# BEST PRACTICES IN SEA TURTLE HATCHERY MANAGEMENT FOR SOUTH ASIA

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Papers in Issue 27 of the *Indian Ocean Turtle Newsletter* highlight the extent to which countries in South Asia use hatcheries as an *ex situ* conservation strategy. Hatcheries are often perceived as 'safe' places to incubate sea turtle nests. Depending on the hatchery location and construction, eggs may be protected from predators, poachers, tidal inundation, and beach erosion. Hatcheries may also be used to raise community awareness about the biology and need for conservation of sea turtles, and provide opportunities for community revenue through ecotourism.

However, there should be ongoing threats to eggs in the natural environment for nests to be moved to a hatchery, as there are disadvantages to this practice. Hatching success in hatchery nests may be far lower than that of natural nests on the beach if poor hatchery management practices are employed, and sex ratios of hatchlings can be skewed if the nest temperatures within a hatchery differ from those on the natural beach. Operating a hatchery following best practice guidelines requires trained personnel and sufficient resources to protect and monitor nests throughout the nesting season (Mortimer, 1999; Shanker *et al*., 2003).

Considering the disadvantages of incubating eggs in a hatchery, sea turtle nests should preferably remain *in situ* for the duration of the incubation period. Nests can be protected in their original location, for example, caged (Kurz *et al*., 2011) or meshed (e.g. O'Connor *et al*., 2017) to exclude predators, or relocated to a higher site on the beach if laid close to the high tide line (e.g. Tuttle & Rostal, 2010). Community awareness and conservation initiatives have proved successful at reducing the loss of nests to poachers (e.g. Rajakaruna *et al*., 2009; West, 2010),

However, if moving eggs to a hatchery will ensure a much higher hatching success than the strategies described above, then hatchery location and construction, methods of egg collection and transport, hatchery nest characteristics and density, and hatchling handling and release, should aim to maximise the number of hatchlings produced. Manuals relevant to the conservation of sea turtles in countries within the Indian Ocean and South East Asia (and globally) can be used as reference material for hatchery operations- Eckert *et al*. (1999), Ahmad *et al*. (2004) and SToI (2011). A visual summary of best practise for sea turtle hatchery management is available on the website *Sea Turtles of India* (https://www.seaturtlesofindia.org/library/outreach-material/). For quick reference, the best practices in hatchery management have been summarised in Table 1; references to studies that support the recommendations have also been provided.

We also recommend that hatchery managers periodically review the need for nests to be moved from their natural location, as changes in predator density and poaching activities may occur over time, removing the need for hatcheries to protect nests. Nests demonstrating a high hatching success and with a low risk of egg loss from depredation, poaching, tidal inundation, erosion, microbial invasion, etc should remain where they are laid.

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Table 1. A summary of best management practices for sea turtle hatcheries.

| | Best Practice Supporting Literature | Supporting Literature |
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| Hatchery location | • Choose a location at least one vertical metre above the highest high tide line and distant from tidal creeks, streams, river mouths etc to reduce risk of inundation or flooding and embryo mortality.<br>• Minimise distance between nesting beach and hatchery to reduce transport time and potential for embryo mortality.<br>• Provide a diversity of nest microhabitats (e.g. shade, slope) to reflect conditions on the nesting beach and avoid potentially skewing sex ratios of hatchlings.<br>• Change location of hatchery every year to avoid accumulation of organic material and high microbial load. Change location of hatchery every year to avoid accumulation of organic material and high microbial load. | Mortimer *et al*. (1999), Shanker *et al*. (2003), Ahmad *et al*. (2004); Spanier (2010); Maulany *et al*. (2012) |
| Hatchery construction *(incl shading)* | • Enclose hatchery in fence constructed of chain link, wire mesh, barbed wire, cane, bamboo or slats as available.<br>• Reinforce the base of the fence with 1-2m of 0.5cm-1.0cm mesh, buried to 50cm deep to prevent entry of burrowing predators.<br>• Minimise the risk of lethal nest temperatures, especially late in incubation, by partially shading the hatchery with a material such as shade cloth or coconut thatch, or shading individual nests with thatch baskets. Permanently shaded hatcheries should monitor their nest temperatures to reflect those of in situ nests, to avoid skewing hatchling sex ratios from natural. | Mortimer *et al*. (1999), Shanker *et al*. (2003), Ahmad *et al*. (2004) |
| Egg collection | • Minimise movement and use of lights until turtle begins laying, to minimise disturbance and the risk the turtle will return to the sea without nesting.<br>• Catch eggs as they are being laid by hand or into a clean plastic bag (be careful not to disturb the turtle by touch or movement during oviposition), or mark location of nest with a length of rope or coloured tape reaching from eggs to beach surface and remove eggs once turtle has finished nesting. Do not probe for nests with a stick or other Implement, to avoid destroying eggs. | Mortimer *et al*. (1999), Shanker *et al*. (2003), Ahmad *et al*. (2004) |
| Egg handling and transport | • Rebury eggs in hatchery within 2-3hr of oviposition to minimise embryo mortality.<br>• Eggs to be transported short distances more than 2hr after oviposition should be removed from the nest without vertical or horizontal rotation and egg orientation indicated by marking the top of eggs with a soft pencil. Original orientation should be maintained during transport.<br>• Transport of eggs for long distances and/or long travel times may require low-temperature or hypoxic environments to maintain embryo viability.<br>• Transport eggs in rigid containers to minimise rolling and potential embryo mortality. | Limpus *et al*. (1979); Parmenter (1980); Harry & Limpus (1989); Mortimer *et al*. (1999), Shanker *et al*. (2003), Ahmad *et al*. (2004); Williamson *et al*, (2017) |
| Reburial of nests | • Rebury eggs in a location within the hatchery that mimics the natural nest environment.<br>• Dig hatchery nest to the same depth as the natural nest.<br>• Mimic the shape of natural sea turtle nests (usually flask shaped with a narrower neck than base).<br>• Place eggs Individually into the nest; do not 'pour' eggs from a bucket or bag.<br>• Cover the eggs with moist sand removed during nest construction; do not expose eggs to dry sand as there is a risk of desiccation.<br>• Incubate a single cutch in the same hatchery nest; do not split clutches between nests, or combine clutches from different nests. | Mortimer *et al*. (1999), Shanker *et al*. (2003), Ahmad *et al*. (2004); van de Merwe *et al*. (2006); Rusli & Booth (2016) |
| Nest density | • Maintain a density of 1 nest/m$^2$ to minimise the effects of adjacent nests on temperature and respiratory gas availability, and allow space for hatchery workers to move. | Mortimer *et al*. (1999), Shanker *et al*. (2003), Ahmad *et al*. (2004); Maulany *et al*. (2012) |

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| Nest enclosures | • Protect nests from predators by constructing cylindrical nest enclosures of rigid material ~60cm in diameter. (Avoid rigid wire as it can injure hatchlings.) Bury 10cm into sand for burrowing predators and cover with mesh or net for aerial predators. | Mortimer *et al*. (1999), Shanker *et al*. (2003), Ahmad *et al*. (2004) |
| Hatching release | • Predict emergence date, often 45-55 days after oviposition. The characteristic 'caving in' of sand above the nest indicates emergence will usually begin within 2-3 days.<br>• Check enclosures every 30-60mins from afternoon to dawn and at other times when hatchlings may emerge (e.g. on overcast days and after rain) around the predicted emergence date.<br>• Release hatchlings as soon as possible to prevent exhaustion, desiccation, loss of vigour, possible injury, or death from predators.<br>• Release hatchlings in groups if possible to improve survival probability; however, early emergers should not be held until more hatchlings emerge as this practice can result in loss of vigour.<br>• Randomise clutch release sites hundreds of metres apart to avoid creating fish feeding stations off the beach, which increases the risk of predation.<br>• Allow hatchlings to crawl from the dune across the beach and enter the ocean unassisted to facilitate imprinting.<br>• Manage observers to ensure hatchlings are not injured or their progress to the sea impeded; parallel lines ~20m apart on the beach give a mark for people to stand behind while hatchlings crawl between lines.<br>• Ensure artificial lights are shielded during hatchling emergence and release, and after they enter the ocean to minimise disorientation.<br>• If hatchlings emerge in heat of day or immediate release is not possible, hold hatchlings in a soft, damp cloth or sack in cool, dark place. Do not hold hatchlings in water as they will enter their 'swim frenzy' period and deplete energy reserves needed for survival and dispersal. | Mortimer *et al*. (1999), Wyneken (2000); Pilcher & Enderby, 2001; Shanker *et al*. (2003), Ahmad *et al*. (2004); van de Merwe *et al*. (2013) |
| Hatchery records | • Number each nest in the hatchery and associate with a standard data record form.<br>• Complete a data sheet or data book entry for each nest, including information such as date of oviposition, clutch size, date of emergence, number of hatchlings, and (if recorded) SCL, weight, and scalation pattern.<br>• Collect data from emerged hatchlings restrained in enclosure e.g. emergence date, and hatchling straight carapace length (SCL), weight and scalation pattern if possible. | Mortimer *et al*. (1999), Shanker *et al*. (2003), Ahmad *et al*. (2004) |
| Monitoring and evaluation | • Calculate incubation period as number of days between oviposition and emergence.<br>• Excavate nest 2-3 days after the majority of hatchlings have emerged and calculate:<br>a) Hatching Success= (Number of hatched eggs/Total number of eggs) x 100<br>b) Emergence Success= (Number of naturally emerged hatchlings/Total number of eggs) x 100<br>• Monitor nest temperature and hatchling sex ratio from a statistically valid proportion of nests in hatchery and compare with data from the natural beach/es for your population of sea turtles. | Mortimer *et al*. (1999), Schäuble *et al*. (2002); Shanker *et al*. (2003) |
| Education and awareness | • Create educational materials (e.g. posters) for visitors to the hatchery to raise awareness about sea turtle biology and conservation.<br>• Encourage students and local wildlife enthusiasts to volunteer at the hatchery if possible. | Shanker *et al*. (2003) |
| Personnel | • Train employees and volunteers in sea turtle biology, conservation, and hatchery management techniques.<br>• Provide access to general articles and manuals about sea turtle biology and hatchery practices.<br>• Run or co-manage the hatchery with the local community when possible.<br>• Collaborate with other community programmes in same area or elsewhere on the coast when possible. | Shanker *et al*. (2003) |

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