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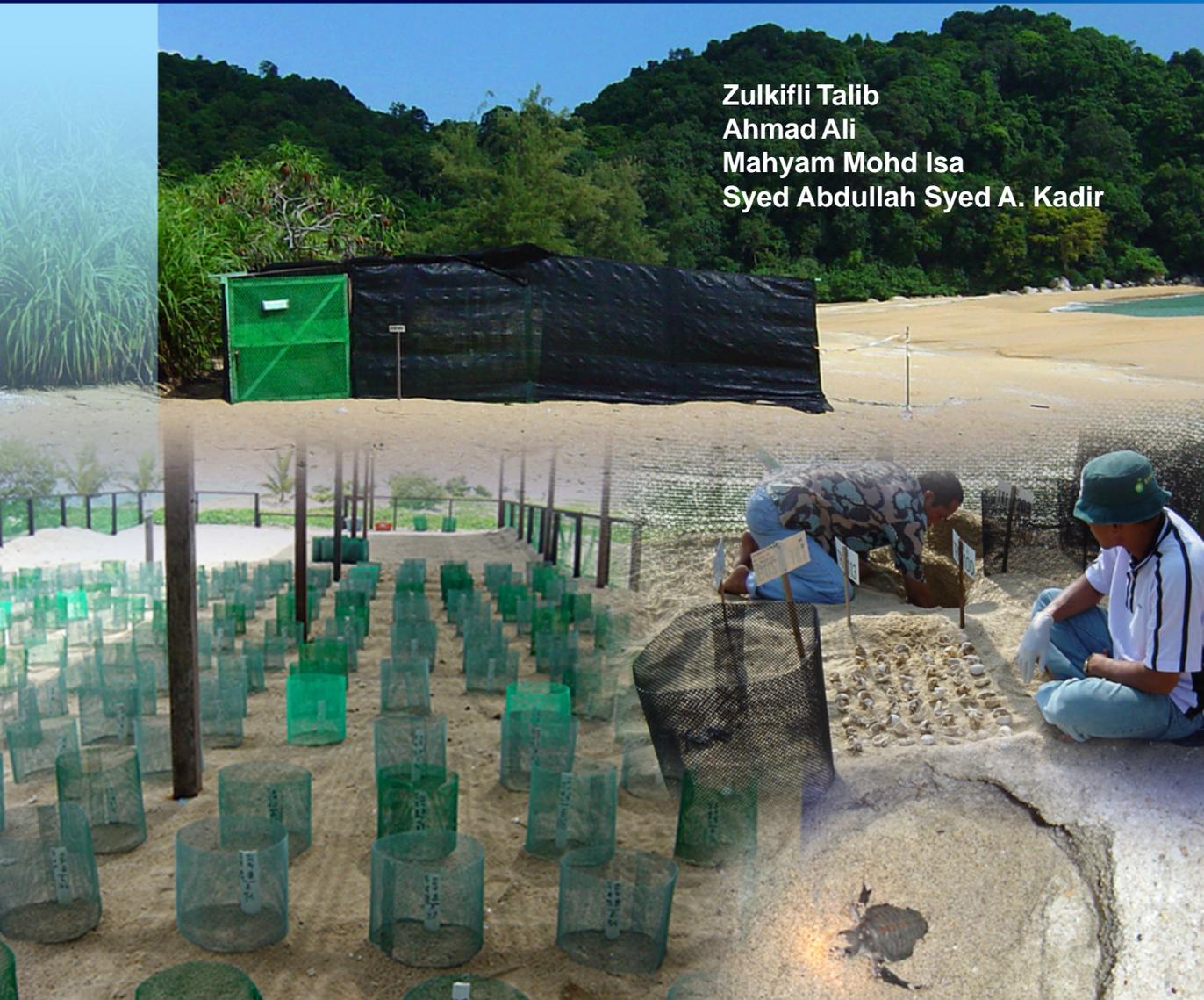
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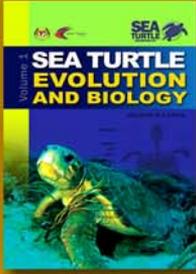


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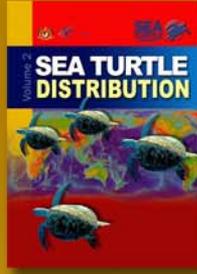
SEA TURTLE HATCHERY

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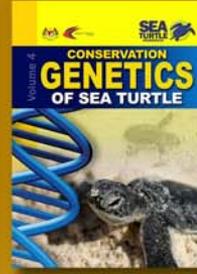
Volume 1



Volume 2



Volume 3



Volume 4



Volume 5

Sea Turtle Information Kit

Sea turtles are valued by people around the world. They are symbol of longevity, fertility, strength and protection from harm. However, sea turtles have also been exploited for their meat, eggs, shells and oil for years. This negatives impacts have accelerated the decline of the sea turtles population worldwide. The Sea Turtle Information Kit is specifically aimed at enhancing awareness, knowledge and understanding of the sea turtles among the public. It is hoped that the Sea Turtle Information Kit will help spread awareness among the public to protect and conserve the sea turtles and also the marine environment as a whole.



**Message from the Honourable
Dato' Junaidi bin Che Ayub,
the Director-General of Fisheries Malaysia**



The Southeast Asia holds a strong appeal to a myriad variety of sea creatures and one of these is the sea turtles. The region produces six of the seven living sea turtle species found worldwide and four of them are found nesting in Malaysia: green turtle (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and olive ridley (*Lepidochelys olivacea*).

Malaysia has, as early as in 1961, initiated and implemented conservation and management programs for the four species of sea turtles that occur in her waters. All the species which constitute a unique heritage in Malaysia have been accorded special attention through various conservation strategies to ensure their adequate conservation and protection.

In a world of diminishing natural heritage caused, in some cases by man-made pollution and overexploitation for commercial reasons, any effort to conserve the sea turtle from total annihilation is a virtuous idea that should be supported by all parties.

The Sea Turtle Information Kit is published to develop awareness, knowledge and understanding of sea turtles among the people. It is not easy to make people understand the serious and complex problems facing the sea turtles. However, with the publication of the Sea Turtle Information Kit it is hoped that it will drive home the message concerning the importance of sea turtles conservation.

I wish to congratulate the team for coming up with the Sea Turtle Information Kit. It is timely that such publication is produced to highlight the plight of the sea turtle. The sea turtles have been around since the dinosaurs' era. Let us protect these remarkable creatures and the habitats that they need to survive.

A handwritten signature in black ink, appearing to read 'Junaidi', written in a cursive style.

Dato' Junaidi bin Che Ayub
Putrajaya

1 December 2006



Foreword
Chief of
SEAFDEC-MFRDMD

The sea turtles have roamed Earth's oceans and sea for million of years. They were on Earth 150 millions years ago, and they have outlived almost all of the prehistoric animals with which they once shared the planet. Sea turtle survived the extinction of the dinosaurs and are still present in the world's ocean today.

Sea turtles once were found by the millions, but the demand for turtle meat, eggs, shell, leather and oil has greatly reduced their numbers. Their populations continue to decline because of the trade in sea turtle product and the loss of essential habitats.

Conservation is about reducing and removing the threat. But in reality, the work of conservation does not lie principally with the animals, plants and ecosystem but actually lies in dealing with humans. Although conservation programs are in existence, results in general have not been encouraging. The Sea Turtle Information Kit is produced with the intention of spreading awareness, knowledge and understanding to make people realize the importance of sea turtles conservation. It is our duty to make sure that the sea turtles still exist for our future generation to see.

I would like to take this opportunity to congratulate the team members headed by Ms Hjh. Mahyam bte Mohd Isa who have worked tirelessly to come up with this Sea Turtle Information Kit. Without their initiatives and sincere commitments, the Sea Turtle Information Kit would not have been realized.

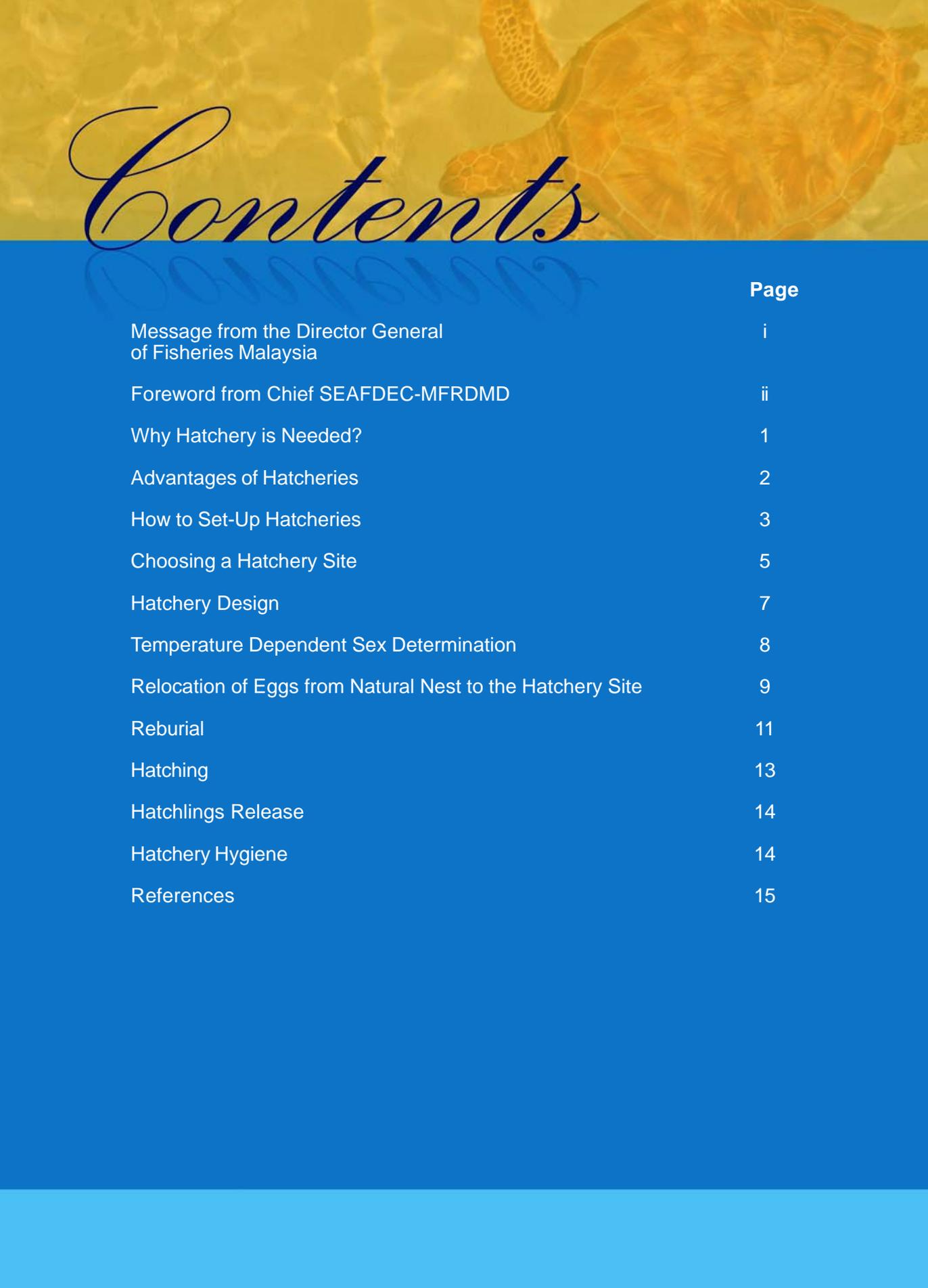
Finally, I would like to express our thanks and gratitude to the Honorable Dato' Junaidi bin Che Ayub, the Director-General of Fisheries Malaysia, for the continuous support and confidence in the team members.

A handwritten signature in black ink, appearing to be 'Raja Mohammad Noordin bin Raja Omar'. The signature is stylized and fluid, with a long horizontal stroke at the end.

Raja Mohammad Noordin bin Raja Omar
Kuala Terengganu

1 December 2006





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WHY Hatchery is needed?

In habitats with consistent high hatching success, sea turtle eggs should be left undisturbed in order to incubate naturally (*in situ*) to ensure a natural sex ratio for the population. Hatchery is practical where excessive egg harvest or mortality cannot be effectively reduced by leaving eggs in the natural state on the beach.





These include:

Clutches laid below the high tide level or below the storm surge/erosion line.



Clutches laid in areas with an extremely high probability of being dug into by another nesting turtle.



Clutches laid in areas with a high probability of being collected by people.



Preyed upon by dogs, pigs, varanid lizards or similar predators.



Clutches laid in sand/soil with high microbial content.

ADVANTAGES of Hatcheries

Hatcheries have several advantages and these include:

Certain proportion of eggs is guaranteed to be protected from risk on nesting beach, such as predation by animals, crabs, people, beach erosion, flooding by high tide, etc.



Number of eggs protected and hatchlings released is documented; hence there is some known measure of success.



Involvement of volunteers and other personnel in conservation related action has a positive effect on spreading awareness.

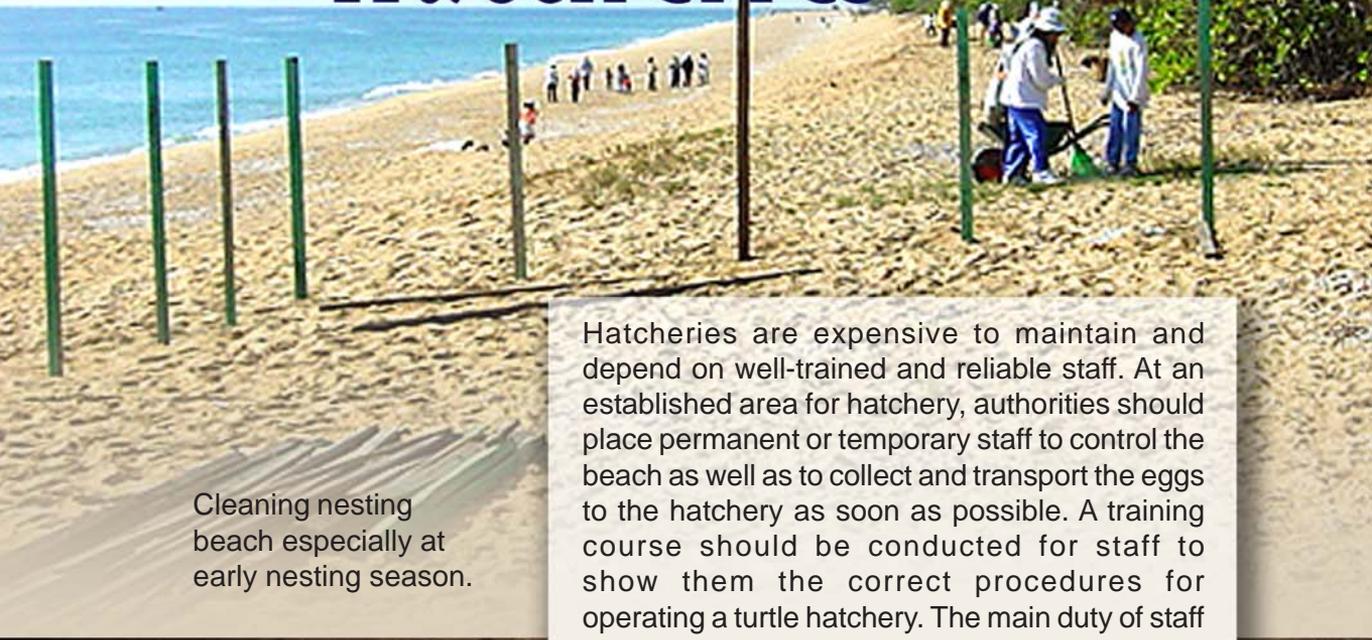


Hatchlings are available at a known time and place for use in education and awareness programs.



The hatchery provides physical focus for conservation activity related to the coast, and can be used for public education and awareness programs.

HOW to set-up Hatcheries



Cleaning nesting beach especially at early nesting season.

Hatcheries are expensive to maintain and depend on well-trained and reliable staff. At an established area for hatchery, authorities should place permanent or temporary staff to control the beach as well as to collect and transport the eggs to the hatchery as soon as possible. A training course should be conducted for staff to show them the correct procedures for operating a turtle hatchery. The main duty of staff consists of:



Record the turtle curve carapace length (CCL), curve carapace width (CCW) and other relevant information.



Relocate the eggs from nesting beach to the hatchery.



Record all information relevant to nests and hatchlings such as date of laying, emergence success etc.



Record the number of hatchlings released into the sea.

CHOOSING A Hatchery Site

Hatchery site should replicate natural nesting habitat. Artificial nest should also be the same as natural nest in terms of depth and width for the species. All vegetation (grass and vines) growing within 0.5 m radius (minimum) of the artificial nest should be removed. Plastic or non metal fence/cages can be used to protect the nests. Metal fences around the nest sites have the potential for altering the earth's magnetic field around the nest and hence altering hatchlings imprinting. The location of hatcheries should be changed approximately on yearly intervals to minimize accumulation of microbial organism such as fungi and bacteria in the sand. The guidelines for establishing a hatchery program are shown below:



The hatchery site should duplicate the natural situation as much as possible. If an area has proved unsuitable for nesting in the past, it is probably not suitable now. There is usually a good reason why turtles do not nest in that particular area.



Be sure that the hatchery will not be flooded by either salt or fresh water. The site should be on a well-drained stretch of beach, with enough elevation that prevents flooding by ground water. The shade should be placed well above the spring high tide level. It should not be subjected to erosion by high tides or storm waves.



Construct as many hatcheries as possible in order to insure that the eggs incubate under a variety of conditions.



The hatchery site should not be placed near vegetation, in order to avoid roots growing into the egg clutch.

The hatchery should be shielded from artificial light to avoid disorientation of the hatchlings.



The distance between hatchery site and nesting beach should be as close as possible. Longer distance may result in lower hatching success due to excessive handling.

HATCHERY

Design



Hatchery with plastic fence.

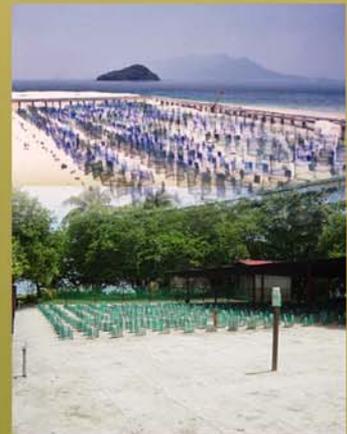
Shading

Shading is important if the nest temperature consistently approach 32°C or higher to ensure that eggs are not killed by heat stress. At nest temperature above 33°C, all eggs are killed (Limpus *et al.*, 1985). It has been demonstrated irrevocable that sex determination in six species of sea turtles is temperature dependent. Cool incubation temperature are known to produce males while warm temperatures produce females (Janzen and Paukstis, 1991).

There are no specific designs for sea turtle hatchery. If there are feral dog, wild boar, monitor lizard or others predator, the hatchery can be enclosed by chain link fence or plastic mesh. To prevent the entry of crabs and other burrowing predators, plastic fence can be used. Ideally, the hatchery should be located and oriented in such a manner to provide the greatest diversity of micro habitats for the nests. The shape of hatchery depends on local condition. If the beach is narrow, then the hatchery perforce has to be rectangular with the long side parallel to the sea. Some hatcheries use sun shade to reduce sand temperature which can affect sex ratio especially during the first 3 week of incubation.



Hatchery with sun shade.



Open Hatchery.

TEMPERATURE DEPENDENT SEX DETERMINATION



Like many other reptiles, sea turtle also possess temperature dependent sex determination. The sex of the hatchling is determined during the middle third of the incubation period by the temperature of the nest of loggerhead (Yntema and Mrosovsky, 1980); green turtle (Miller and Limpus, 1981); hawksbill (Mrosovsky, et al., 1992); olive ridley (Mc Coy et al., 1983) and leatherback (Mrosovsky, 1984)

The pivotal temperature is the theoretical constant incubation temperature that would produce an equal proportion of male and female hatchlings. The pivotal temperature is not constant for all sea turtle species but varies among the species and can vary among populations within a single species. Based on incubation data for Terengganu leatherback, it is predicted that the pivotal temperature is in the range between 29.2-30°C (Chan, 1993); loggerhead turtle for the eastern Australia stock is 28.6°C, green turtle for the Great Barrier Reef stock is 27.6°C and flatback for eastern Australia stock is 29.3°C (Limpus, 1997);

For all species, nest temperature above the pivotal temperature produce mostly female hatchlings while below the pivotal temperature will produce mostly male hatchlings. At very low nest temperatures, approaching 26°C, all species produce 100% males and at very high temperature approaching 32°C, all species produce 100% females.

Incubation temperature for sea turtle eggs is highly variable parameter, being a function of the latitude of the beach, sand color, orientation to the sun, degree of shading, nest depth, time of year, rainfall etc. However, on any one beach prediction can be made once detailed temperature profiles have been quantified. The temperature regime of nests and hence hatchling sex ratios can easily be altered by:

- Transferring eggs from natural nests to artificial nests.
- Altering the vegetation of the nesting habitat and hence altering the extent to which nests are exposed to the sun or shaded.
- Altering access of turtles to nesting sites (by the presence of rock walls, buildings, bright lights) and forcing the turtles to choose alternate nesting sites.

RELOCATION of EGGS from Natural Nest to the Hatchery Site

Sea turtle eggs are not designed to be moved after they were laid. Wherever possible, the sea turtle eggs should be left to incubate where they are laid. If the circumstances are such that the eggs need to be moved in order for incubation, thus it is best to complete the movement of the eggs within two hours of them being laid and with no rotation of the eggs.

If a clutch of eggs is to be relocated to hatchery, these guidelines should be followed closely:

- Although nests are easy to find, the eggs can be difficult to locate once the turtle has covered up the nest. If the workers found a nesting turtle, it is best to collect the eggs during oviposition or slightly after she finished laying eggs.



- Complete the movement within 2 hours of the eggs being laid and certainly no later than 5 hours after they have been laid. Special care is needed when handling eggs that are more than 2 hours old.

- Avoid rotation of the eggs, especially vertical rotation. If carrying eggs in vehicles, place containers on cushions or foam and drive with care.



- Use a stiff sided container to carry the eggs. Use bucket rather than cloth sacks.

- Do not wash the eggs, especially in sea water. Hand should be clean and dry before handling the eggs.
- If possible they should be buried at the same depth as the natural nest, which vary depending on species of turtle. Table 1 shows the depth of natural nest for various species of sea turtles.

Table 1: Natural Nest Depth of Different Sea Turtle Species

Green	Leatherback	Loggerhead	Hawksbill	Olive Ridley	Flatback
69 cm ¹	88 cm ¹	58cm ¹	45 cm ¹	49 cm ¹	55 cm ¹
44-60 cm ²		45 cm ⁴	44-60 cm ²		
77 cm ³					

Source: Limpus, 1977¹; Mananunsap and Rongmuangsant, 1988²; Ahmad and Kamarruddin, 2002³; <http://tofino.ex.ac.uk/euroturtle/outline/logger4.htm>⁴

REBURIAL

Incubation Hole

The nest should be constructed in the shape of the natural nest i.e with a narrow neck and flask shape bottom. The mouth of hole is about 20 cm wide, increasing to about 30 cm at the bottom. The hole is about 60-70 cm deep depending on species of the turtle. The eggs are carefully placed by hand into the hole, which is covered with moist and then dry sand at the top level. A plate with information of serial number of nest, date of collection and number of eggs transplanted is placed on top of the clutch. Nest should be relocated in low densities in hatchery, which at least 1 meter between nest, so that they do not affect each other during development. By doing so, the hatchery workers can move about without stepping on the nests.



Constructed nest with narrow neck and a flask shape bottom.

Note: If nest excavation is hampered by cave-ins during periods of very dry weather, pour a bucket of fresh water into the unfinished nest and the continue nest construction (Mortimer, 1999).

Hatchery nest should be situated at least 1 m apart to minimize their impact upon one another and to allow room for hatchery workers without stepping on the nests.



Recording the Nest

Each nest in the hatchery should be numbered and recorded in a data sheet or book (at particular date of laying and number of eggs). This is to accurately estimate date of emergence. The following data should be recorded for each nest:

- Date laid • Species of turtle
- Beach name • Clutch size
- Nest location



Incubation Period

In normal condition incubation period varies by species and depends on the temperature, humidity and depth of the clutch. Table 2 shows the incubation period of different sea turtles species.

Table 2: Incubation Period of Different Sea Turtle Species

Green	Leatherback	Loggerhead	Hawksbill	Olive Ridley	Flatback
54-87 days ¹	49-70 days ¹	45-70 days ¹	51-61 days ¹	49-70 days ¹	about 56 days ¹
44-49 days ²	54-58 days ⁴		47-54 days ²	58-64 days ³	
49-76 days ⁵					

Source: Limpus, 1997¹; Mananunsap and Rongmuangsant, 1988²; Chantrapornsyl, S. 1992³; Chan and Liew, 1995⁴; Kamarruddin and Abdul Rahman, 1994⁵;

Several essential environmental conditions are required to achieve the most successful incubation of sea turtle eggs under natural condition (Limpus et al., 1985; Limpus 1993 and Miller 1985). These are as follows:

- Sea turtle eggs require well ventilated, low salinity, high humidity sand that surrounding the nest.

Sea turtles usually lay their eggs above the level of tidal inundation and at least 50 cm below the beach surface (depth varies among the species). Sand that is regularly washed over by sea water during high tide can be too salty and cause reduced incubation success of the eggs.

- Sea turtle eggs are killed by flooding with either salt water or fresh water. Flooding by either sea water or fresh water for a few hours will usually drown the eggs. It is important that the air spaces between the sand grains do not become filled with water. Nest need to be above the water table, normal high tide and /or storm surge level.
- Fertilized sea turtle eggs can be expected to have more than 90% incubation success when nest temperature are in the range of 25-31°C (without predator, etc).
- There is a high probability that some fungi and bacteria, when present in the sand of the nesting beach, can reduce the incubation success of some species of turtle eggs.

HATCHING

Hatchling emergence, usually in a group, occurs at night on which they would rapidly head towards the sea. Expected dates of hatchling emergence can be estimated from the date of collection, or condition made by the “caving in” of the sand surface above the nest when hatching begins. A week before hatchling expected to emerge, netlon mesh cylinders with mesh size of 1.0 cm, should be placed around each nest. This made easier to collect hatchlings as they emerge from the sand. Small mesh size is recommended so that the hatchlings cannot put either their heads or their flippers through the openings. Cylinder should be buried to a depth of about 10 cm to discourage crabs from burrowing into the enclosure.



Hatchlings fence made from netlon.



Hatchling ready to emerge.



Expected dates of hatchlings emergence can also be predicted by the “caving in” of the sand surface above the nest.



Hatchlings ready to be released.

HATCHLINGS Release

Hatchlings and Imprinting Process

Hatchlings must be released as soon as possible after they break through the sand and should be released on the same night that they emerge. The sooner they are released, the more energy they will have to swim out from shore, into deep water and away from predators. Hatchlings should run down the beach, to allow for the possibility that they “imprint” onto the beach. To minimize hatchlings mortality to predators, they should be released at different spots to avoid feeding station of predators. Hatchlings must be released in groups to help saturate the predators.

If and when immediate release is not possible, hatchlings should be kept in styrofoam box or in other boxes and, keep in cool and dark places. They should not be placed in buckets of water as they will be swimming in frenzy behavior in the bucket and exhaust their yolk reserves. They should not be kept in cage so that the head or flipper will not get stuck.



Do not keep hatchlings in sea water.

HATCHERY Hygiene

After about a week the hatchlings have emerged, every nest must be excavated, examined and all broken shell, unhatched eggs and death hatchling should be removed. They should be buried or burn as far away from the hatchery site. The following data should be recorded:

- Date laid
- Date excavated
- Depth from surface of the sand to the bottom of the nest after excavation
- Number of live and active hatchling
- Number of dead hatchlings
- Number of weak hatchlings
- Number of empty egg shell (i.e. from which hatchlings had successfully emerged)
- Died pipping (i.e. embryos that died in the process of hatching from the egg)
- Intact eggs (each intact egg should be broken, open over a screen, rinsed and assigned to one of the following categories:
 - a. Yolk only; no sign of embryo
 - b. Embryo without pigmentation; not yet shaped like a turtle; no carapace; generally less than 2.5 cm long. (Total length should be recorded)
 - c. Embryo poorly pigmented, but possessing a carapace; and
 - d. Embryo completely pigmented.



Examine the nest after the hatchlings have emerged and record all the data.

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