

## **GUIDELINES FOR TURTLE HATCHERY MANAGEMENT**

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### General

In general it is preferable not to use hatcheries once conservation management has been successfully established in an area. The main reasons for moving nests to a hatchery are that the nesting area is not secure because of poaching, predators, or other threats such as pollution or tidal flooding.

While a well managed hatchery can have high rates of hatch success, the workload involved in achieving an appropriate standard of management is high and is not justified if there are alternatives which have a reasonable likelihood of success. In addition, concentrating nests in one relatively small location means that there are many clutches at risk from a localised impact (e.g. vandalism, tidal flooding, disease, predators).

Before establishing a hatchery it is advisable to consider whether it is feasible to move threatened nests to other, safer natural locations rather than using a hatchery.

The only valid reason for moving a nest from its original location is that the hatch success is threatened in some way. Typically this would be because the nest is located too low and will be inundated by high tides, either directly or by seawater seeping in below the surface. Flooding with salt water can kill developing embryos, though the severity of the impact apparently depends on the stage of development and the duration of the flooding. Eggs are particularly vulnerable when first laid (first 2 weeks) and when near hatching. At that time even relatively short periods of flooding with salt water (e.g. 30 minutes) can result in 100 percent mortality. Outside these periods eggs can usually tolerate several hours of flooding. However it is not necessary to move eggs to a hatchery, as nests can be moved to adjacent higher areas (where these are available), and thus left to hatch in a natural situation.

Another significant threat is theft of eggs. In situations where there is a high likelihood that a nest might be poached, the risk can be minimised by moving the nest. This does not necessarily require that the nest be moved to a hatchery. Relocated nests have a much smaller "footprint" (i.e. the obviously disturbed area) than natural nests, and this small area can be easily disguised. Therefore the preferable option would be to move the clutch to the nearest suitable location - providing that the placement of the eggs in the new nest cannot be observed by those responsible for stealing eggs.

### Selecting the Location of a Hatchery

Care should be taken when selecting the hatchery location. The surface of the hatchery site should be located well above the level of the highest spring tides to prevent underground flooding of the eggs. Besides this, the hatchery location should not contain excessive amounts of roots, humus or weeds. If theft is a threat the hatchery must be secure or have adequate supervision. In addition the hatchery should preferably not take up space in a natural nesting area, or block access to natural nesting areas. As

much as possible the hatchery area should conform with species specific parameters, such as sand temperature and moisture content.

### Sex Ratios

Hatchling sex is determined by incubation temperatures. Until more information is available, and in the light of negative consequences of interference, for the time being it is assumed that the safest course of action is to maintain natural hatching sex ratios.

Knowledge of the natural sex ratio of nesting sea turtle population is an important component of any hatchery management plan. The natural sex ratio in the region where the hatchery is located must be studied and the findings of this study should be applied to hatchery management, e.g. to determine the percentage of the hatchery that will be sufficiently shaded to produce male hatchlings.

### Hygiene and General Substrate Management

A high standard of hygiene is necessary if a level of hatch success approaching (or surpassing) the natural situation is to be achieved.

Factors which are known (or reported) to have adverse impacts on embryo development include:

- remains of unsuccessful eggs and dead hatchlings of previous nests being left in the ground;
- humus and rotting wood\* in contact with eggs;
- roots of plants (possibly penetrating eggs and also possibly entangling hatchlings on their way to the surface);
- cigarette ash in contact with eggs\*; and
- food such as cooked rice in contact with eggs\*.

[\* reported by an experienced egg collector from Derawan Island]

One of the effects of substances such as ash, humus, etc. is to induce the growth of fungus around and into the eggs (these fungi are commonly black or red). Food material will also attract ants and predators to the vicinity of the eggs.

In general, eggs should be kept free from any contaminants during collection, transport and when being placed in the new nest. People working with eggs or observing such activities should not be permitted to smoke or eat in the vicinity. Smoking and eating should also not be permitted in the hatchery. If rotten wood, humus or substantial amounts of plant roots are encountered during the digging of a new nest hole, the hole should be abandoned (after removal of the wood or humus). Where minor amounts of roots are encountered these should be removed (cut or pulled out).

It is important not to handle eggs or hatchlings when insect repellent, sunscreen, fuel or any other chemical residues may be present on your hands.

After the remains of a nest are disposed of, the nest should be left open to "air" for about 24 hours to help reduce the levels of bacteria and fungus.

Some sources suggest that to prevent infestation from fungus and bacteria, the same hatchery site should not be used during two consecutive nesting seasons. However if high standards of hygiene are observed and hatch success rates are constantly monitored, an area can continue to be used as long as good results are being achieved.

## Predators

Eggs and (particularly) hatchlings in the hatchery are at risk from predation by rats, monitor lizards, ants, crabs, and birds.

Rats particularly tend to notice when hatchlings have emerged and will chew through the plastic mesh fence around the hatchery and then through the nest fence to get at them.

Ants sometimes swarm quickly over new hatchlings and will eat their stomachs and eyes. Anything left on the ground in the hatchery for even a few hours is likely to attract ants which will shelter under it. For this reason, buckets, planks of wood, etc should not be left on the ground in, or immediately around, the hatchery.

Monitor lizards are probably more attracted to rotten eggs or dead hatchlings than to fresh eggs and this is one reason for cleaning out hatched nests as quickly as possible. Once the remains in the nest have been processed (classified and counted) they should be disposed of in the sea (or in a waste bin that will be removed from the area). Do not do this in the area where hatchlings are released as it will attract predators.

Crabs can sometimes dig into a nest to try to eat some of the eggs. Ghost crabs which are active on the beach at night will try to catch and eat hatchlings. Hatchery fences should be able to keep out these crabs.

Birds of prey often circle over the beach and areas behind the beach, particularly in the mornings. These birds are probably looking for hatchlings that have become trapped in weeds or other obstacles on their way to the beach during the night. Birds of prey will tend to learn the location of a hatchery if hatchlings are left in the area during daylight, and will readily take hatchlings.

## Use of Metal Mesh in the Hatchery

There is some evidence from research that hatchlings are affected by the earth's magnetic field and may even use this as one of the cues for relocating their natal area after their developmental years in the sea. For this reason, there is a need to guard against using materials in the hatchery that will disturb the local magnetic field. In particular, metal mesh should not be used for nest fences or nest covers, and new hatchlings should not be held in steel buckets.

Plastic garden mesh can be used for the outside fence of the hatchery and for the nest fences. However this material deteriorates fairly quickly as a result of the high UV component in tropical sunlight, and becomes brittle after less than one year. It is necessary to locate a source of this material and keep a supply of it available for repairs, but it must be stored out of the sunlight.

## Putting Clutches into the Hatchery

If a nest must be moved, it is preferable that it be moved within 2 hours of laying. Unless the turtle is seen laying, however, it is more likely the eggs will be moved first thing in the morning. Special care is needed when handling eggs that are more than 2 hours old. The delicate embryonic membranes and blood vessels of older eggs are easily torn if the eggs are rotated or jarred. Dislodgement of the embryo results in death. Do not move eggs more than 12 hours after laying.

If some of the eggs in a clutch are broken, do not bury them with the clutch in the hatchery, as they will rot and possibly affect the rest of the eggs as well as attracting predators. Bury broken eggs separately from the nest (outside of the hatchery) or throw them in the sea. However, when a record is made of the total number of eggs in a relocated clutch, broken eggs should also be recorded, e.g. "101 + 3" where "+3" represents the number of broken eggs.

## Moving the Eggs

Take a bucket and put some damp sand in the bottom to a depth of about two finger widths to stabilize the eggs. When moving the eggs, move them one at a time into the bucket. Try to minimize the amount of sand that is moved with each egg, though, as sand can abrade the shell if the bucket must be carried over long distances. It is very important not to rotate the eggs (vertically or horizontally), as rotating the egg can result in mortality. Make sure the eggs are stacked in the bucket in a way in which they cannot roll when the bucket is being carried to the hatchery.

When carrying the bucket to the hatchery, take care not to rotate it, as quick rotation may kill the eggs. A piece of coloured duct tape placed on the lip of the bucket can be used to keep the orientation of the bucket constant and prevent rotation while walking to the hatchery.

Hatchery nests should be located at least one metre apart to minimize their impact upon one another and to allow room for hatchery workers to move around.

The egg chamber that is dug in the hatchery for the eggs should mimic as closely as possible a natural egg chamber. The average natural nest depth (to the bottom of the clutch) should be measured in the field and duplicated in the hatchery. The hole should be dug in moist sand and should be shaped like a flask, with a wider rounded bottom and a straight narrow opening leading from the egg chamber to the surface. The diameter of the neck of the egg chamber must be about 25 cms, and the diameter of the bottom of the chamber approximately 30-32 cms. The walls of the hole should be smooth in all places.

When the egg chamber is ready, the eggs can be placed in the hole. Take the eggs from the bucket, again one at a time and without rotating them, and place each egg carefully into the egg chamber. When all the eggs of the clutch have been placed into the egg chamber, the damp sand removed during excavation of the artificial nest should be used to cover the eggs, firmly tamping it in place in layers of 8-12 cm. Dry sand

should not contact the eggs, and should be used only during the final stages of covering the nest.

### Marking Nest Locations in the Hatchery

Each nest that is put into the hatchery should be numbered and associated with a standard data record form. If a plastic ribbon with relevant data written on it is buried inside the nest and later the nest locator stakes or the data sheets are lost, some or all of the data can be retrieved from these ribbons.

When a clutch has been placed into an egg chamber and has been covered with a thin layer of sand (about 10 cms), a short length (about 15-20 cms) of plastic ribbon (surveyor's flagging tape) with the relevant nest data written on it should be placed in the hole. The data written on this ribbon should include: date laid; sector of beach where laid; date relocated; number of eggs; hatchery nest number; name or initials of person(s) physically doing the relocation. A finepoint permanent marker (e.g. permanent OHP pen) can be used to write on the tape. Make sure the ink is dry before putting the ribbon into the hole. Then refill the hole as described above.

Once the egg chamber is closed a stake should be placed directly over the hole. This stake should have a duct tape (or insulation tape) "flag" on which are recorded the same details as on the ribbon inserted in the hole. Make sure that the pen used to record this data has permanent ink and can withstand UV light. If possible use a marker pen designed for writing on cattle ear tags. As much as possible, these nest stakes should be of a uniform size, so as to maintain the professional appearance of the hatchery. For many visitors, particularly official visitors, the hatchery is the most obvious manifestation of the conservation management activities, and for this reason it should be maintained in such a way as to create a good impression.

Remember also that if visitors are allowed around the hatchery area, quite possibly the only impression that they get of the level of professionalism of management will derive from the nest markers and the storage of tools and equipment around the hatchery.

### Fencing Nests in the Hatchery

It is important that nests in the hatchery are fenced at least 5 days before the earliest possible hatch date. For Green Turtles it is usually best to fence a nest 45 days after the date on which that nest was laid, but you need to check the average local incubation times. This date should be available from the hatchery data sheet. By restraining the hatchlings that emerge inside the nest fence, data recording (e.g. number, species, etc.) is facilitated.

The nest fence should be of a sufficiently small mesh size so that hatchlings will not get their heads stuck in it. When the nest fences are made out of the same sized mesh as the external fence, an additional layer of a smaller-sized plastic mesh overlaid from ground level to a height of around 20 cms, will prevent this. This additional layer also makes it more difficult for rats to chew through the nest fence.

The mesh of the nest fences should be buried about 10 cm into the sand to prevent rats from digging under the fence to reach the hatchlings and also to prevent the escape of hatchlings.

The fence should be left around the nest until after the nest has hatched or five days after the latest likely hatch date. For Green Turtles this is likely to be around 65 days after the date when the nest was laid.

The use of nest fences with wooden frames and mesh tops should be avoided in the hatchery. The reason for this is they encourage ants to gather under the wooden sides where these rest on the sand and the ants are then likely to attack the hatchlings.

### Managing the Hatching Process

The average time for Green Turtles eggs to hatch in N.E. Kalimantan is 52-62 days; though warmer weather will result in shorter incubation periods. The average time to hatch is longer during the rainy season. The average time for a nest to hatch in the open, unshaded areas of the hatchery can be several days shorter than in shaded areas. It is essential to collect and analyse data on hatching times in the region where the hatchery is established and to base hatchery management on this.

Hatchlings usually emerge from the nest between 6 pm and 10 pm, when the air cools down and it is dark. (Note that in the rainy season, when temperatures are generally lower than during other parts of the year, nests are more likely to hatch between 6 pm and 8 pm. At other times of the year it is likely to be between 7 pm and 10 pm.)

The hatchery should be checked every hour during the late afternoon and at frequent intervals (at least every 30-60 minutes) during the first half of the night for recently emerged hatchlings and for rats or other predators which have entered the hatchery. If a nest that is due to hatch has not hatched by midnight, it will probably not hatch during the night. Such nests should always be checked again as early as possible in the morning and occasionally throughout the day, particularly on cloudy days.

Nests with hatchlings just below the surface often have a small area of surface sand which has caved-in, creating a shallow crater. Sometimes the nest stake will drop into a space created by the hatchlings as they dig their way upward. Remove the stake when the nest starts hatching.

Once a few hatchlings have emerged from a nest, making a scratching / shuffling motion with the fingers in the loose sand will sometimes encourage the remainder of the hatchlings to "erupt". Apparently they are conditioned to respond to the sound of the earlier hatchlings moving on the surface.

Once a significant number of hatchlings has emerged, it is useful to dig down carefully into the nest to help release other hatchlings - BUT if these still have lumps of egg yolk attached to their abdomens, or their bodies are not yet straight, they should be gently re-buried to a depth of around 10 cms with their heads upward and covered with loose damp sand. This will give them a chance to absorb the remainder of the egg yolk and they will emerge from the sand by themselves when they are truly ready to be released.

All hatchlings that emerge should be checked to see if they are ready for release (see above). If they are ready for release, they should be counted and placed in a basin. Avoid shining flashlights into the container too often as this encourages them to scramble more determinedly and will use up their energy store.

DO NOT dig up a nest where hatchlings have not begun to emerge (unless there is some unusual reason which suggests that this needs to be done - e.g. tidal flooding of a nest due to hatch within a day or two). The concept of "helping" hatchlings which have just left the egg is misguided, and is likely to result in increased mortality. Hatchlings can take 3-5 days to reach the surface after emerging from the egg, and there are several crucial events which need to happen during this time. These include: straightening their bodies (curled from their long period in the egg); absorbing the remainder of the yolk sac (as their energy source during the "swimming frenzy" of the first 3-5 days of their life); and abrading away the yolk sack membrane as they move through the sand.

If hatchlings emerge during the day they can be kept in a cool, dark place until the evening. A covered styrofoam cool-box with a layer of damp sand or a soft, damp cloth sack can be used for keeping them. However, if they do not settle within half an hour or so, it may be best to release them immediately rather than have them expend too much energy. Hatchlings should NOT be kept in water prior to release. Hatchlings kept in a container of water will engage in "swim frenzy" behaviour and are likely to exhaust their energy reserves stored in the yolk sac; they may even imprint on conditions in the container rather than those at sea.

When a nest has not hatched after 65 days, the nest should be excavated as soon as possible and the contents recorded (see below).

### Releasing the Hatchlings

Hatchlings should be released only at night unless there is some pressing reason to release them during the day. Daytime release subjects hatchlings to much more risk from predators than does nighttime release.

Releases should be done at different parts of the beach each time, and each release should occur at a point at least one hundreds meters from previous release points. Fish and other predators quickly learn to wait in the area if hatchlings are consistently released in the one location. It is important also that hatchlings from one nest be released all at once. Do not release them in small groups, as this might increase the chances of their being taken by predators while crossing the reef flat. Large numbers of hatchlings moving in a group are likely to confuse predators, thus reducing the losses.

Hatchlings should be released as far as practicable from sources of light which might disorient them. Hatchlings find their way down the beach and out to sea partly by moving toward the lowest bright horizon. They are therefore frequently attracted by lights from buildings. It is necessary to consider not only the lights which are visible from the beach but also the extent to which lights are visible from the sea. These lights can attract the hatchlings back to shore. Experiments have shown that hatchlings can be affected by light sources up to three miles away.

Do not release hatchlings directly into the water. There is research data to suggest that they may need to run down the beach so as to orient themselves and possibly to imprint the characteristics of the natal beach. Release the hatchlings about 6 metres from the sea.

Once hatchlings have been released onto the sand, do not shine flashlights onto them or take flash photographs. This will disorient them. However where hatchlings are confused by artificial light sources, or by particularly dark / overcast nights, it may be necessary to guide them to the water by shining a light onto the water some distance from the shore. Once they enter the water this light should be switched off. Keep the light switched off while walking away from the place where the hatchlings were released, to prevent the hatchlings being attracted back to the beach.

### Collection of Hatch Data in the Hatchery

For every clutch of eggs that is brought into the hatchery, there is a certain set of information that should be collected at different points in time. Careful collection of data and future analyses of these accumulated data will help to provide a better understanding of the success rate of the hatchery and factors which affect it, and also certain biological aspects of the local turtle populations.

When a clutch of eggs is placed in the hatchery, the following data are to be recorded on a Hatchery Data Sheet:

- 1) Nest number - each nest that is put into the hatchery must be given a nest number, possibly starting with an "H" (for hatchery) to distinguish it from field nests.
- 2) Nest date – the date on which the nest was laid.
- 3) Sector of beach where laid – Sector code (if beach length is divided into sectors) to indicate where on the beach the nest was laid.
- 4) Location in the hatchery – where in the hatchery the nest is located. The hatchery area can be divided into a grid of one metre squares – the coordinates of these can be painted onto the outside fence to allow quick estimation of location. A nest can be located in e.g. "G2". It is useful to add to this location on the Hatchery Data Sheet, whether that particular location is mostly open ("O") or mostly shaded ("S"), e.g. "G2 / S".
- 5) Number of eggs – the total number of eggs or clutch size. Make sure to also record the broken eggs, e.g. "101 + 2".

When a nest hatches, the date of hatching and the total number of live hatchlings from that nest should be recorded on the Hatchery Data Sheet (see (1) below).

After the nest has hatched, the nest should be carefully excavated and the nest contents should be examined and divided into categories (see (2) – (6) below). According to each category (e.g. shells, undeveloped eggs, etc.) the material can be laid out in rows of 10. This facilitates the counting and recording of the material in the various categories.



Categories and definitions of nest contents to be recorded on data sheets:

- 1) Live hatchlings – number of live hatchlings that emerged from the nest.
- 2) Shells – number of empty egg shells counted. Only shells that make up more than 50% of the size of a complete egg shell should be counted; shell fragments should not be counted.
- 3) Deformed hatchlings (FH) – number of hatchlings which are deformed.
- 4) Dead hatchlings (DH) – number of hatchlings that have left their shell, but died before emerging from the nest.
- 5) Undeveloped (UD) – number of unhatched eggs with no obvious embryo.
- 6) Partially Developed (UH) – number of eggs that show signs of development, but did not hatch.

#### Hygiene While Emptying Nests

The material remaining in a hatched nest can include a variety of fungi. Care needs to be taken to keep these organisms away from the eyes, mouth and lungs. If at all possible, dig old nests and sort nest debris using only one hand. This leaves the other hand free for wiping sweat from the eyes, etc.. After sorting is completed wash your hands thoroughly using soap. Surgical gloves can be worn for digging out nests, but the precaution regarding eyes, mouth and lungs still applies.

Dispose of nest debris in the sea or a waste bin that will be removed from the area, and wash buckets and other containers thoroughly with seawater.

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