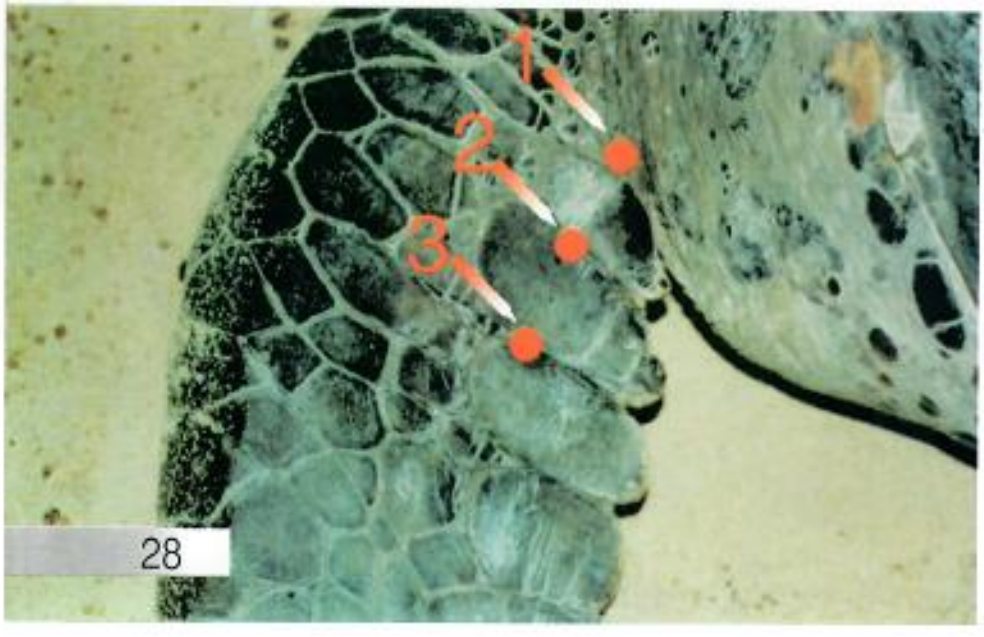
All workers should be fully trained prior to conducting tagging on their own. A comprehensive training program should include classroom and field sessions. Classroom training should include slides or video show of the past tagging activities conducted by experienced staff. New staff should work side-by-side with experienced staff until they are fully confident of their ability to tag using external or PIT tags.

New workers should be fully trained prior to conducting tagging on their own

Powerful, fast and unexpected swings of the front flippers can inflict painful blows

Where To Tag?

External tags used on the front flippers should be attached at a proximal location, where the swimming strokes will cause minimal up-and-down movement of the tags. Tags have also been applied with success to the hind flippers of immature and nesting females especially leatherbacks (Balazs, 1999). Never apply tags directly through scales as these grow similar to fingernails and tags will eventually drop off. Some workers use the site proximal of and adjacent to the first large scale or between the two large scales. On hind flippers, the tagging site is proximal of and adjacent to the first large scale. Due to the tag loss, double tagging (one tag on each of the flippers) is now a standard procedure.

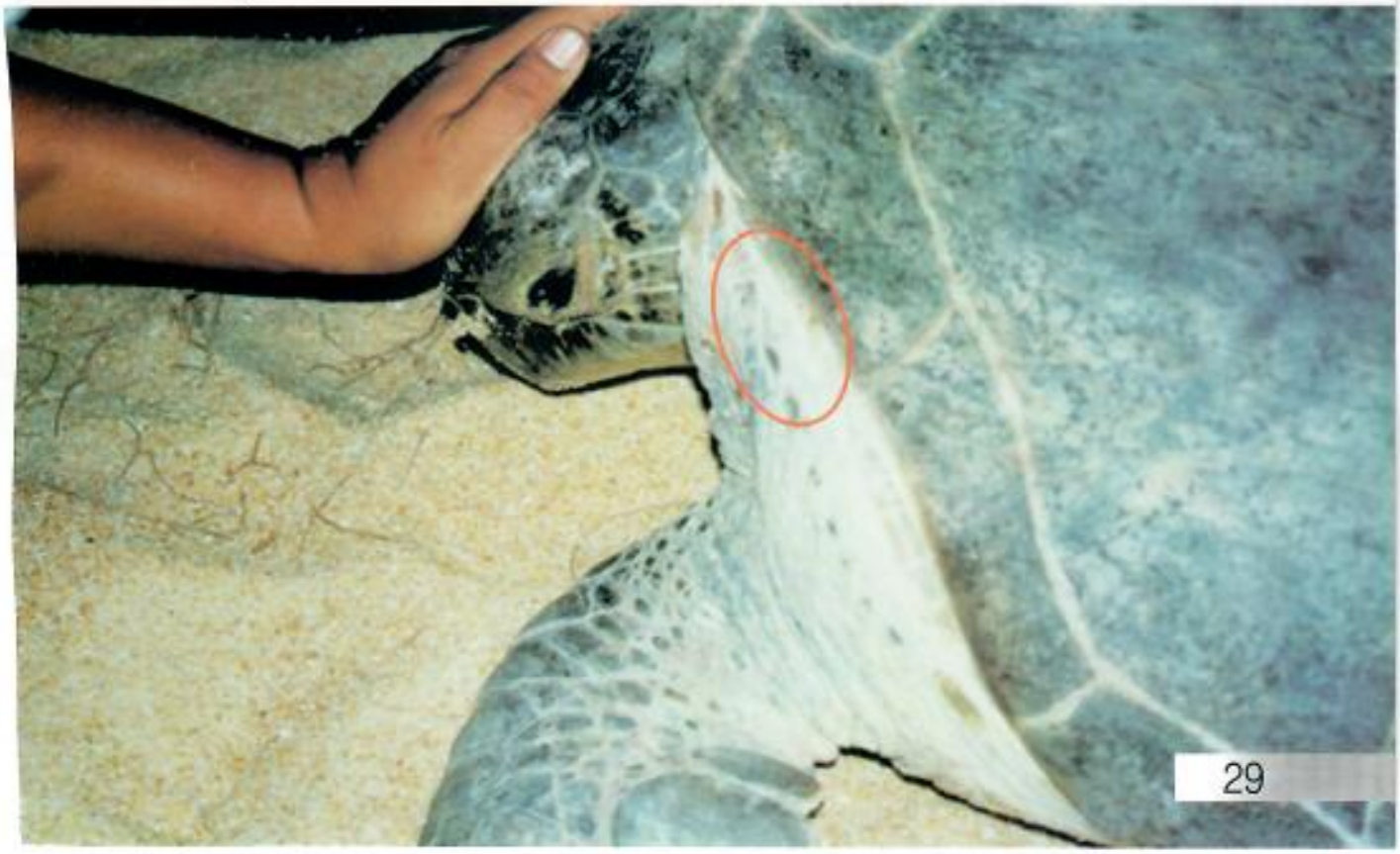


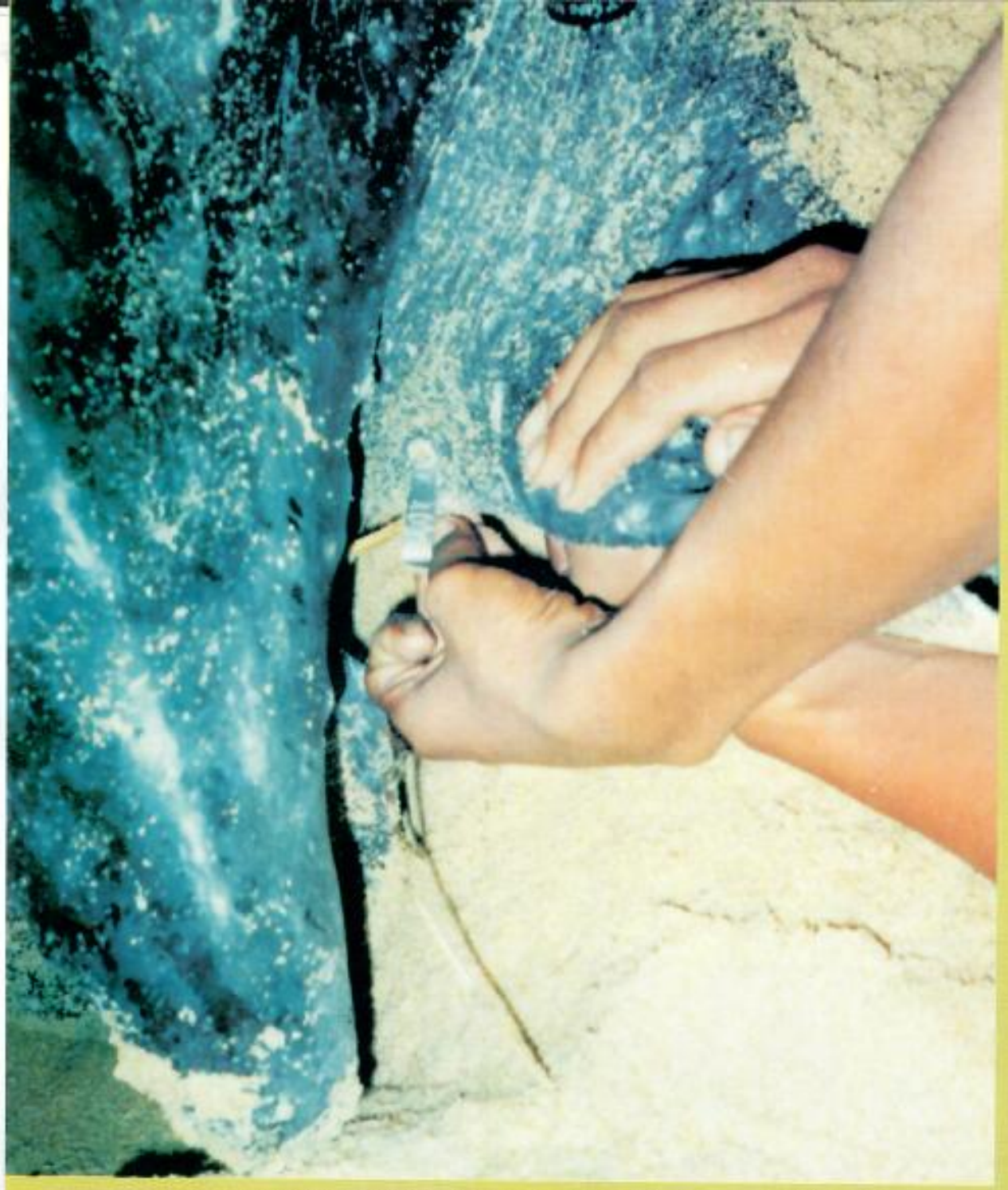
Recomended tagging positions for front flippers of all species except leatherback

Never apply tags directly through scales

For PIT tags, all workers should insert the tag into a turtle's shoulder muscle (muscle tissue under the carapace on the left side of all turtle species between flipper and head). By standardizing the PIT tag insertion area, the scanning of any nesting sea turtles that have been previously tagged will be more easily done by workers.

Standardized PIT tag insertion area for all sea turtle species in the Southeast Asian region





A leatherback turtle with a titanium tag applied to a right hind flipper

Leatherback Turtle

For the leatherback turtle, tags are usually fixed adjacent to rear flippers. Tags are applied on the tissue between the tail and the hind flippers on both sides as shown above.

All Other Species

For all other species, tags are applied to the front flippers. The optimal tagging site is adjacent to the first large scale on the proximal edge. If that site is unavailable due to tissue damage etc., tags should be applied between the first and the second scales or the second and the third scales.

Olive ridley turtle

Green turtle

Flatback turtle (Photo courtesy of C.J.Limpus)

Hawksbill turtle

Loggerhead turtle

How To Tag?

Once the nesting female has completed oviposition or a foraging sea turtle has been captured, the following tagging steps should be followed:

Tagging Using Inconel Tag

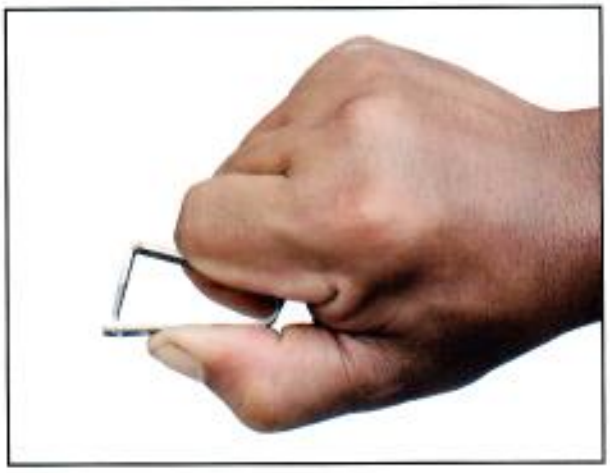
- Step 1: Check flippers for previously applied tags and/or tag scars: If the nesting female has been previously tagged, record country code and number. If the tag number is unidentifiable by barnacles, remove it. Old tags found on the recaptured turtles that are unreadable due to corrosion or being embedded with tissue should be removed and replaced with a new tag. If a turtle from a different program is re-tagged, the original tagger should be informed of the change.

Step 1: Check flippers for previously applied tags and/or tag scars

- Step 2: Clean tagging site: Precaution needs to be taken to prevent the spread of infectious diseases during tagging. Some researchers apply Betadine, 70-90% alcohol, antibiotic ointment, or other agents on flipper where the skin is to be pierced by the tag. All metal tags must be cleaned prior to use to remove lubricating oil or other residues resulting from manufacturing process. Soaking the tags in alcohol as final step may also be advisable (Balazs, 1999).

Step 2: Clean tagging site

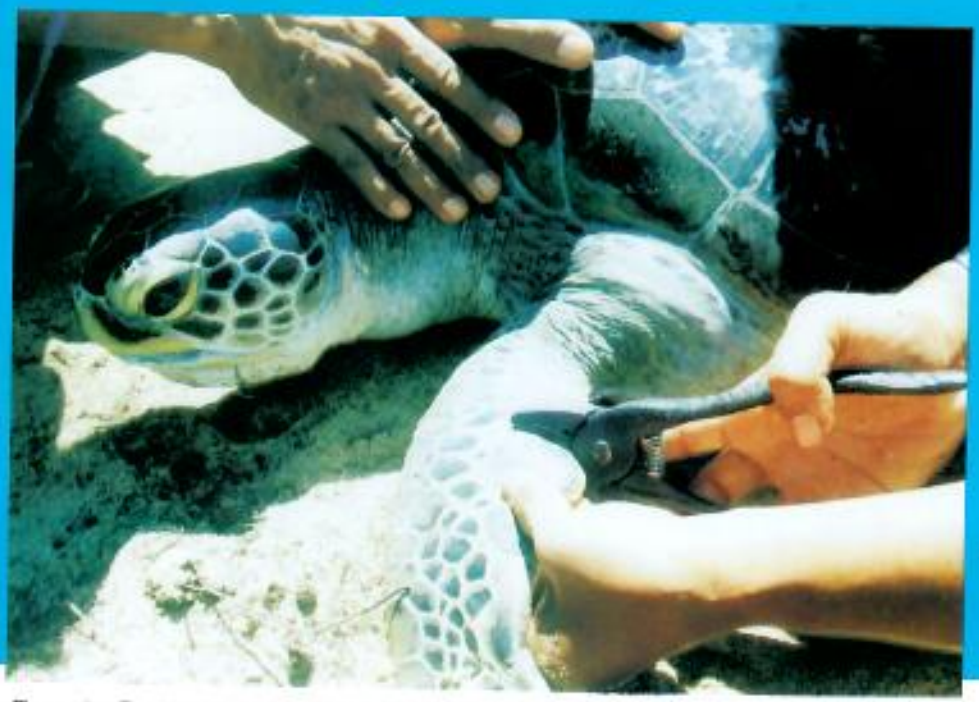
- Step 3: Check alignment of tag: This can be done by gently squeezing the tag between the fingers to ensure the piercing tip is aligned with the hole on the opposite face. Tag that fails to lock when applied to a turtle is difficult to re-apply, even by using the additional tools.



Step 3: Check alignment of tag

- Step 4: Insert tag into a tag applicator: Make sure the tag clicks in securely and the hole of the tag is above the indent of the applicator. This ensures that when the self-piercing tip goes through the hole it will bend around and secure the tag properly. Mark one jaw of the applicator with colour paint as a reminder of the correct way to insert the tag.

- Step 5: Position the tag over the tagging site: Ensure that the piercing tip is placed between the scales on the dorsal surface of the flipper and the inside bend of the tag is lightly touching the proximal edge of the flipper. Placing the tag too far onto the flipper will restrict its movement and placing the tag too close to the proximal edge of the flipper may result in tag loss.



Step 5: Position the tag over the tagging site

Step 4: Insert tag into tag applicator

- Step 6: Apply the tag: There are two distinct motions in applying metal tags. The first step is to squeeze the applicator firmly so that the tag's tip pierces the flipper. The second step, a moment later, involves a greater force to ensure the tip correctly interlocks through the hole. It is recommended that both hands are used and the applicator is gripped as far back as possible to obtain maximum leverage. Caution must be taken because piercing of the tag often causes sudden movements of the flipper. Powerful flipper strokes can also throw sand in eyes and cause foot and hand injuries.

Step 6: Applying the tag

- Step 7: Check correct tag application: After attachment, check that the tip has been properly interlocked through the hole. The tip of the tag should overlap the edge of the hole by at least 3 mm. If the overlap is insufficient, carefully fit the tag back into the applicator and apply greater pressure. If this is still unsatisfactory, remove it and apply another tag carefully to minimize discomfort to the turtle.

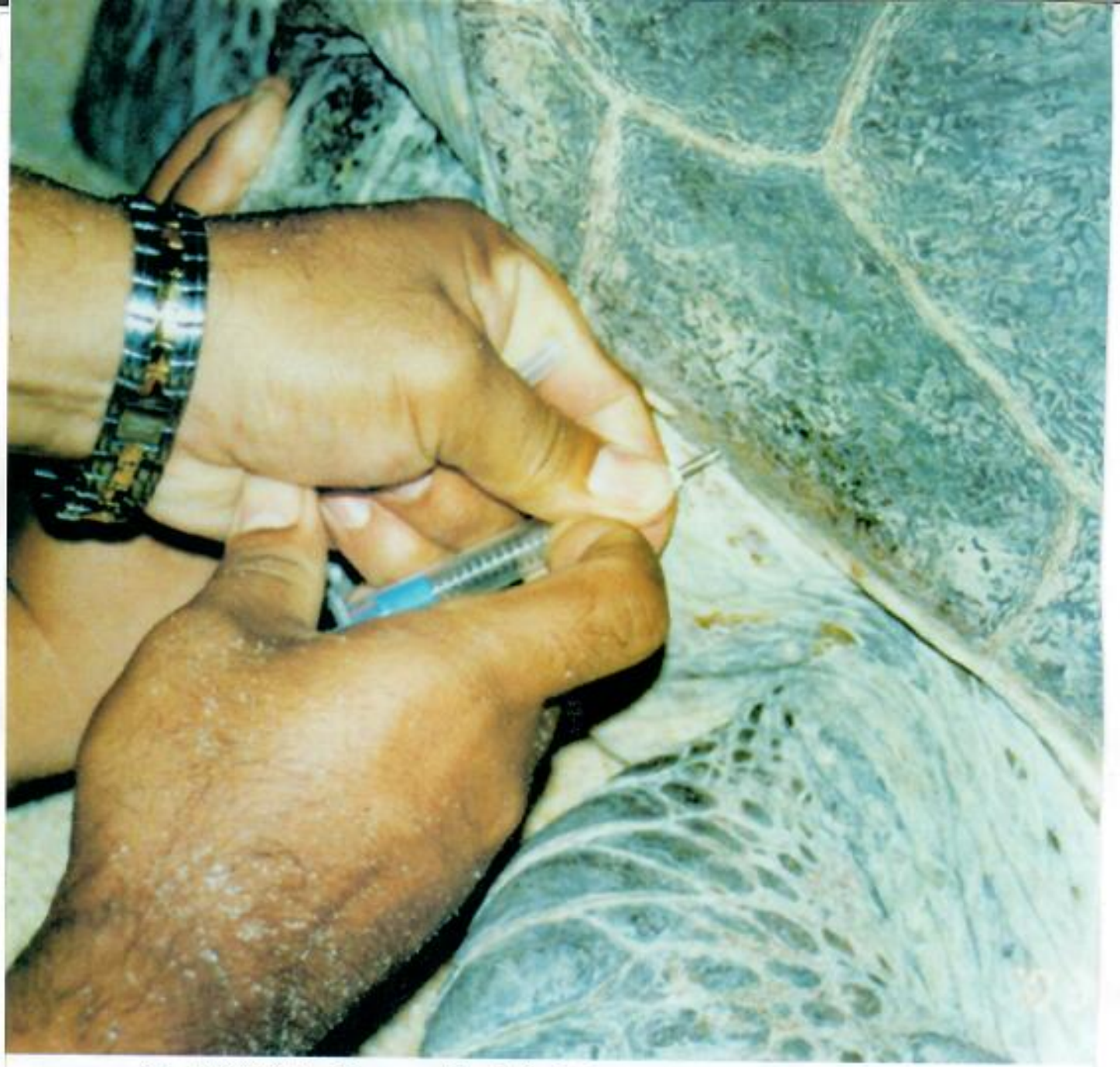
Step 7: Check correct tag application

Tagging Using PIT Tags

PIT tags are easier to apply for the experienced workers. However, all workers should take care of the injector's needle of a PIT tag that can cause injury to a finger or other body parts if the turtle suddenly moves when the tag is injected into the muscle tissue. In addition, PIT tags can sometime move within body tissue or lost if not properly injected. Before inserting PIT tag into the muscle tissue, it is important to check whether it is still functioning. This can be done by scanning a PIT tag at a close range. A serial number of tag printed on the pack should be similar with that shown on the reader's screen. The following steps have been found to be safe and effective in applying PIT tags:

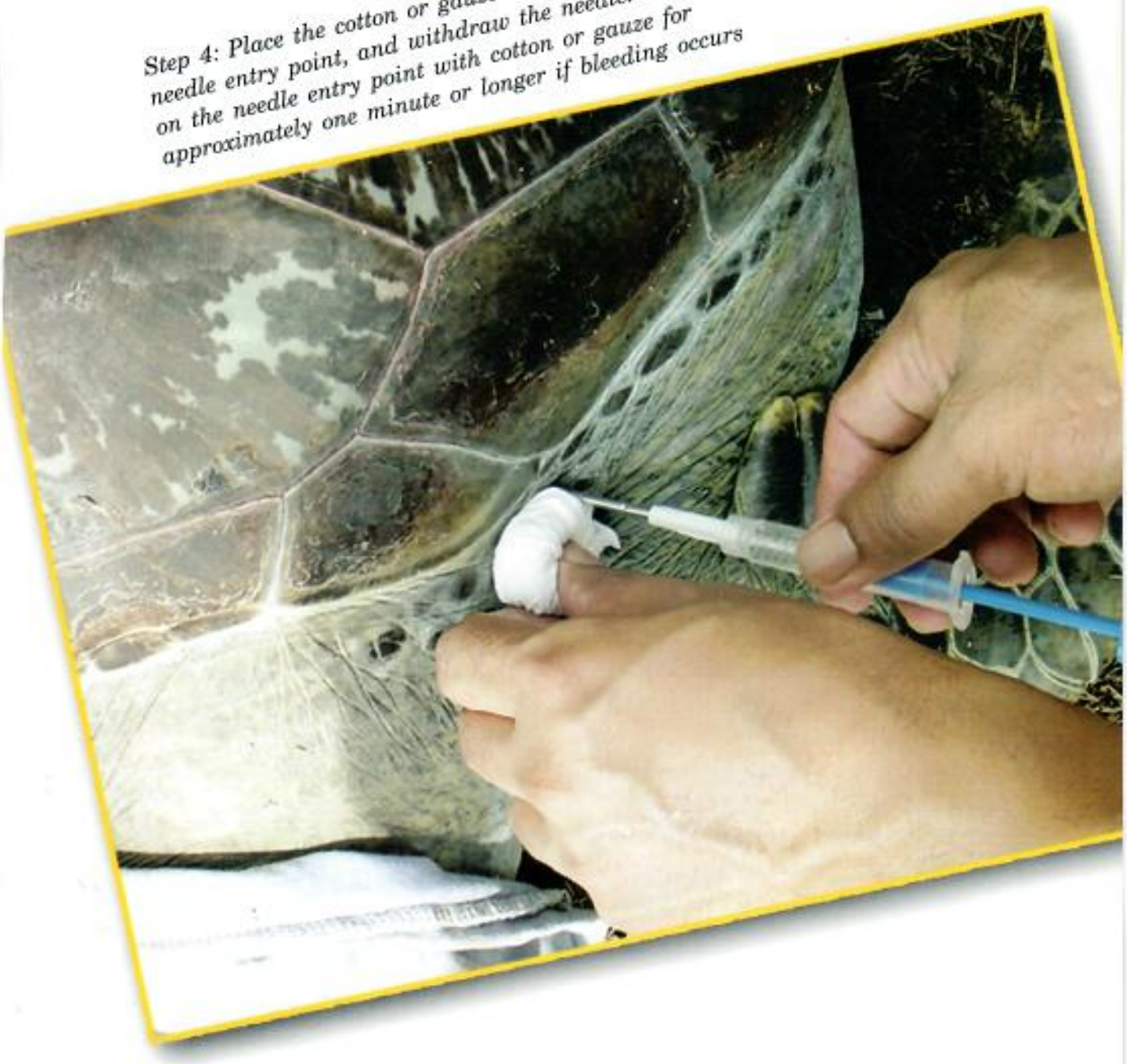
Step 1: Identify the area where the tag will be applied. Clean away all sand and debris and apply with antiseptic

Step 2: Prepare the PIT tag needle and sterile gauze/cotton soaked with an antiseptic solution



Step 3: Hold the flipper and head firmly (get assistance if necessary) so the flipper cannot move; and insert the tagging needle into the muscle tissue (about 1-2 cm) and use the plunger to insert the tag through the needle

Step 4: Place the cotton or gauze with antiseptic over the needle entry point, and withdraw the needle. Keep pressure on the needle entry point with cotton or gauze for approximately one minute or longer if bleeding occurs



Step 5: Switch on the reader and swipe at a close range to insertion area. The reader will show a serial number of PIT tag on the screen if tagging is successful. If not, scan again at the PIT tag needle. In rare cases PIT tag remained inside injector if the plunger is not completely pressed

Disease Precautions

Precautions need to be taken to prevent the spread of infectious diseases during tagging. Tag applicators must be disinfected after coming into contact with blood or other fluids. Two complete sets of tagging equipment are recommended; one set for turtles that are diseased and the other set for apparently healthy turtle. Used tagging equipments should never be transferred between projects in different regions (Balazs, 1999)

Keep the injector needle safely for proper disposal

COMPLETING TAGGING DATA SHEETS

The important issue in conducting turtle tagging program is the need to accurately record and store for future retrieval the tag serial number, tag type, tag size, date, place of tagging, and all data as listed on tagging data sheet and adult scales count as shown in Appendices I and II. All data sheets should be completed for every turtle encountered in a tagging study. The common tagging parameters collected are categorized into the following;

Date and Time

This refers to the date and time of encountering the turtle. In order to categorize all nesting turtles from one night into the same date, the turtle date has been established. Turtle date is the 24-hr period from 12 noon to 12 noon the following day (Example: Turtle date 15th May 2005 is the period from 12 noon 15th May 2005 to 12 noon 16th May 2005.)

Location Data

i) Country code (ISO code)
ii) State/district
iii) Name of beach
iv) Sector of beach (if applicable)

Tag Data

Record the tag serial number and position of newly applied and recaptured (previously applied) tags. The tag serial number must include the prefix denoting the country. The location must include the flipper tagged and the position of the tag on that flipper. (Codes for tagged flippers is as shown on the left).

Code	Flipper
LF	Left Front
RF	Right Front
LH	Left Hind
RH	Right Hind

(Example: A tag applied to position 1 on the Left Front flipper will be denoted as LF1)

Species Data

Six species of sea turtle are listed. Tick only the appropriate box.

Species	Code	Tick appropriate box
Green	CM	( )
Leatherback	DC	( )
Loggerhead	CC	( )
Hawksbill	EI	( )
Olive ridley	LO	( )
Flatback	CC	( )

Measurement Procedures

Sea turtles are measured to accomplish a number of objectives, and there are many technique and equipment options. Sea turtles are measured on nesting beaches to relate body size to reproductive output, to determine minimum size at sexual maturity, and to monitor nesting female size for a particular rookery. At the foraging ground they are measured to determine frequency of size classes present as well as to monitor growth rates. The size frequency of a population is an important parameter of that population's demographic structure. Analyses of growth rates can indicate habitat quality and physiological status. Linear measurements can either be taken with calipers (straight-line measurements) or with a flexible tape measure (curve measurement). Measurements should be made in metric units (Bolten, 1999).

For the purpose of this tagging program, the curved carapace length (CCL) and the curved carapace width (CCW) will be measured. These measurements are compulsory for any nester when she is tagged for the first time.

Curved measurement tend to be less accurate and less precise because of irregularities and epibionts on the surface of the turtle's shell. However, flexible tape-measures are relatively less expensive than the calipers and more convenient to carry and maintain. Flexible, fiberglass tape-measures are better than metal tape-measures for curved measurements because they are more closely conform to the shape of the shell and do not corrode. Cotton tape-measures should be avoided because they stretch easily. Tape-measures should have metric units. To ensure accuracy and precision, the length of the tape-measure should exceed the maximum expected length of the turtles, so that the reported lengths are the result of a single measurement rather than the sums of partial measurements. Epibionts interfering with measurements should be removed when the accuracy of the measurements is important (Bolten,1999). Normally, researchers measured CCL and CCW of a nester only one time during the same nesting season. A flexible tape-measure should be regularly calibrated against a steel tape-measure. Accuracy can be maintained by having only one individual takes all measurements.

Curve Carapace Length

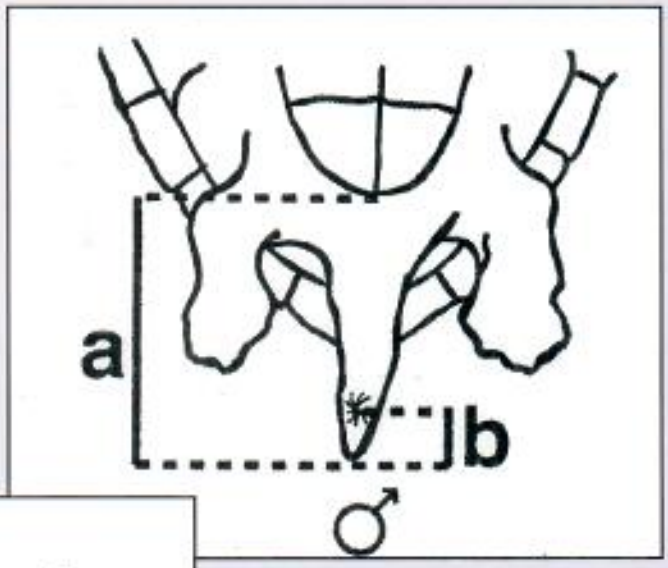
Curved carapace length is measured from where the skin of the neck meets the shell at the anterior point of the carapace along the midline to the posterior notch.

Curve Carapace Width

Curve carapace width is measured at the widest point of the carapace and position may differ between individuals.

Measurements of Other External Organs

The head width, plastron length and tail length are less frequently measured in sea turtles than the carapace length. The head width is measured at the widest point with calipers. Plastron length should be measured with calipers along the midline from the anterior edge to the posterior edge of the underlying bone when it extends beyond the scutes. Total tail length (TTL) is the distance from the midline of the posterior margin of the plastron to the end of the tail following the curvature of the tail. Post-cloaca tail length (PTL) is the distance from mid-cloaca opening to the end of the tail following the curvature of the tail (Bolten, 1999).



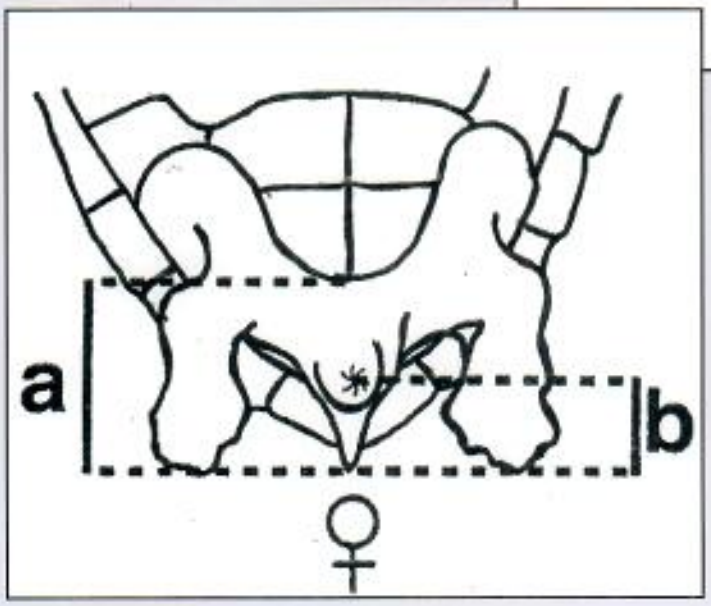


***Figure 3**: (a) Total tail length and (b) post-cloacal tail length of adult male (right) and female turtles (below) (Illustration from Bolten, 1999)*

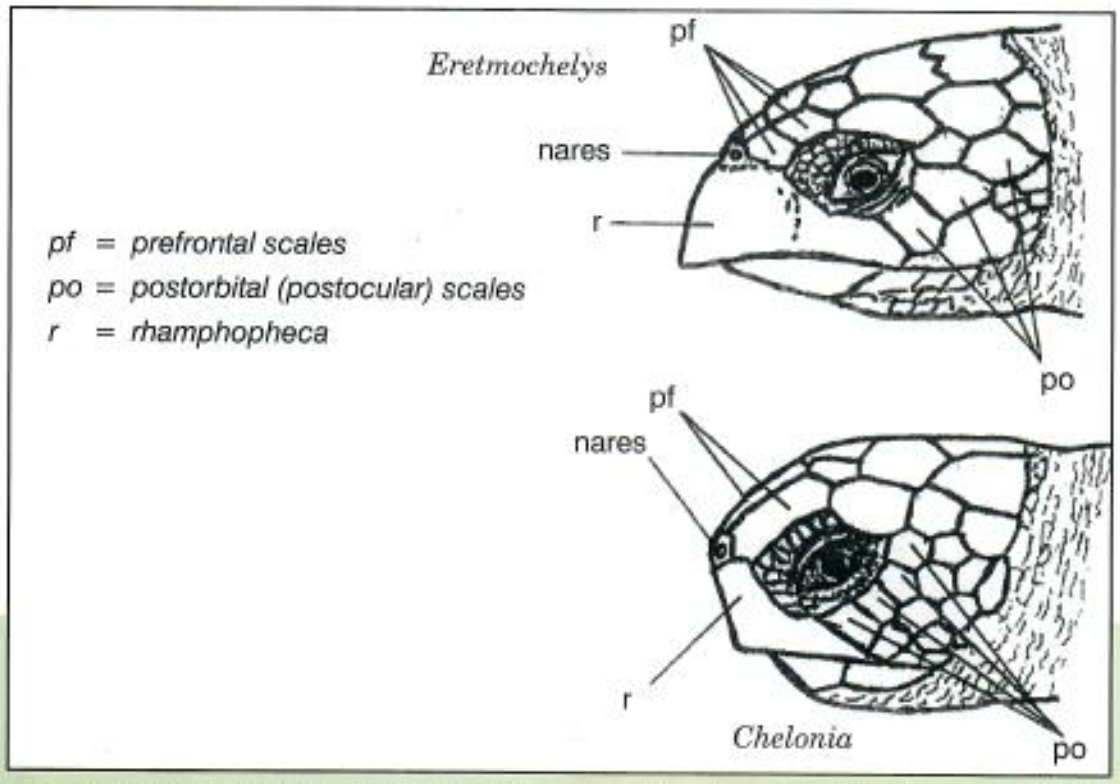


Figure 4: *Anatomical features of sea turtle heads noting the locations of the prefrontal and postorbital scales which are diagnosed in the identification of some species (Illustration and text from Pritchard and Mortimer, 1999).*

Scale Counts

Scutes are cornified plates forming the surface of the shell of all sea turtles species except for leatherback turtle. Scale counts should be made on all nesting females and recorded on the back of the adult scale count data sheet (Appendix II). The number of scales will differ between and within species so care must always be taken to correctly count the scales. The nomenclature suggested by Pritchard and Trebbau (1984) is recommended and summarized as follows;

- Vertebral scutes are the large scutes along the midline of the carapace.
- Costal scutes are the large scutes forming a longitudinal series on each side of the vertebral.
- Marginal scutes are the numerous small scutes around the edge of the shell, except the median scute on the midline anterior to the vertebrals (which is the nuchal scute) and the paired posterior marginals (which are the supracaudal scutes)

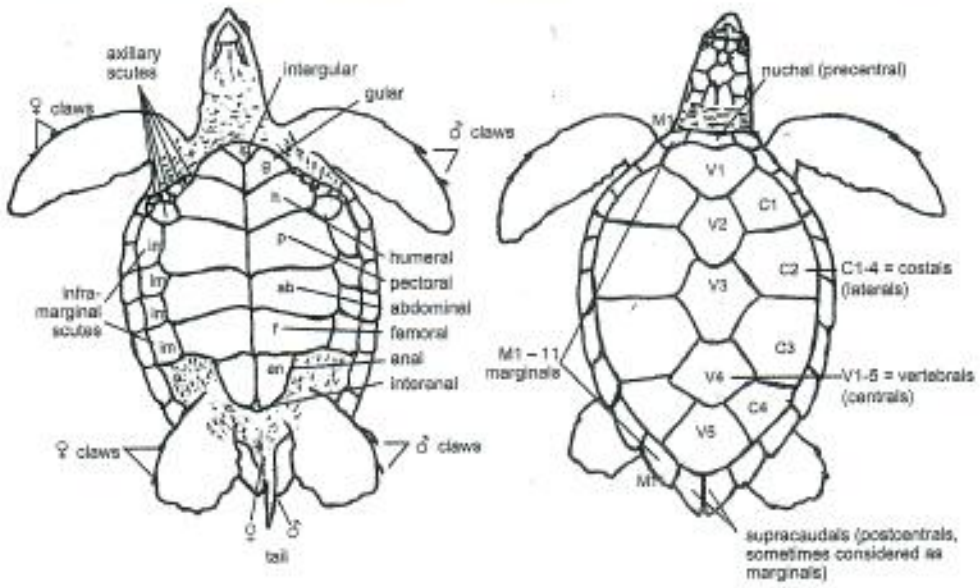


Figure 5: *External morphological features of adult sea turtles plastron (lower shell) and carapace (upper shell) for family Chelonidae. (Illustration and text from Pritchard and Mortimer, 1999)*

Record any damage or commensals

Damage and Commensals

Any damage or commensals (barnacles, algae, mud, etc.) observed should be recorded and indicated on the turtle sketch in the tagging data sheet.

NESTING INFORMATION

Naturally, sea turtles lay their eggs at various habitats on beach slope or dune in order to maintain natural sex ratio. These include bare sand, grass, under shrub, under tree etc. Information on the nesting patterns of a population combined with other information could be used to estimate sex ratios. It is necessary to know where the turtles are nesting on the beach, and when they nest. For the purpose of SEAFDEC tagging project, nesting information will include:

- Beach position: This refers to the position of the nest along the beach slope as shown below.

  Below HWM – below the HWM (high water mark)
  Beach slope – area between HWM and beginning of the first sand-dune
  Dune 1 – anywhere on dune 1
  Dune 2 – anywhere on dune 2

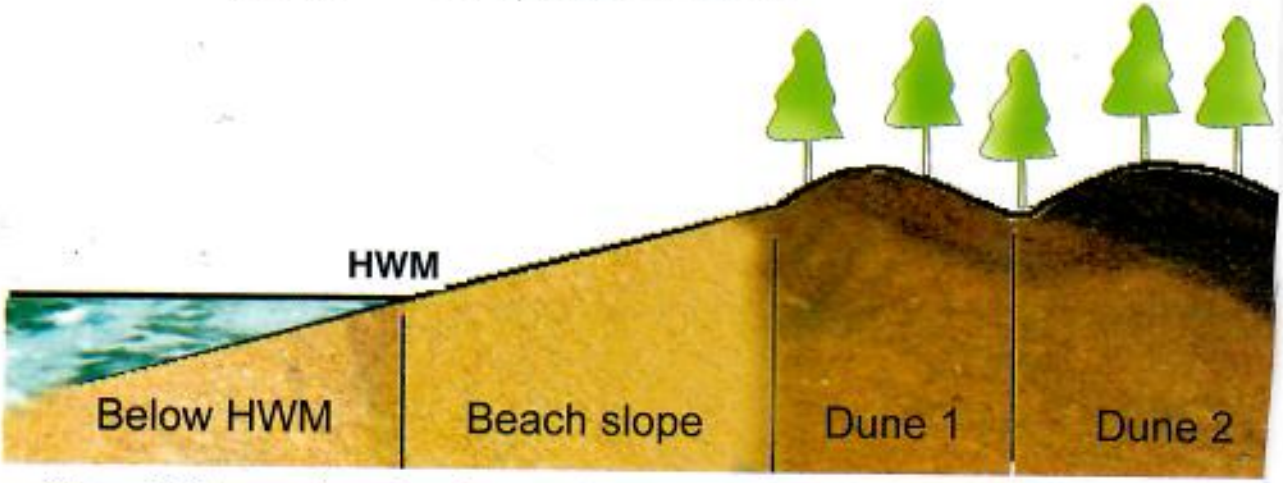


Figure 6: *Cross-section view of a typical beach slope, representing the nest position zones.*

- Habitat: This refers to the vegetation surrounding the nest as shown in pages 49 to 51.

Turtle nests on bare sand (sand without vegetation)

Turtle nests on grass/creepers and in the sand between grass and creepers

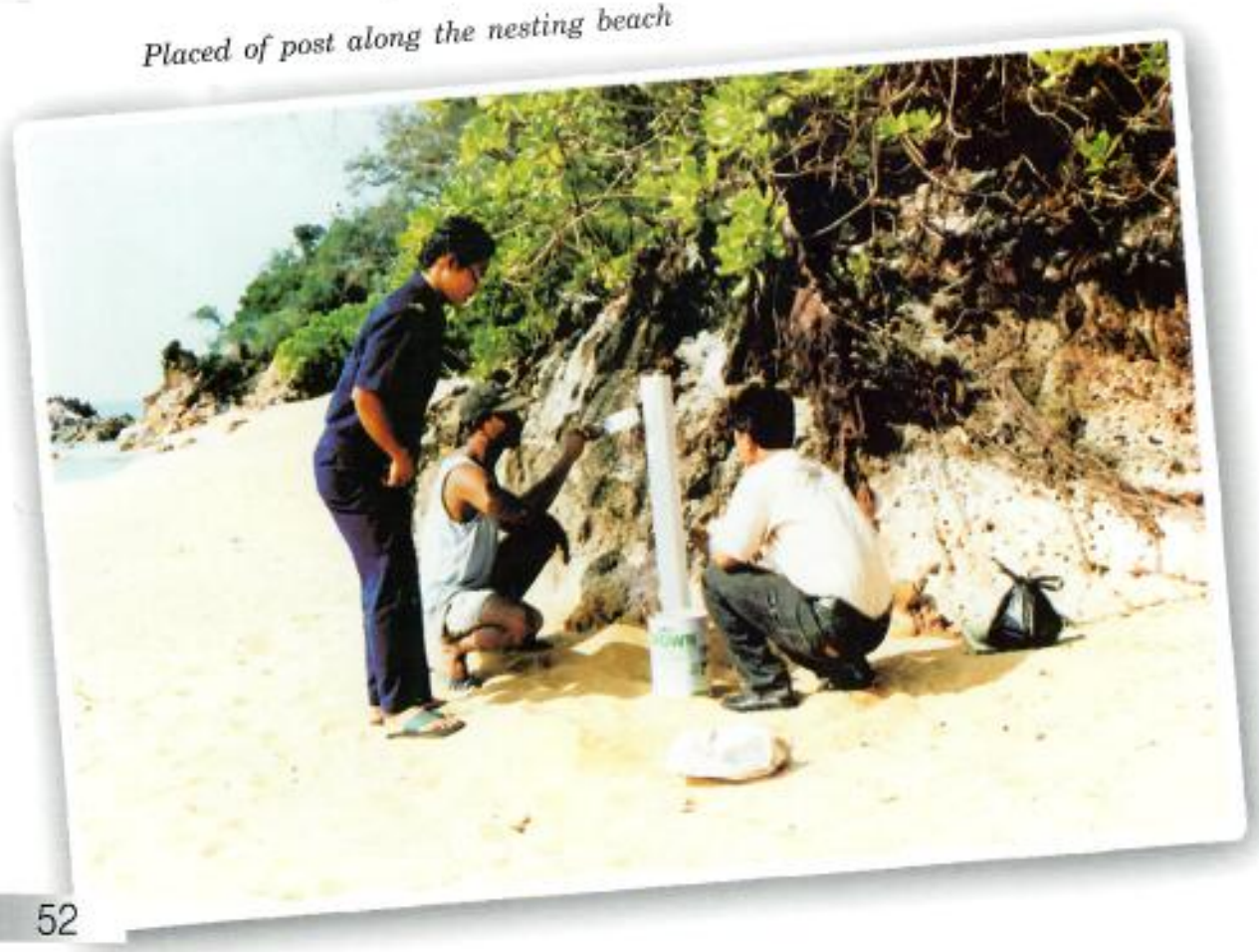
Turtle nests under shrub

Turtle nests under tree

Recording Nest Location

- Nest location: In order to know where the exact location of the nest, number of posts should be placed at regular intervals (approximately 25m apart). Many workers usually used trees or other natural marks as reference points rather than man-made posts.

Placed of post along the nesting beach



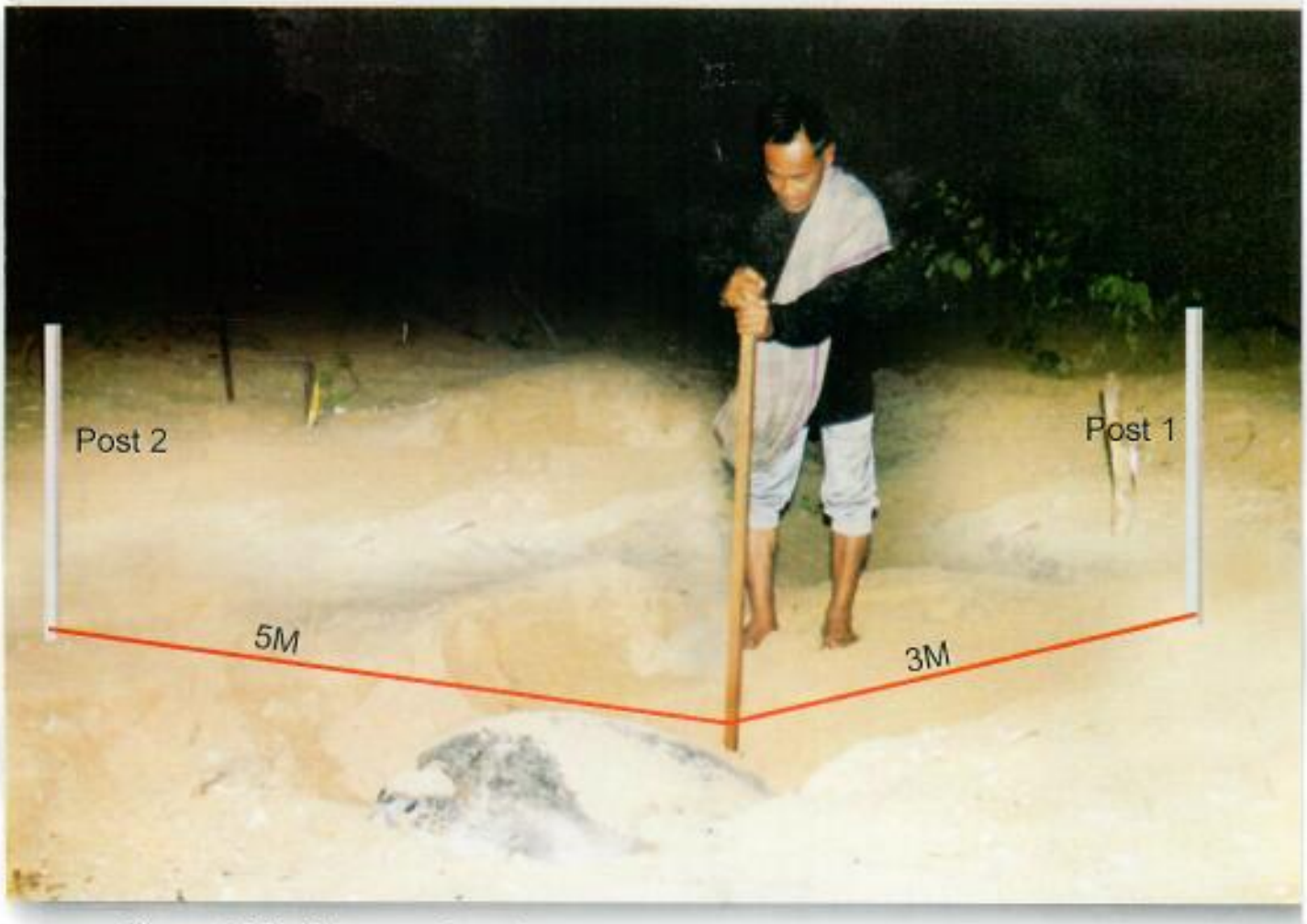
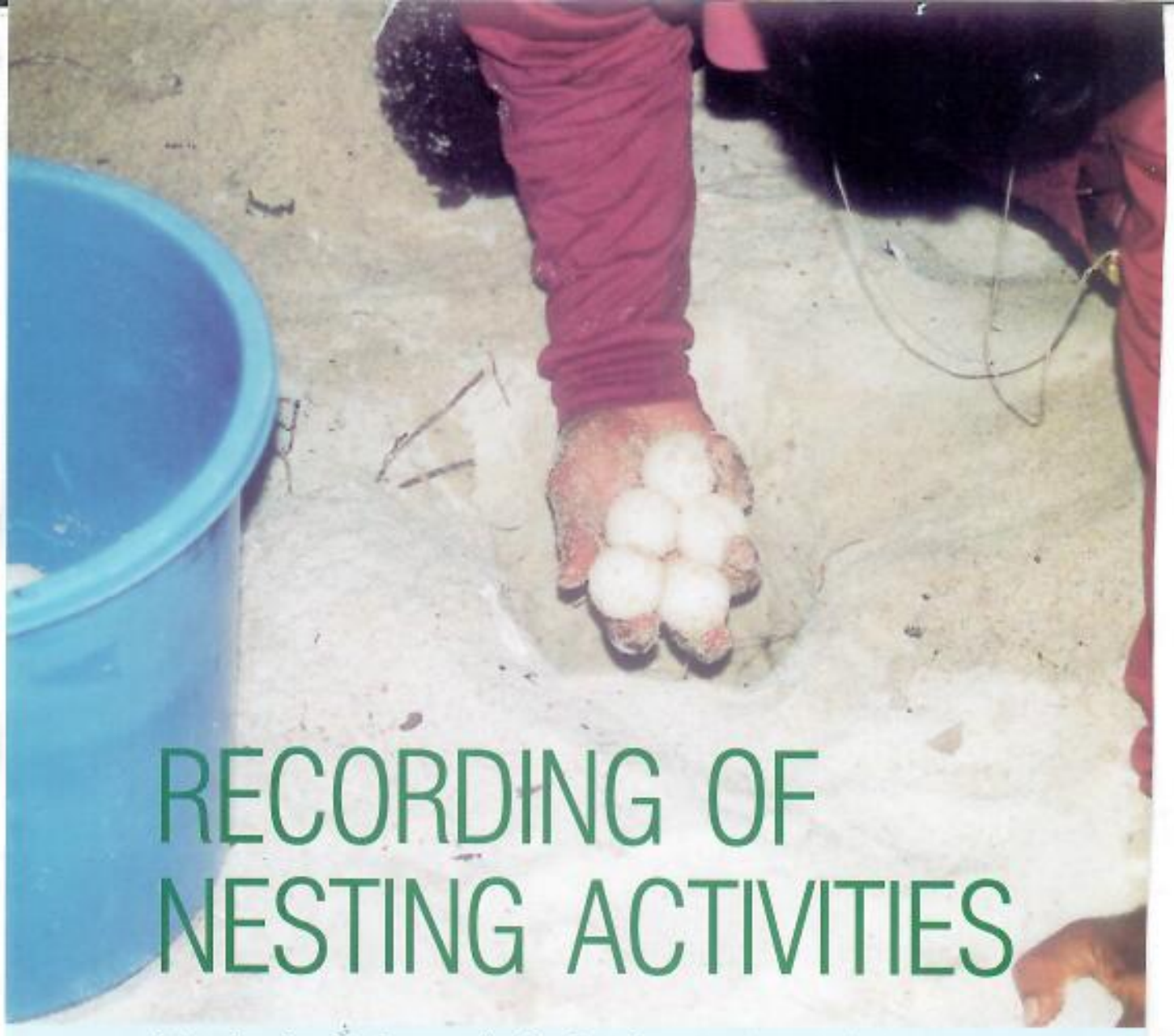


Figure 7: *Marking a nest location*

- Nests can then be accurately mapped by measuring the distance to the two posts it is laid between as shown in Figure 7.

Example on how to determine the exact position of a nest.

This nest is laid seaward 3m from Post 1 and 5m from Post 2. All measurements are made from the base or any other standard point of each post to the center of the nest.



RECORDING OF NESTING ACTIVITIES

Relocation the eggs from nesting beach to the protective custody (into a hatchery)

Adult sea turtles are timid. More consideration is needed for these marine animals which do not leave the sea for most of their lives. Most turtles come ashore to nest at night. When patrolling on a beach, move quietly and slowly and avoid switching on a torch. The absence of a return track should alert all workers to take special care not to interrupt nesting.

The nesting activity should be recorded for each nesting female encountered as shown below:

- Laid: This refers to successful oviposition.
- Laid/disturbed: This refers to oviposition began but not completed due to disturbance.
- No lay: This refers to unsuccessful nesting attempt or false crawl.
- Number of body pits: After emerging from the sea and found a suitable area, nester will scrap loose sand with all four flippers to form a large depression. This excavation made just prior to digging the egg chamber. This is call body pit.
- Number of egg chambers: Egg chamber is a cavity excavated by the rear flippers into which the turtle deposits a clutch of eggs.

Nest and Clutch Data (Relocation Data)

In some cases, relocation of eggs is necessary in order to protect the eggs laid below the high tide level, in erosion-prone area and in the areas where egg predation by people or animals are intense. For clutches that are relocated, additional data are required to be filled in tagging data sheet.

- Relocated: Just circle yes or no to indicate if the nest has been relocated
- Number of eggs: Record the number of eggs relocated
- Time of oviposition: Record the time when oviposition is completed
- Time of relocation: Record the time when relocation is completed
- Nest depth: Measure and record the distance from the sand surface to the top of the eggs and the bottom of the nest.

Meteorological Data

A turtle coming ashore is susceptible to sudden bright light, movement by particularly large objects, and low frequency sound. The time of full moon and new moon with high tides are favoured. In order to gather information during nesting activity some meteorological information need to be recorded. In this regards, workers need only to circle the appropriate situations for the following meteorological information as listed in the tagging data sheet:

- Moon phase (new, half, full, unknown)
- Weather (rain, cloudy, clear)
- Tide height at time of emergence from the sea (high, low, medium)

TAG RECOVERY

Tagged turtles that are never seen again are meaningless. Recovery is hence crucial for all parties involved. The three means of recapturing a tagged turtle include intentional capture by the researchers, accidental or intentional capture by fishers, and the chances encountered by the public, such as finding a turtle stranded ashore. Directed efforts can be carefully planned to increase the possibility of recovering tagged turtles. Other means are mostly a matter of luck and the willingness of the person involved to report the tag information.

Tag Recovery at Nesting Beach

Tag recovery in this instance refers to all sea turtles encountered with tags in nesting habitat studies. All parties involved in the tagging projects in SEAFDEC Member Countries should record the tag serial numbers of turtles encountered with tags and make this information available to the rest of the region.

Tag Recovery from Fishing Activity

Fishers should be educated in recording basic tag information (e.g. tag serial number, location encountered, health status) and encouraged to share this information with the authorities. Avoid any incentive programs as this can often result in fishers targeting sea turtles for the tag rewards.

Tag Recovery from Public

In order to receive more recovery data, publicity is necessary. This can be achieved by informing the public through distribution of a tagging posters and flyers (for example: "Tag Wanted" flyer as shown on Figure 8). In addition, Member Countries are encouraged to inform the public on how to report tag data through all media available.

Jabatan Perikanan Malaysia

SEAFDEC

TAGS WANTED!!!

The Department of Fisheries (DOF) Malaysia with funding from the Federal Government and SEAFDEC is undertaking turtle tagging program in coastal areas of Malaysia bordering the South China Sea and the Indian Ocean to study the migration and life cycle of sea turtles.

If You Find A Tagged Turtle... Write Down...

- tag numbers (do not remove tags from live turtles)
- when, where and how the turtle was caught
- what happened to the turtle
- your name and address

Give these information, or send The Tag (from dead turtles) to:

Marine Fishery Resources Development and Management Department
Southeast Asian Fisheries Development Center (SEAFDEC)
Fisheries Garden, Chendering
21080 Kuala Terengganu, Terengganu
MALAYSIA
Tel: 09-6175940, 6171543 Fax: 09- 6175136, 6174042
Email: mfrdmd@mfrdmd.org.my

Figure 8: *Malaysian public tag recovery leaflet*

STORAGE OF TAGGING DATA

It is important that all information on a tagging program is accurately recorded and stored for future retrieval such as tag numbers, return address, tag type, tag size, date and place of tagging, and all other data collected. The principal value of tagging program results from the recovery and recognition of a turtle at some later date. The archiving of all tagging information should therefore occur, with duplicate copies stored separately as a safeguard against catastrophic loss (Balazs, 1999). Computer is essential for storing, processing and analyzing data. New information can be entered immediately into data files.

REGIONAL SEA TURTLES DATABASE

Most sea turtle data in this region comprize of data gathered from nesting females and hatchlings. Both data are from tagging activities and hatchery programs. These data, when properly collated, can still provide a meaningful and representative evaluation of population dynamics. In this region, the scenario becomes quite complicated, when a nester nests at multiple beaches. In order to obtain an accurate representation of population dynamics, data need to be shared and integrated, rapidly and efficiently among researchers within the country as well as at regional level.

The Marine Fishery Resources Development and Management Department (SEAFDEC-MFRDMD) in Collaboration with the Western Pacific Regional Fishery Management Council (WPRFMC), the Department of Fisheries Malaysia, the Secretariat of Pacific Community (SPC) and the South Pacific Regional Environment Program (SPREP) is now developing a database system for the management of long-term data from sea turtle tagging projects implemented in this region. When completed and in service this database system should enable the SEAFDEC Member Countries;

- to update information for the purpose of monitoring and assessing conservation and management program,
- to store and retrieve long-term data related to sea turtle tagging,
- to transfer and exchange of standardized information among research and/or monitoring programs and
- to analyze the accumulation of time series of tagging data in order to get information on sea turtle population dynamics in this region

The raw data without further processing have little value. A properly managed and structured database enhances the efficiency of information archival and transfer. Regional database of tagging information offers several advantages if they are used properly with long term funding support. This database will ensure the accurate archiving of data, protection against loss, timely retrieval of tag information and the capacity to analyze data on a regional basis to facilitate regional management of sea turtles.

Appendix I
Sea Turtles Tagging Data Sheet

Date:	
Time:	

PLACE

ISO Code: _____
Sub-Area: _____
State: _____
Beach: _____
Sector: _____

RECORDED BY:

TAG/MEASURED BY:

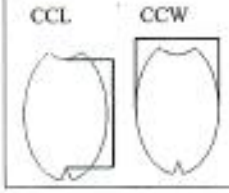
TURTLE

Species	Code	
Green	CM	( )
Leatherback	DC	( )
Loggerhead	CC	( )
Hawksbill	EI	( )
Olive Ridley	LO	( )
_____		( )

MEASUREMENTS

Carapace

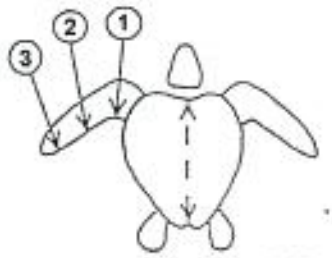
CCL _____ cm
CCW _____ cm



TAG NUMBER		LOCATION
New		
Recapture		

Sex:	Female: ( )	Male: ( )
	Undetermined: ( )	

LF RF
Position



LH RH

DAMAGE		COMMENSALS	
Carapace	( )	Barnacles	( )
Front flipper-left	( )	Algae	( )
Front flipper-right	( )	Mud	( )
Hind flipper-left	( )	_____	( )
Hind flipper-right	( )		
Head	( )		
_____	( )		

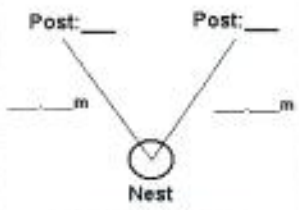
MOON		WEATHER		TIDE	
New	( )	Rain	( )	High	( )
Half	( )	Cloudy	( )	Low	( )
Full	( )	Clear	( )	Med	( )
Unknown	( )				

REMARKS

NEST

Below HWM	( )
Beach slope	( )
Dune 1	( )
Dune 2	( )
Bare sand	( )
Grass/creeper	( )
Under shrub	( )
Under tree	( )

NEST LOCATION



Seaward/Landward

ACTIVITY

Laid	( )
Laid/disturbed	( )
No lay	( )
No. of body pits:	_____
No. of egg chambers:	_____

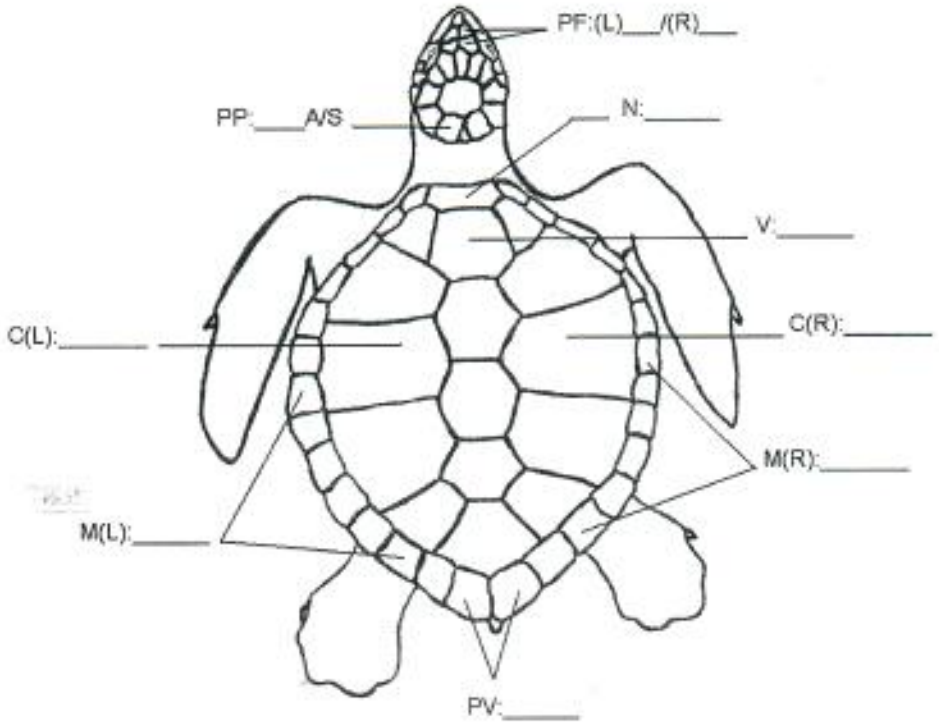
RELOCATION DATA

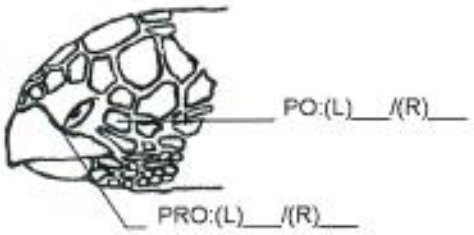
Relocated	Yes/No
No. of eggs	_____
Time of oviposition	_____
Time of relocation	_____

Nest Depth:

Top: _____ cm
Bottom: _____ cm

Adult Scale Counts





Code	Scale Name	Code	Scale Name
PF (L/R):	Pre Frontal (Left/Right)	PV:	Post Vertebral/Supracaudal
N:	Nuchal	PP(A/S):	Post Parietal (Asymmetrical or Symmetrical)
V:	Vertebral		
C(L) & C(R):	Costals (Left & Right)	PO(L/R):	Post Occular/Postorbital (Left/Right)
M(L) & M(R):	Marginals (Left & Right)	PRO(L/R):	Pre Occular (Left/Right)

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SEAFDEC Addresses

The Secretariat
P.O. Box 1046, Kasetsart Post Office
Chatuchak, Bangkok, 10903 Thailand
Tel: (66-2) 940-6326, Fax: (66-2) 940-6336
E-mail: secretariat@seafdec.org
http://secretariat.seafdec.org/

Training Department
P.O. Box 97, Phrasamutchedi,
Samut Prakan 10290, Thailand
Tel: (66-2) 425-6100, Fax: (66-2) 425-6110 to 11
E-mail: td@seafdec.org
http://td.seafdec.org/

Marine Fisheries Research Department
2 Perahu Road, off Lim Chu Kang Road
Singapore 718915
Tel: (65) 6790-7973, Fax: (65) 6861-3196
E-mail: mfrdlibr@pacific.net.sg
http://www.seafdec.org/mfrd/

Aquaculture Department
Tigbauan, Iloilo 5021
Republic of the Philippines
Tel: (63-33) 335-1009, 336-2891
Fax: (63-33) 335-1008
E-mail: aqdchief@aqd.seafdec.org.ph
http://www.seafdec.org.ph/

Marine Fishery Resources Development and Management Department
Taman Perikanan Chendering
21080 Kuala Terengganu, Malaysia
Tel: (609) 617-5940, 617-1543,
Fax: (609) 617-5136 / 4042
E-mail: mfrdmd@mfrdmd.org.my
http://www.mfrdmd.org.my/

Susun atur & dicetak
oleh:
PERCETAKAN YAYASAN ISLAM TERENGGANU SDN. BHD.
Pejabat: Lot 5k 53, Kawasan Perindustrian Gong Badak, 21300 Kuala Terengganu, Terengganu Darul Iman. Tel: 609-666 4611. Fax: 609-666 2611/666 1063
Cawangan: Lot 1.102, Ground Floor, Wisma Central, Jalan Ampang, 50450 Kuala Lumpur. Tel/Fax: 603-2162 4726