



## Part 8

# MARINE TURTLE-RELATED RESEARCH

OLIVE RIDLEY TURTLE WITH SATELLITE TRANSMITTER (PHOTO: KARTIK SHANKER)





## A Review of Olive Ridley Nesting and Mortality in Orissa<sup>1</sup>

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Orissa has three known arribada beaches at Gahirmatha, Devi river mouth and Rushikulya (Pandav et al 1998). The largest arribadas in Orissa have been reported from Gahirmatha, and estimates have ranged from 100,000–800,000 nesting turtles, leading many authors to call this the largest population in the world (from Bustard 1976 to Patnaik et al 2001). However, since standardised techniques have not been used to census turtles, the size and status of this population is unknown. This is critical because of recent fishery-related mortality in Orissa, where over 90,000 dead turtles have been counted in the last eight years. In the past 25 years, a variety of approaches and methods have been used by different agencies to estimate female populations at arribada beaches, and the reliability of these estimates has been questioned (Shanker et al 2004). These data, however, have been quoted in books, reports, magazine and newspaper articles, creating some ambiguity about the status of this population.

Shanker et al (2004) reviewed over 20 publications on nesting in Orissa, and used data from multiple sources to arrive at consensus estimates for each year. They also used the strip transect method to census an arribada in March 1999, and estimated nesting of ~180,000 turtles. The absence of reliable data on which to base conservation action is a major lacuna. This emphasises the need for collaboration between research and management agencies and the need to train management personnel in estimation techniques and data collection for effective monitoring of status, threats and trends.

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<sup>1</sup> Portions of this chapter have been reprinted (with permission from Elsevier publications), from K Shanker, B Pandav and B C Choudhury, 'An assessment of the olive ridley (*Lepidochelys olivacea*) nesting population in Orissa, India,' (2004). *Biological Conservation* 115: 149–160.



## Review of nesting at Gahirmatha

A review of over 20 publications for arribada estimates in Gahirmatha, which include most accounts of arribadas in Orissa, revealed that many estimates are derived from the same source (Orissa forest department), but do not match with each other (Shanker et al 2004). The most reliable estimate for each arribada was derived using concordant data from different sources. However, given the inconsistency in the literature available, it is also possible that none of the estimates are reliable and that we actually know very little about the Orissa rookeries, except that major arribadas (>100,000 turtles) have occurred during most years since 1974, and that current population sizes are in the range of 150,000–200,000 nesting females. Gahirmatha hosted at least one major arribada (>100,000 turtles) during most years from 1974–2001. Numerous small arribadas (eight arribadas of <1,000 turtles, four arribadas of 1,000–10,000 turtles) have been reported in Gahirmatha from 1976–85 (Dash and Kar 1990). These data are not available for subsequent years. The data in published literature was used to arrive at a consensus estimate for each year between 1976–99. The justification for the estimate for each year is given in detail in Shanker et al (2004).

Barring 1999, standardised methods have not been used to estimate turtles nesting in arribadas. None of the published reviews of nesting in Orissa (Dash and Kar 1990, Chadha and Kar 1999, Mohanty-Hejmadi 1999, Patnaik and Kar 2000, Mohanty-Hejmadi 2001, Patnaik et al 2001) discuss the methods used in counting turtles or in estimation. No details appear in peer-reviewed publications, and estimates published in books and reports by different authors do not match (even when the data are ostensibly from the same source) or include an estimate of variance.

The estimates of the Orissa forest department are believed to have been derived from a sampling method suggested by H R Bustard (Kar 1980), where all stranding turtles in demarcated strips or plots were marked and counted (Mishra and Kar 1986). The total count of turtles stranding within the sectors were then extrapolated to the entire beach (Mishra and Kar 1986). The proportion of strandings that resulted in oviposition was not determined (B Pandav, pers. obs.). Since many turtles are likely to strand several times before nesting successfully, turtle census during arribadas requires that only ovipositing turtles be counted (Valverde and Gates 1999). In Gahirmatha, the nesting beaches became fragmented in 1989 and frequently inundated with seawater, leading to multiple strandings before nesting, especially during arribadas (B. Pandav, pers. obs.). In fact, arribadas are believed to have failed during 1997 and 1998 due to inadequate dry surface area on the nesting beaches (Prusty et al 2000). Hence it is likely that the figures reported for Orissa overestimate the number of turtles to an unknown degree, especially in recent years.

Despite these shortcomings, it is possible to reach some conclusions regarding the nesting population in Gahirmatha. A comparison of reliable estimates at the two ends of the spectrum suggests that, as yet, there has been no drastic decline in the population over the last 25 years. Reliable estimates are reckoned to be ~150,000 for the mid-1970s, ~280,000 for the mid-1980s, and ~180,000 for the late 1990s—all of which fall well within the normal range of variation known for this species from other rookeries.

However, the trend analysis does indicate an increase through the 1980s, which may have been due to the enforcement of legislations in the late 1970s, which stopped the heavy direct take of turtles. Data from the 1990s suggests that this population may be declining or on the verge of a decline. This is also consistent with the recent increase in fishery-related mortality and other threats.

#### REVIEW OF NESTING AT OTHER ARRIBADA BEACHES

Orissa has two other arribada beaches, at the Devi river mouth (Kar 1982) and Rushikulya (Pandav et al 1994, Pandav 2001b), neither of which has been regularly monitored (Pandav et al 1998). The Rushikulya nesting beach was discovered only in 1994, when about 200,000 turtles are believed to have nested there (Pandav et al 1994). Pandav (2001b) 'guesses' that 25,000–50,000 turtles may have nested here annually between 1995–98. Two medium arribadas (>10,000 turtles) in 2001 and one minor arribada (<10,000 turtles) in 2002 are documented, but no estimates are available. Arribadas were also reported at Pentha at the Barunei river mouth, 30 km south of Gahirmatha, during March and April 1999 (Shanker and Mohanty 1999, Patnaik et al 2001). The timing of these arribadas (usually a few weeks after the arribada at Gahirmatha, see Table 1) and the fact that arribadas have been recorded only at any two sites within the same season supports the hypothesis that it is mostly the same turtles that nest at all the rookeries.

#### REVIEW OF MORTALITY

Biswas (1982) reports the shipping of 6,000 turtles during three months in 1974–75, and 21,000 turtles during three months in 1978–79 from Orissa and West Bengal. Das (1985) reports that prior to 1981, six to seven truckloads (each with 125–150 turtles) arrived in Kolkata everyday. He calculates that this amounts to 80,000 turtles per season. Many accounts report an annual catch of 50,000 turtles from the Orissa and West Bengal coast till about 1980 (see Silas et al 1983). Though it is not clear for how long fishing had been this intensive, it is likely to have reached this level only in the 1970s, after the introduction of mechanisation. After the implementation of the Indian Wildlife (Protection) Act, 1972 with respect to turtle fishery in Orissa, the exploitation decreased substantially. In the 1980s, incidental mortality of a few hundred ridleys per year was reported in Orissa (James et al 1989). Pandav (2001a) provide a detailed account of mortality in Orissa and the rest of the Orissa coast, with an increase from 5,000 per year in 1994 to 13,000 turtles per year in 1999, a total of ~46,000 dead turtles along the Orissa coast in six years. Current mortality rates (Biswajit Mohanty, pers. comm.) are believed to be ~15,000 turtles per year. Reports suggest an increase in fishing intensity from < 1000 mechanised boats in the late 1980s to > 4000 boats by 1996.

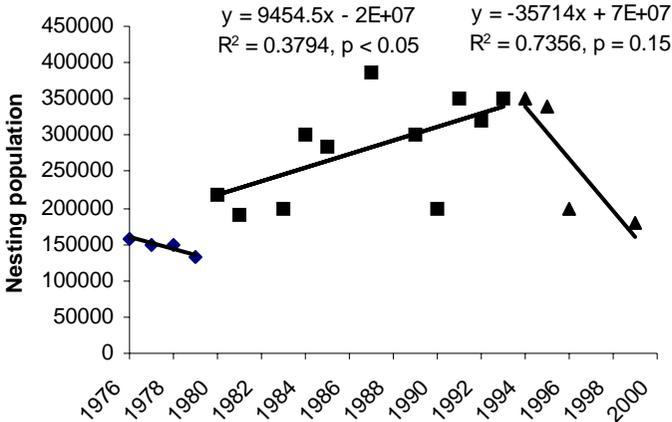
#### POPULATION TRENDS AT GAHIRMATHA

Non-linear quadratic fits show an increase through the 1980s, followed by a decline in the 1990s (Figure 1). This is consistent with known patterns of exploitation. Linear regressions were carried out separately for the late '70s (with intentional take), 1980–93 (low mortality) and 1994–present (high incidental mortality). Here, the trends show

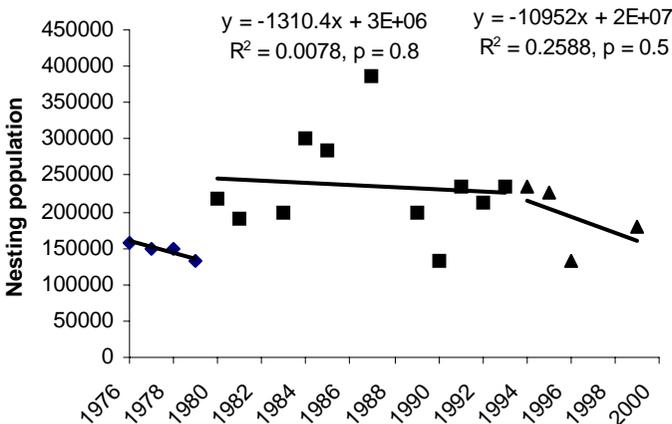


stability or increase in the '80s and a sharp decline in the 1990s (Figure 1). However, the decline in the 1990s is not statistically significant since it is represented by fewer data points.

a)



b)



**Figure 1.** Nesting trends in Gahirmatha over the last 25 years after dividing the data into three time zones: till 1979, when intentional take was drastically reduced; 1980–93, relatively low mortality; and since 1994, when incidental mortality has been increasing.

(a) consensus data from Table 1,

(b) adjusted data for 1989–98, based on a correction factor which was derived by comparing our estimates for 1999 with estimates from other sources. Equations, R<sup>2</sup> values, and p values are given for the second and third time zones for each figure.

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**Table 1.** Consensus estimates for nesting population size in Gahirmatha derived from multiple sources; the estimate refers to the largest arribada during a season, usually the first. No estimates are available for arribadas at the Devi river mouth and Rushikulya. The estimates marked in bold are considered as particularly reliable. Dates of mass nesting at the three rookeries in Orissa from Shanker et al (2004).

Year	Consensus estimate	Date Of Arribada			
		Gahirmatha	2 <sup>nd</sup> arribada	Devi	Rushikulya
1975–76	<b>158,000</b>	?	No data	No data	
1976–77	150,000	?	No data	No data	
1977–78	150,000	Dec 28–Jan 2		No data	No data
1978–79	133,000	Feb 3–9		No data	No data
1979–80	218,000	Feb 9–11		No data	No data
1980–81	191,000	Jan 12–19		Date unknown	No data
1981–82	0	No arribada		No data	No data
1982–83	200,000	Feb 3–6	Apr 4–9	No data	No data
1983–84	300,000	Jan 25–Feb 5	Mar 25–29	No data	No data
1984–85	<b>280,000</b>	Jan 14–30	Mar 16–19	May 26–29	No data
1985–86	50,000	Mar 31–Apr 6		No data	No data
1986–87	386,000	Jan 5–14	Mar 8–14	No data	No data
1987–88	0	No arribada		No data	No data
1988–89	300,000	Jan 25	No data	No data	
1989–90	200,000	Mar 4–14		No data	No data
1990–91	350,000	Mar 6–14	Apr 28	No data	No data
1991–92	320,000	Jan 23–Feb 1	Mar 21	No data	No data
1992–93	350,000	?	No data	No data	
1993–94	350,000	Feb 2–13		No arribada	Mar 1–8
1994–95	340,000	?	No arribada	Mar 14–16	
1995–96	200,000	Jan 1–16		No arribada	Mar 6–8
1996–97	0	No arribada		Mar 14–17	Jan 31–Feb 3
1997–98	0	No arribada		No arribada	Mar 20–23
1998–99	<b>180,000</b>	Mar 26–30		Feb 22–23	No arribada
1999–00	?	Mar 13–19		No arribada	No arribada
2000–01	?	Feb 2–?		No arribada	Feb 26–Mar 4
2001–02	0	No arribada		No arribada	No arribada

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## Discussion

The Gahirmatha rookery was reported by the Bombay Natural History Society in 1973 and later gained international attention after a report by Bustard (1976), where it was first labelled as the ‘World’s Largest Sea Turtle Rookery?’, albeit with the question mark. Since then, the label has been applied indiscriminately, despite recent increases in the nestings at Oaxaca, La Escobilla, Mexico and at Ostional, Costa Rica. Whether or not



Gahirmatha is indeed the world's largest rookery is moot. However, a more important question pertains to the status of this population.

A major cause for concern is that arribadas did not occur in Gahirmatha in 1997, 1998 and 2002 even though offshore congregations were formed, which is the highest incidence of failure in the documented history of this rookery. Studies of arribadas in Mexico suggest that ridley populations that are subjected to a high level of disturbance may become unpredictable in the size and timing of arribadas (Marquez et al 1976). Nesting has also been reported from new sites (Patnaik and Kar 2000) (but this may reflect lack of monitoring in previous years rather than a shift in nesting habitat by the turtles). The unpredictability in the site, size and timing of arribadas in Orissa may reflect a high level of disturbance in the offshore waters. The failure of arribadas raises another issue, which is the lack of recruitment for the future.

The sampling of a large number of adult ridleys between 1996 and 1998 suggests a decline in adult size (Shanker et al 2004). While the trend is marginal (and could certainly reflect statistical rather than biological significance), it could be explained by the mass mortality of breeding adult ridleys on the Orissa coast. About 90,000 dead turtles have been counted on the Orissa coast since 1994. Since only some proportion of turtles wash up on the coast (7–14 per cent according to Epperly et al 1996), the number of turtles actually killed is likely to be even higher. If a significant proportion of the adult population has been killed, and the number of recruits of smaller size classes in the population is significant, this would result in a decrease in average size in the population. Given our estimate of <200,000 turtles in 1999, and documented mortality of over 90,000 turtles within the last decade, it is possible that the Orissa population may be seriously threatened.

Limpus (1995) points out that the abundance of olive ridleys at a few sites has led to the impression that these turtles may not be endangered. However, arribada rookeries have declined and collapsed in Mexico and Surinam due to exploitation and bycatch (Limpus 1995), and small populations in Pakistan (Asrar 1999), Myanmar (Thorbjarnarson 2000), Malaysia and Thailand (Limpus 1995) have declined drastically. While the Orissa population may not have declined yet, it would be prudent to monitor the population closely and reduce mortality.

The conservation of sea turtles in Orissa needs high levels of coordination between government agencies such as the forest and fisheries departments, the coast guard and navy, as well as non government organisations and local communities. This requires awareness of the issues amongst all stakeholders. There is a deep concern about the commitment of some agencies to the conservation of ridley turtles in Orissa. The estimates of large numbers of nesting turtles in 2000 and 2001 (in Mohanty-Hejmadi 2001, Patnaik et al 2001) (which have been routinely quoted in the press and in reports) might create a false sense of security and confer a false status upon ridley turtles in the region, leading government agencies (such as fisheries organisations) to downplay concerns and minimise and dilute conservation efforts. Many stakeholders, particularly the trawler-owners' associations, have questioned the endangered status of ridleys and the need for stringent conservation measures (Behera and Mishra 2001). Since the data

has appeared in books (Dash and Kar 1990, Patnaik and Kar 2000) and symposium proceedings (Mohanty-Hejmadi 1999), other authors have quoted these sources for demonstrating trends and for justifying their conservation agenda. These data are required for population assessments for the IUCN Red List. Using the data from any one of the above sources could clearly lead to erroneous conclusions.

The lack of reliable data has also hindered the formulation of appropriate management plans. For example, would some level of utilisation be sustainable? Can eggs be harvested? Recent attempts to involve artisanal fishing communities in the conservation of sea turtles have been successful. It has been suggested that, given the poor economic conditions of the coastal communities, programmes whereby local people benefit from the turtles (such as egg harvesting during arribadas and ecotourism) may serve conservation objectives better than total protectionism.

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