A large group of olive ridley sea turtles is resting on a sandy beach. The turtles are scattered across the foreground and middle ground, some facing the camera and others with their backs to it. The beach is a mix of light and dark sand. In the background, the ocean waves are breaking onto the shore, creating white foam. The sky is a pale, overcast grey.

# Census technique for arribadas

Monitoring olive ridley sea turtles in Orissa

Kartik Shanker, B.C. Choudhury & Chandrasekhar Kar

**Olive** ridley sea turtles (*Lepidochelys olivacea*) exhibit the phenomenon of synchronous mass nesting, known as arribadas. Olive ridleys are generally considered to be the most abundant of the sea turtles. Nesting aggregates of over 100,000 females have been reported from Pacific Mexico, Pacific Costa Rica and Orissa on the east coast of India. Despite their seeming abundance and wide distribution, many populations have greatly depleted by human activities. The single most important mass nesting and mass breeding area for olive ridleys in the Indian Ocean is the Orissa coast and coastal waters, which have three known arribada beaches along the sandpit at river mouths of Devi and Rushikulya. Recent genetic studies indicate that olive ridleys on the east coast of India are distinct from other ridleys and might be ancestral to populations in the ocean basins, which serve to increase the conservation importance of this particular population as an evolutionarily one.

One of the most important questions for conservation is with regard to trends: is the population increasing, decreasing or stable? To answer this question, reliable data on population sizes are required for a number of successive years. Given the amount of year-to-year variation, the long time to maturity, and life spans of sea turtles, it is necessary to gather systematic data for decades.

Because nesting females are the only part of the population that are easily visible nearly all estimates of population size in sea turtles are based on nesting beaches. This means that we are ignoring the situation with all members of the population that are reproducing, all males (regardless of age) and those reproductive females that do not nest during the period when we carry out our beach surveys. Hence, it should be remembered that the population estimates are based on a relatively small part of the total population. This booklet provides a simple method to count the numbers of turtles during arribadas.





### Counting turtles during arribadas

During arribadas, thousands of turtles come ashore simultaneously to nest. Standard survey methods are not effective in counting such a large number of nesting turtles. Though many nesting beaches have been monitored for years, the lack of adequate counting methods has meant that estimates are not useful for studying the population to determine whether it is increasing, decreasing or stable.

### The idea of the transect

Strip transect is a useful method to count stationary objects such as plants in a forest or nesting turtles on a beach. The strip is considered to be a representative sample of the area. The width of the strip is narrow enough to enable easy counts of the animals within the strip. Once an estimate is available for this strip, it is extrapolated to the entire beach. Strips are usually laid perpendicular to the coastline of the beach, which provides a good sample of different zones of the beach. Several parallel strips are sampled simultaneously, providing a coverage of the length of the beach along which nesting occurs.

Many earlier counting methods have counted all nesting turtles including the ones which were digging the nests within blocks or strips without checking whether or not turtles were laying. Many of these turtles may have returned without nesting and returned later to nest. Hence many such counts result in overestimates of nesting. The best way of avoiding this problem is to count only turtles that are actually laying eggs.

# Preparation

- a. A number of parallel transects are established on the beach where mass nesting typically occurs. These transects are straight lines running from the tide line to the vegetation or sand dune i.e., point beyond which nesting typically does not occur.
- b. The transect should be marked with poles covered with fluorescent tapes to demarcate the line. The poles will help maintain a straight line when working at night with very little light.
- c. The poles should be in a straight line and ideally about 10 metres apart, so that each pole along the transect can be viewed from the previous pole at night with a small torchlight.
- d. The poles should be connected by a taut coloured rope to act as a guide. This will help maintain a precise direction and to define the central line of the transect.
- e. Transects should be placed every 100 metres.

Preparations to be completed before the arribada

1. Poles need to be placed to demarcate the transects
2. Poles should be painted or marked with coloured markers for visibility
3. Rope should be attached to the poles at an appropriate height (> 6 feet)
4. Surveyors should be familiarized with the census technique and transects laid on the beach

The things to carry during the arribada

1. Datasheet or notebook and a pen to write
2. Torch covered with thin red polythene or plastic cover
3. 2 metre long pole marked in the centre

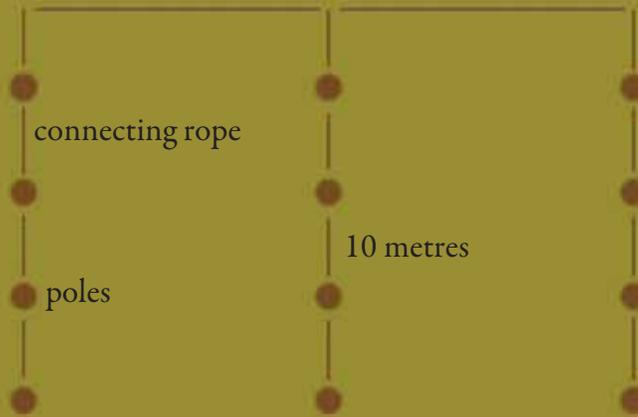
# Anatomy of Transect



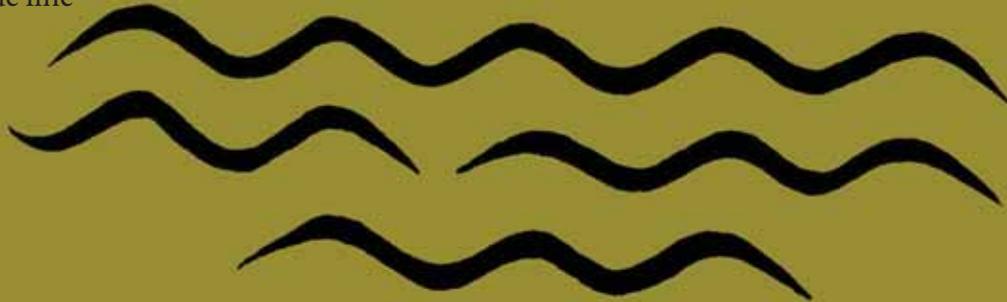
End of transect

100 metres

100 metres



high tide line



# Step by step - walking the transect

Step 1 Walk in a straight line between transect poles using the rope as a guide. Start at the high tide line and finish at the last pole at the other end.

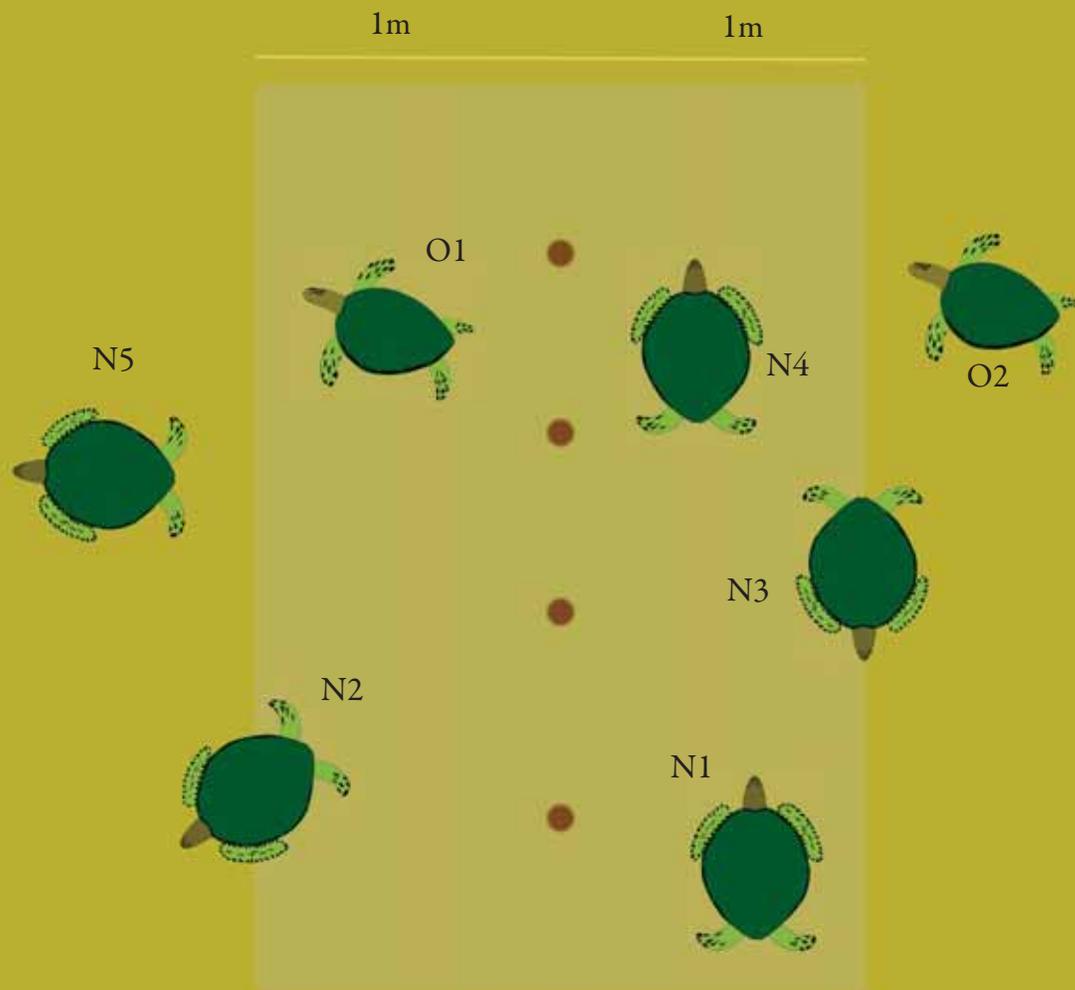
Step 2 Check for turtles within 1 metre of the transect on either side. Ensure that the turtle is within the transect and actually nesting. Use the calibrated 1 metre stick to determine whether the nest is within the transect. Only nests that are fully within the transect should be counted. When a turtle is partially within the transect, to determine whether it is in or out can be confusing. The nest hole of the turtle should be within the one metre width specified for the transect, then it is considered to be within the transect.

Step 3 Only egg laying turtles should be COUNTED. Non laying turtles should be ignored and NOT be included in the count.  
If the turtle is within the transect, check whether it is laying eggs or not. This can be done by digging behind the turtle and checking if oviposition (egg-laying) has started. One can also observe the turtle for a few minutes; egg laying turtles have their hind flippers splayed out and cloacal contractions will also be visible. Turtles that are still digging will make periodic movements of their hind flipper. Before and after egg-laying, a period of rest is usually followed by digging or sand-throwing.

Step 4 Each transect should be walked once every hour after the onset of the arribada.

## Important

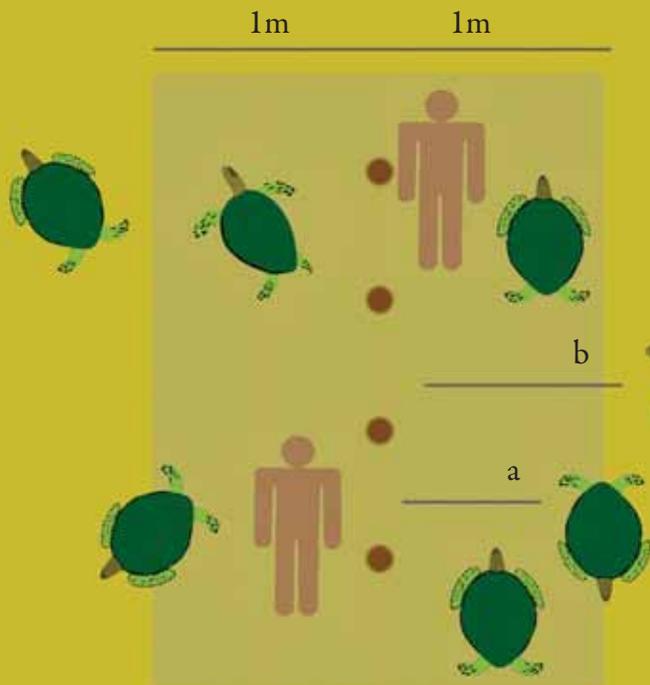
Each surveyor group should complete the transects within 10-15 minutes. Hence each observer should not cover more than 10 transects. If nesting is spread over 2 km, this requires 20 transects (at 100 metre intervals) which can be covered by 2 surveyor groups. Note that these detailed observations can be taken by as few as 2 to 3 observers.



N1 - N5 are turtles that are LAYING EGGS  
 O1 - O2 are turtles that are NOT LAYING EGGS

N1, N2, N3, N4 AND O1 are WITHIN THE TRANSECT  
 N5 AND O2 are OUTSIDE THE TRANSECT

The total number of egg laying turtles within this transect = 4



Step 1: Walk along the transect.

Step 2: Check whether the turtle is within the transect i.e., within 1 metre of the pole on either side.

In the diagram,

(a) the turtle is within one metre and should be considered.

(b) the turtle is not within one metre and should be considered.

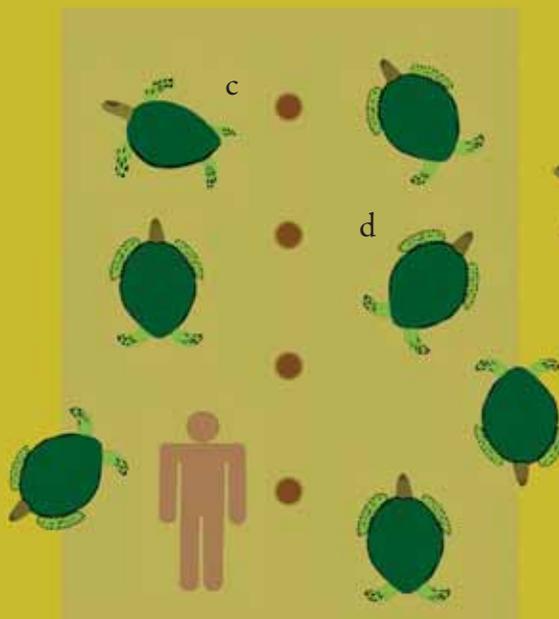
Step 3: Count egg laying turtles within transect

If the turtle is within the transect, check whether it is laying eggs or not. This can be done by digging behind the turtle and checking if oviposition has started. One can also observe the turtle for a few minutes; egg laying turtles have their hind flippers splayed out, while those that are still digging will make periodic movements of their hind flippers.

In the diagram,

(c) the turtle is not laying eggs and should NOT be counted.

(d) the turtle is laying eggs and should be COUNTED



# Data Collection

## VARIABLES TO BE MEASURED

### TOTAL AREA OF ARRIBADA: (TOTAL AVAILABLE NESTING AREA)

Mass nesting usually occurs over several kilometers of beach, depending on the availability of space and suitability of the beach. The intensity of nesting will not be constant across the entire beach, and there will be areas that have much higher densities than others. Hence, one must ensure that areas of low and high intensity nesting are sampled. A simple way to ensure this is to have equally spaced transects that cover the length of the beach where nesting occurs. Hence, if nesting occurs over a range of 2 km of beach, transects can be spread 100m apart from end to end, giving a total of 20 transects.

### TOTAL DURATION OF ARRIBADA:

The number of turtles coming ashore to nests varies throughout the arribada. Usually, the number of nesting turtles is lower during the first and last days of the arribada, with a peak in the middle.

To account for this variation, the duration of the arribada should be divided into sessions.

A session may be defined as a period (day or night or both) of continuous nesting. This may vary due to the intensity of nesting or the length of each session. Hence, the number of nesting turtles must be estimated separately for each session of the arribada.

For each session it is important that sampling is initiated at the beginning of the arribada, when there are more than 100 turtles on the mass nesting beach. If this is not carried out for any reason, the time of the beginning of the arribada must be recorded, so that nesting can be estimated for the duration when no sampling was carried out.

Similarly, sampling must be carried out till the end of the arribada, or an accurate estimate of the time of the end of the arribada must be made.

### WIDTH OF THE TRANSECT:

The width is defined by the distance one chooses to sample. In practice, a transect of 2 metre width can be measured as 1 metre on either side of a marked central line. An alternative to this is to have two parallel lines at a distance of 2 metres extending from one end of the beach to the other.

### TRANSECT LENGTH:

Transect can be equal or unequal in length. If transects sample the beach from the high tide until where nesting ends, they will tend to be unequal in length since this distance will vary in different sectors of the beach. In this case, the length of each of the transects must be carefully measured.

### DURATION OF OVIPOSITION:

A very important factor in the calculation of the number of nesting turtles in an arribada is the time taken to lay eggs or the duration of oviposition. During the arribada, turtles must be carefully observed while nesting, and the exact amount of time taken for oviposition (from laying the first to the last egg) must be measured. This can be measured for at least 30 animals to get a good estimate for each population.

### Data Analysis

$$\text{Estimate of Nesting} = \frac{\text{Total available nesting area (m}^2\text{) x Duration of arribada x sum of total of egg laying turtles}}{\text{width of transect x number of sampling periods x sum of length of transects x average duration of oviposition}}$$

# Sample Data Sheet

## Sample data

This represents data from Day 1 of the arribada described above. Each of the 17 transects was counted on the hour from 6 PM to 6 AM the following morning.

Time	1	2	3	4	5	6	7	8	9	10
6.00 PM	0	0	0	1	0	0	3	6	5	0
7.00 PM	0	0	0	0	0	0	3	3	7	0
8.00 PM	0	0	0	0	0	0	2	7	8	0
9.00 PM	0	0	0	0	0	6	3	8	3	0
10.00 PM	0	0	0	0	0	3	6	7	0	3
11.00 PM	0	0	0	0	0	2	3	5	1	3
12.00 AM	0	0	1	0	0	4	2	7	0	1
1.00 AM	0	0	0	2	0	7	4	6	2	2
2.00 AM	0	0	0	0	0	6	1	7	1	2
3.00 AM	0	0	0	0	1	4	1	5	0	0
4.00 AM	0	0	0	0	0	7	1	3	0	1
5.00 AM	0	0	0	0	0	4	2	5	1	1
6.00 AM	0	0	0	0	0	2	2	4	2	0

## Authors

Kartik Shanker

Centre for Ecological Sciences, Indian Institute of Science, Bangalore, & Ashoka Trust for Research in Ecology and the Environment, Bangalore

B.C. Choudhury

Wildlife Institute of India, Dehradun

Chandrashekar Kar

Forest Department, Government of Orissa

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