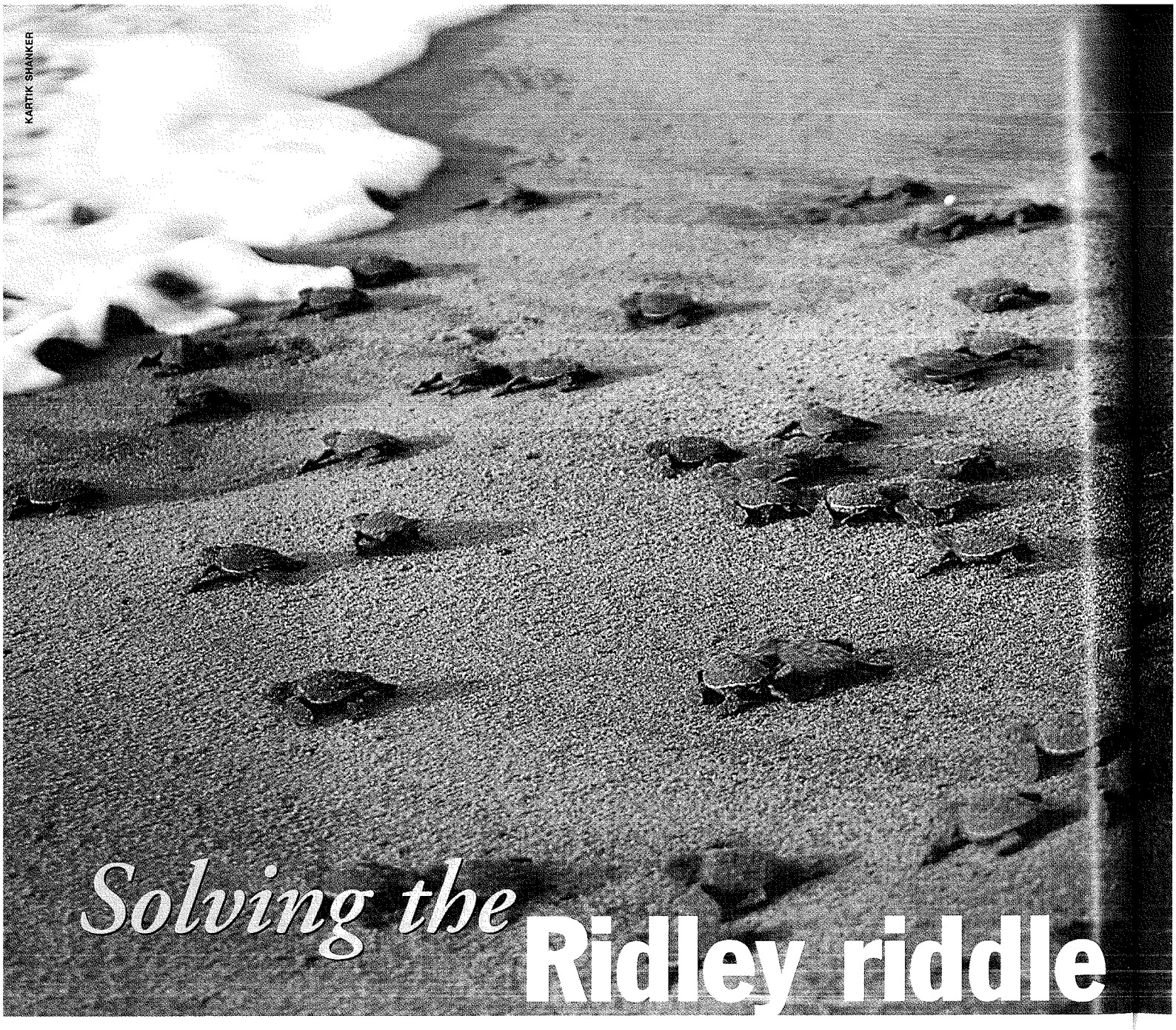


KARTIK SHANKER

Solving the Ridley riddle

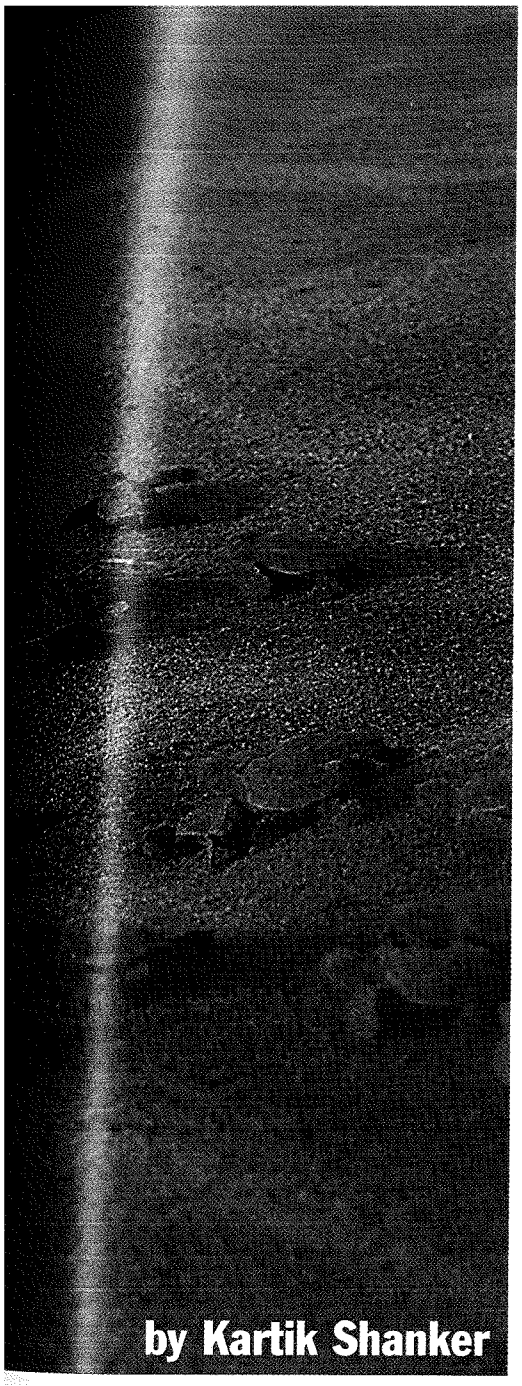
The turtle we had christened Chandra made its way down the beach and into the surf as we watched. Hopefully, Chandra would successfully run the gauntlet of offshore illegal trawlers and make it to safer waters, the black box attached to her shell transmitting data to us all the while.

Chandra was the first olive ridley sea turtle in India to be fitted with a Platform Transmitter Terminal (PTT) and we hoped to get from it information on the movements and habits of Orissa's olive ridleys. Together with Chandrasekhar and Sudhakar Kar of the Orissa Forest Department, B.C. Choudhury and Bivash Pandav of the Wildlife Institute of India (WII), and Jack Frazier of the Smithsonian Institution's Conservation and Research Centre, we had carried out India's first ever satellite tagging of olive ridleys on Orissa's Devi beach, as part of a Government of India-UNDP project to study and conserve sea turtles.

Tracking turtles

While tag returns from Sri Lanka and anecdotal accounts of offshore congregations along the east coast give an indication of turtle movements, there is an abysmal lack of information about them once they leave the coast, and hence the need for satellite telemetry to track their movements and enhance protection.

From April 17-19, 2001, our team had been camping at the Devi river mouth. We would have liked to attach the PTTs at Rushikulya, the southernmost rookery, where the turtles would have the least chance of being caught by trawlers. But it was late in the season, nesting was sporadic and earlier patrolling had suggested that Devi might be the best site. Sanjeev Chaddha, the local DFO, had arranged for four nesting ridleys to be detained. First, the turtles were measured and monel tags (numbered metal tags that identify each animal) attached to the flippers. The tags have an address so they can be returned to whoever tagged the turtle. The Kiwisat 100 transmitters, each weighing about 600 gm. (ridleys weigh about 50 kg.) were attached to the turtle's shell using epoxy, which doesn't generate heat or harm the turtle. The base of the transmitter and the most anterior part of the carapace were covered with epoxy and the transmitter was pushed into place. The



by Kartik Shanker

There is an abysmal lack of information about turtles once they leave the coast of Orissa, hence the need for satellite telemetry to track their movements and enhance the protection of their habitats.

turtles were then released in the presence of members of the local fishing community. We named the first turtle 'Chandra' after Dr. Chandrasekhar Kar. Two transmitters were switched on by local children and the turtles named after them, while the fourth was christened 'Devi' after the location.

The PTTs have temperature sensors and surface time counters to indicate the proportion of time spent on the surface. A switch ensures that the PTT is switched on only when the turtle surfaces, conserving the battery when underwater. The battery is designed to last a year, if the turtle spends 30 per cent of its time on the surface. The data from the PTTs is now being received, analysed and mapped at the WII. Initially, all four turtles moved in different directions in offshore waters. Since then, Chandra has been moving steadily southwards, while the others are moving in large circles off Orissa and Andhra Pradesh. Readers who wish to keep track of their movements can do so at www.wii.gov.in and www.kachhapa.org where a weekly updated map is posted.

Enigmas of the deep

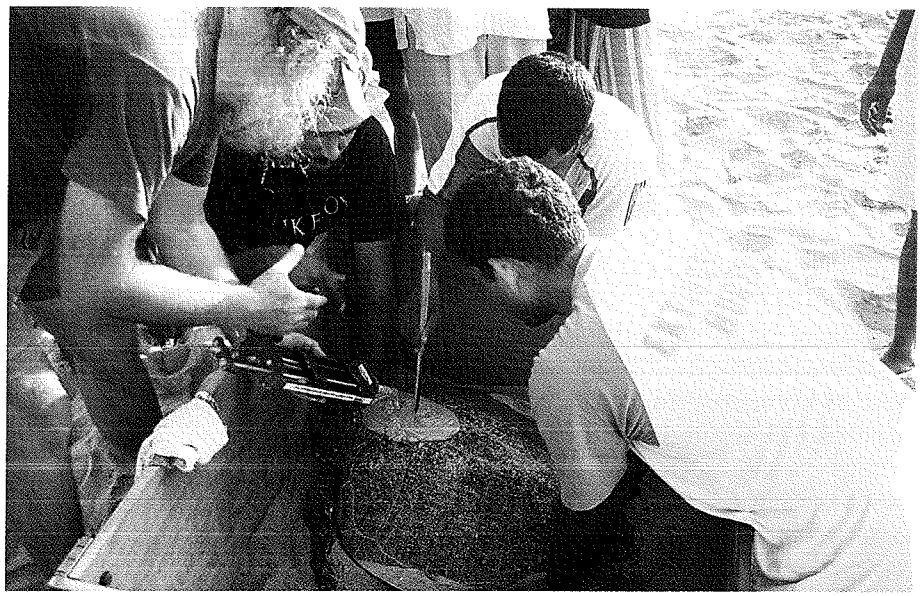
Sea turtles defy logic, defeat common sense and confound attempts to enumerate them, especially when thousands come ashore simultaneously for their mass nesting or *arribada*. Many researchers have been honoured (or burdened!) with the title of sea turtle expert. Jack Frazier has worked on sea turtles for over 30 years, yet he is quick to point out that there is no such thing as a turtle expert.

Turtles' life cycles are remarkable and complex: loggerheads undertake amongst the longest breeding migrations, over 12,000 km. across the Pacific, while leatherbacks are amongst the deepest diving vertebrates, going down to 1,300 m. in search of jellyfish. Green turtles and loggerheads diverged over 50 million years ago, but sometimes hybridise, making them amongst the oldest 'bastards' known to science! Telemetry and molecular genetics have helped answer some questions, but many mysteries (such as the reasons and mechanisms of mass nesting) remain unanswered.

A turtle begins life beneath the sand on a tropical beach. The female, having migrated from a feeding ground perhaps thousands of kilometres away, mates in offshore waters, crawls ashore at night, digs a flask-shaped nest with her hind flippers, lays 100-150 soft-shelled eggs, covers them and returns to sea. She may nest several times in one season, and then return to her feeding area. After about seven weeks, during which the eggs are incubated by the sun and metabolic heat (sex of the hatchling is determined by temperature, females above a critical threshold, males below), the eggs hatch, and the hatchlings emerge *en masse* at night and scramble for the sea, which they locate by its brighter horizon. They then orient themselves with wave direction, swim offshore, and gradually get imprinted with the earth's magnetic field, which they probably use as adults to return to their natal shores to nest. The hatchlings are believed to spend their early lives in seaweed rafts and driftlines offshore, until, years later, they move to other shallow water habitats. Mortality in this early stage is high.

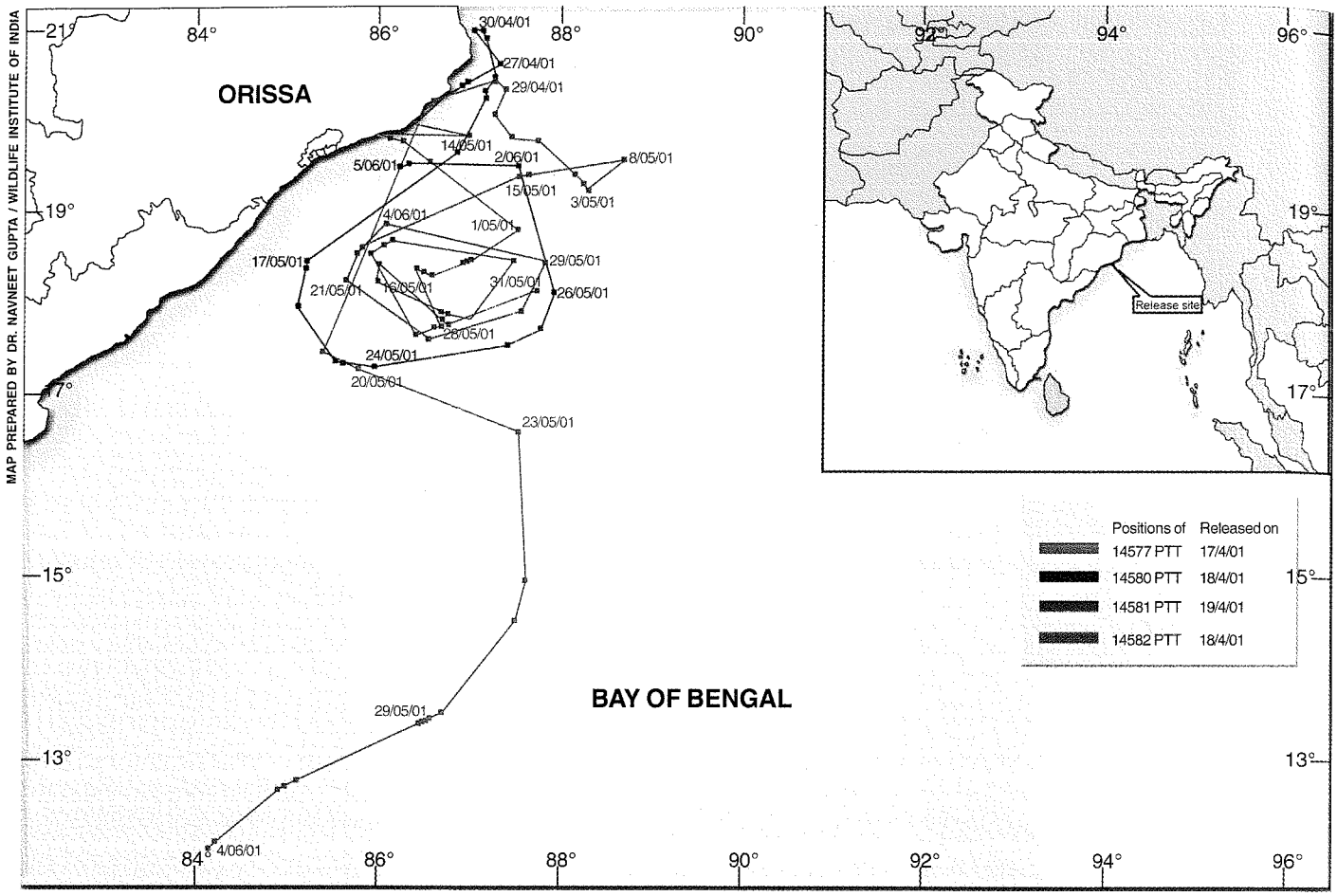
Unanswered questions

Do adult turtles return to their natal beaches to nest? Where do they migrate after they nest, what routes do they follow and where do they forage? These are some of the questions that turtle biologists have attempted to address over the years. While molecular genetic



B.C. CHOUDHURY

The PTT is attached to the turtle's carapace (above) using an epoxy resin. A clutch of hatchlings (facing page) returns to the sea. Molecular genetic techniques reveal that hatchlings return to their natal beaches to nest as adults.



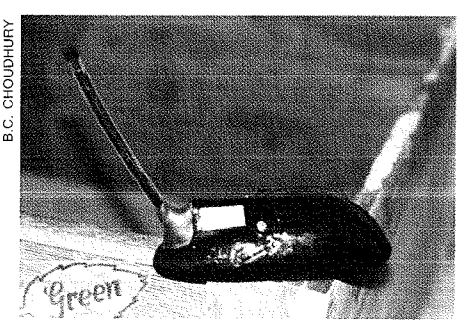
studies have provided an answer to the first question, satellite telemetry is helping address the latter.

While ridleys nest sporadically on India's east and west coasts, the best-known mass nesting beaches are Gahirmatha, Rushikulya and the Devi river mouth on the Orissa coast. Our study of ridley genetics along the east coast shows that this population may be the source for all contemporary ridley populations. Ridleys in the Pacific and Atlantic may have gone extinct periodically over evolutionary time and been recolonised by ridleys from the Indian Ocean, specifically India's east coast population. Orissa might even be the cradle for the world's ridleys, which makes this population vital from a global perspective. Tracing their migratory routes and ascertaining threats thus takes on greater urgency. For example, much concern has been expressed over trawling-related mortality, and despite the efforts of the forest department and local initiatives like Operation Kachhapa, the toll remains high. The 70,000 odd dead turtles counted in the past six years are probably only a fraction of the total deaths. Such high mortality rates can harm this population irreversibly.

Turtle gaffes

It is quite easy to go wrong when working with sea turtles, as biologists have found time and again to their dismay, horror and often embarrassment. One of the great sea turtle gaffes took place with early sea turtle hatchery programmes in the US, when styrofoam boxes were used to incubate eggs. Later, when it was discovered that temperature determines the hatchlings' sex, scientists realised that they may have produced almost exclusively males over the years! Similarly, in the 1980s, the strategy of 'head-starting' was adopted. This involved growing the hatchlings in captivity till they were a certain size to reduce early mortality. But when the theory of 'natal homing' gained credence, scientists began to believe that the imprint of the natal beach may help adults find the same beach to nest as adults. Head-starting could have done more harm than good!

B.C. CHOUDHURY



The Kiwisat 100 satellite transmitter with a hydrodynamic design and a keel to protect the antenna

The numbers game

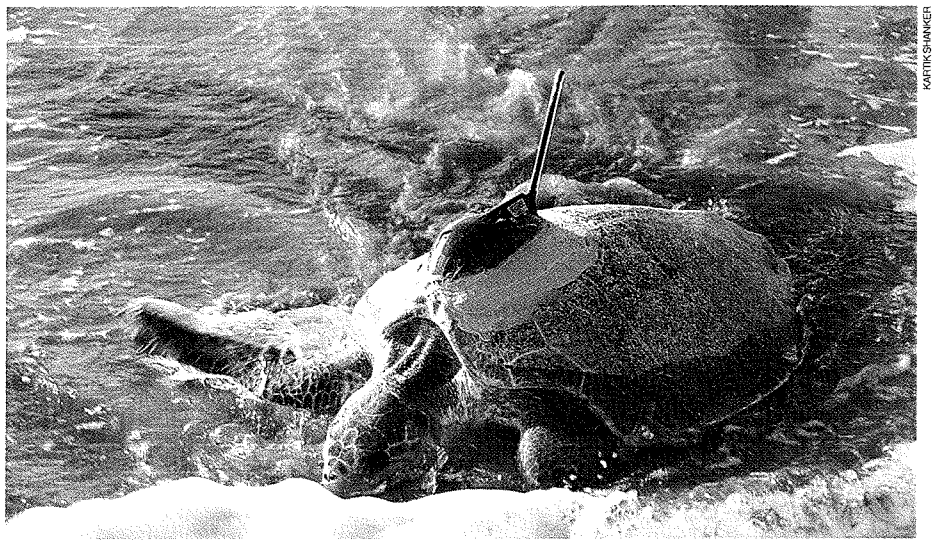
There has been considerable controversy over the number of ridleys that have nested at Orissa's mass nesting beaches. Were the last two years' nesting tallies (an absurdly precise 7,11,542 for the year 2000 and a total of 10 lakhs for 2001) really records?

It is unclear whether this indicates the total nests during a season or the number of turtles. Reports suggest that the two have been used synonymously. In fact, the figure for 2001 and other years is the sum of estimates from different mass nesting events. This is erroneous because these are likely to be the same turtles nesting at different places at different times as tagging and genetic studies have shown. Ridleys may nest twice or thrice in a season.

In India, standardised techniques have not been used to count sea turtles in Orissa. Different scientists and conservationists have been involved at different times, often with untrained assistants. With such large numbers, it is easy to go wrong, and by a large margin. This is why one requires an estimate of the magnitude of

Satellite telemetry

Satellite transmitters are attached to the animal whose movements are to be studied. The transmitters send high frequency signals that are received by polar orbiting weather satellites. ARGOS, a French company, has equipment on board these satellites to track animal movements. The transmissions are first decoded to identify the transmitter, as each has a unique code. The transmitter's position is calculated and this data is downloaded by ARGOS and distributed to the client. The latitudes and longitudes can now be plotted on a map and the migratory routes traced. In India, this technology has been used for species such as the Common Crane and Bar-headed Goose (*Sanctuary* Vol. XXI No.1, February 2001).



KARTIK SHANKER

One of the four olive ridley sea turtles returning to the sea after being fitted with a PTT (No 14581)

error, which can be computed using statistical methods. Traditionally, turtle counts in Orissa have not included error estimates. Standard scientific protocol includes error estimates which means, for example, that when I say I counted 142,000 turtles, I must also be able to say that, based on statistical calculations, I am 95 per cent sure that the real value lies between 107,000 and 192,000. Depending on circumstances, (such as the quality and quantity of data) these errors, called 'confidence intervals', might be higher or lower. Without such estimates, we have no way of knowing how precise a tally is and 864,000 turtles might actually be 541,000.

Compounding errors

However, the biggest error made by most biologists and conservationists in counting Orissa's turtles is that all emerging turtles have been counted. Not all turtles that come ashore nest, particularly during mass nesting when space is constrained and turtles may have to return several times before they can nest. The total number of turtles or nests is thus an unknown proportion of the number that emerged. This means that the real number of nesting turtles in Orissa is an unknown proportion of the numbers reported. This proportion could vary within and between season and site. The simple solution is that any enumeration must only count the turtles actually laying eggs (ovipositing).

Where does this leave us? We know that Gahirmatha is a large rookery with hundreds of thousands of nesting turtles, and that several thousand nest at Rushikulya and Devi. In 1999, Bivash Pandav, using a sampling technique at Gahirmatha, estimated that about 200,000 turtles had nested at the end of March. This is probably the closest we have to a scientifically reliable estimate.

Sampling techniques for counting turtles in *arribadas* are available, and involve counting them in narrow strips (one to two metres wide) at intervals of 100 to 200 m. These strips extend from the high tide line to the vegetation and only ovipositing turtles are counted. The counts must be carried out every hour or two during the *arribada* and this way several kilometres can be covered by a few assistants. These methods are not time, labour or money intensive, and should be used. The forest department, in collaboration with wildlife biologists, plan to use the latest methods to enumerate ridleys in future *arribadas*. The 'record numbers' that have been quoted (and widely reported in the media and scientific meetings) are dangerous as this could lead to the ridley's endangered status being questioned and obscure the fact that large numbers are still falling prey to trawlers.

Linking science and conservation

The combination of conventional tagging, satellite telemetry and genetics may help us understand the migrations and movements of these enigmatic creatures, enabling us to devise better strategies to conserve these populations. For this, the findings of these studies need to be integrated into management programmes.

For example, Bivash Pandav and Karthik Ram's offshore studies in Gahirmatha show that the major reproductive patch (where courting males and females 'hang out') is only about 50 sq. km., a miniscule fraction of the 720 sq. km. marine national park. This patch, and perhaps a few others near the Devi river mouth, need to be afforded intensive protection by government agencies with the help of local communities.

Unlike the conservation of terrestrial creatures, a complicating factor with these highly migratory marine reptiles is that despite protection in India, they are still subject to threats on the high seas and in the waters of neighbouring countries. Conservationists across borders need to work in conjunction with fisheries sectors to develop effective protection strategies. Turtles – migratory, endangered, charismatic – are ideal flagship species for promoting marine conservation. Measures that protect turtles will ensure the overall health and vibrancy of the oceans, and the millions of humans that depend on them.

The sea turtle project

In 1999, the Ministry of Environment launched a sea turtle conservation project, funded by the UNDP, with the WII as the implementing agency. The project aims to strengthen sea turtle conservation and management by gathering baseline scientific information and assessing threats in coastal states and offshore islands. An evaluation of community-based conservation, a review of relevant legislation and characterisation of nesting beaches based on GIS and satellite imagery is part of the project, which will involve forest and fisheries departments and local communities in developing conservation strategies and implementing action plans. Orissa, with its large olive ridley rookeries, is the focal point of the project.

Editor's note: Ironically, the MoEF is simultaneously considering the grant of clearances to industrial-scale projects such as the Dhamra port and a Bharat Petroleum Corporation Limited oil terminal that would destroy or irreparably degrade the same study sites.