

Hornbill

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BOMBAY NATURAL HISTORY SOCIETY



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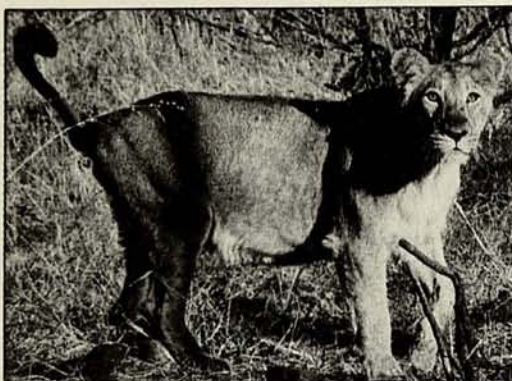
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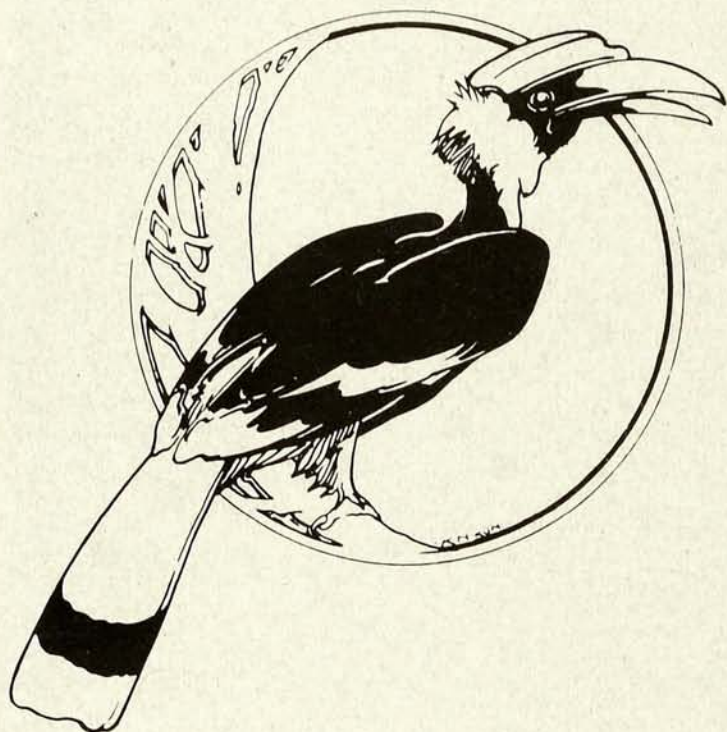
EDITORIAL

Apathy first, conservation next

The issues that politicians raise in an election year are a fairly accurate barometer of public opinion. That they rarely fulfill their promises is another matter altogether; but if a sufficiently large (or influential) group of people feels strongly about any issue, you may be sure that politicians will profess to feel just as strongly. Conversely, if an issue is ignored during the campaign (when practically any issue is a stick to beat your opponent with), it means that it either does not exist, or is so trivial that no words need be wasted on it. Among all the talk about stability, religion and rising prices, scarcely a word was said about the environment — either for or against government policy. And that is a sad reflection on the state of the environmental movement in India.

Except to some extent in Gujarat, very few politicians have felt it necessary to talk about whether and how they plan to slow down deforestation, restore forest cover or prevent (or even, in time-honoured populist fashion, encourage) encroachment into protected areas. One sometimes wonders whether even a stridently anti-conservation stand would not have been better than this silence on an issue we feel is so very important. It is possibly better — and certainly far more flattering — to be hated or even insulted than to be ignored, and considered as being of no account.

That, essentially, is the tragedy — not so much that people are choosing 'development' over conservation, or that timber contractors are leveling prime forest acres at a time, but that the average person couldn't care less. Until the problems of the environment catch the public eye, until they are widely perceived to be not just serious but desperately urgent, we will continue to slide inexorably towards ecological disaster.



Published and printed quarterly by Ulhas Rane for the Bombay Natural History Society. Printed at Conway Printers, Bombay. We welcome contributions on any aspect of natural history or conservation. Articles can be up to 3,000 words in length, and must be accompanied by clear, sharp photographs (prints or transparencies, either black and white or colour). Copyright for photographs used will remain with the photographer. Suitable payment will be made for any material accepted. Reg. No. R.N. 35749/79, ISSN 0441-2370.

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COVER

Malabar gliding frog (*Rhacophorus malabaricus*),
photograph by Isaac Kehimkar

THE CALLS OF THE WILD

ALOYSIUS GNANASEKAR



*G*oa in the rains — the tourist brochures paint very pretty pictures of the many things Goa has to offer. But there's more to this coastal idyll than beaches and feni, as I discovered during a field collection trip in 1988. We were targeting amphibians — frogs and toads — which, though common, abundant and critical to the health of any wetland ecosystem, are less studied than more 'glamorous' species. Amphibian life begins, in a manner of speaking, with the rains. They spend the summer in aestivation or summer sleep, under rocks, in crevices, mud-holes or often sheltered under the peeling bark of an old tree. Then, with the first showers, they wake up, ready to find mates and breed.

Sunjoy Monga

DURING THE COURSE of my work at the BNHS I had collected frogs from south India and the north-east. This would be my first visit to Goa. We chose the Bondla sanctuary in central Goa, about two hours' drive from Ponda. The abundant ground cover in the area supports a very large and diverse population of amphibians, particularly in the monsoon. There were four of us on the trip: Humayun Abdulali, who has spent the best part of four decades making field observations on natural history, B. P. Sinha, the then Chief Conservator of Forests, Goa, Dr Maria Barbosa, a BNHS member, and myself.

The weather, cloudy with signs of imminent rain, promised a productive trip. We reached Bondla at noon. Since our work would not begin till dark we spent some time in the small zoo inside the sanctuary. It was unremarkable except for a large stag-like mammal amongst a group of chital, as large as a sambar but spotted like a chital. According to the zoo authorities, it was a hybrid between the two species. Such a hybrid has not so far been recorded in literature, and it is more likely that it was an unusually large chital stag.

NIGHT FELL, and the chorus began almost immediately — the *brong brong brong* of Jerdon's ramanella (*Ramanella montana*), the *creek creek creek* of the common cricket frog (*Rana limnocharis*), the *tik tik tik* of bush frogs (*Philautus* spp.) and the louder *drong drong* of the ornate microhylid frog (*Microhyla ornata*). Their calls came from all around us; but though the place seemed to be swarming with frogs, we knew from past experience that it would take a whole night of painstaking effort to collect just a few animals.

We would train our flashlights on every likely spot. Bushes, patches of grass, heaps of stones, rainwater pools, each was a microhabitat for one or more species. Once a frog was located (almost invariably by sound), we would ease towards it and then make a sudden grab — usually unsuccessful, because amphibians are, quite literally, slippery customers.

The sound is generated by the vibration of the vocal chords and amplified several-fold by resonance in the vocal sac. Hanging below the throat, this sac comes in a variety of sizes and shapes. The common toad has a single sac about 4 cm in diameter; other species such as the bullfrog have much larger double sacs. The volume of noise

rarely bears any relation to the size of the animal. The call of the 3 cm ornate microhylid, for example, can be heard up to 500 m away; at close range it is positively deafening.

The frogs would usually stop calling as soon as we trained a light in the direction of the sound. We would then have to switch off the flash and wait for them to call again. The small frogs in particular are expert ventriloquists. Locating them in semi-darkness, camouflaged as they are, is next to impossible. It took us nearly an hour to locate a pair of bush frogs. The search was all the more maddening because we could hear them calling loudly all the while, almost as if they were taunting us. We eventually found them sitting inside a dry, curled-up leaf inside a bush we had searched not once but twice.

We split up in different directions to cover more ground and I headed for a rainwater pool where I could see several Jerdon's ramanella floating on the surface, calling continuously. This time there was no difficulty spotting them. The pool seemed to be shallow and I strode forward confidently — and sank knee-deep in mud. The more I struggled the deeper I sank. Somehow I managed to collect the frogs, but there was no way out of the pool; my legs were firmly imprisoned in the mud. I was eventually rescued by a local boy (who I suspected had remained hidden for a while, watching the fun, before coming to my help).

A group of young checkered keelback snakes (*Xenochrophis piscator*) swam past our feet in the draining rain water, and once or twice we glimpsed chital, roused from slumber by the noise and the lights, moving away from us. The same night we collected a female burrowing frog (*Tomopterna breviceps*) as she moved through the wet grass and a common tree frog (*Polypedates maculatus*) which was calling from a tree in front of the rest house. Altogether we obtained 20 specimens of seven species from Bondla — not bad for a night's work.

THE NEXT morning we moved to Volpoi, whose moist deciduous forests are the densest in Goa. We were squelching along a muddy path in pitch darkness and pouring rain, accompanied by two forest guards. After Bondla, our expectations had soared; we were looking forward to another successful night. But six disappointing hours later, we were on our way back to the rest house with nothing in the bag except for a few very

common species. Suddenly we stopped. Above the noise of the rain came a loud, clear chorus of *trek-trek-trek*. None of us had heard that particular call before. The flashlights came on, lighting up a scene straight out of a wildlife fantasy.

In a clearing among the palas and teak trees lay a small pool, surrounded by clumps of bamboo. Perched on the shoots were at least 50 male Malabar gliding frogs (*Rhacophorus malabaricus*), broadcasting their presence to any female within hearing range (three females had already gathered at the site). The bright green frogs sat bathed in the yellow light of our torches. Every few seconds one of them would leap off its perch and vanish into the darkness. Each departure was marked by a flash of red, as the toes fanned open to reveal the bright red webbing between them.

The green body colouration, a characteristic of tree frogs, is an adaptation for camouflage. The extensive web is spread when the frog leaps from one perch to another, allowing it to glide forward rather than dropping vertically — similar to what is seen in some mammals such as flying squirrels. The bright red web also serves as an effective means of

avoiding predators. At rest, the toes are held together and the web is not visible. When the frog is attacked, it separates the toes, opening its web, and leaps away. The sudden appearance of a large red web presumably startles the predator, confusing it for just long enough for the frog to escape.

We collected a few green frogs and returned to the rest house. There was little sleep for me that night; I would wake up every hour to check on the health of our new acquisitions before falling back into fitful slumber. We took the live frogs along with us wherever we went, partly to keep them under continuous observation, but mainly to show them off. The collection trip had been successful: 38 specimens of 11 species collected in three days. The recovery of the Malabar gliding frog was the first ever from Goa, extending the known range of the species northwards from Coorg in Karnataka, over 500 km away.

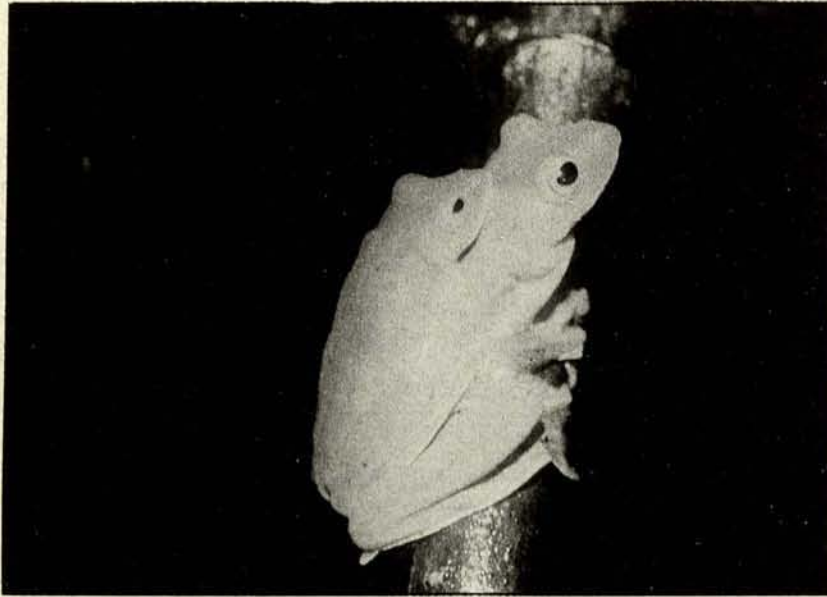
BUT WHY collect frogs — or any animal for that matter? The question is pertinent, but easily answered. Firstly, collection of a limited number of specimens will not, to the best of



Malabar or fungoid frog (*Rana malabarica*). This 5 cm long creature of the night spends the day hidden in rock crevices or under fallen trees.

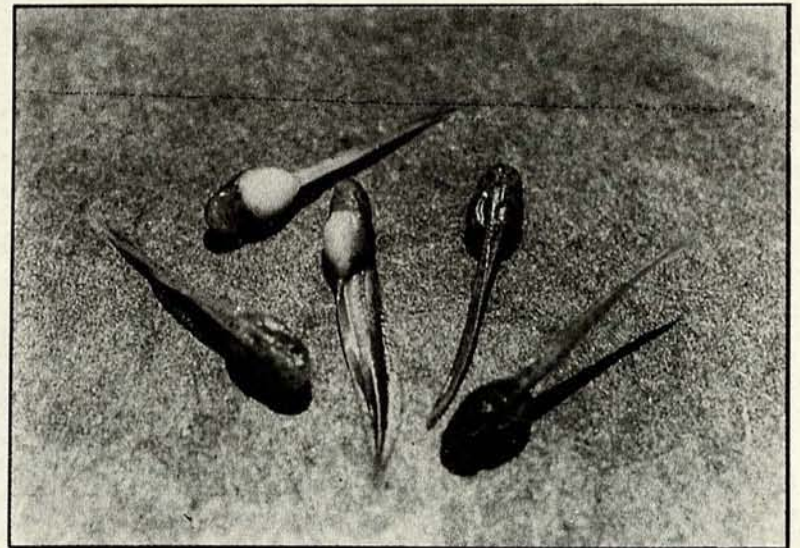
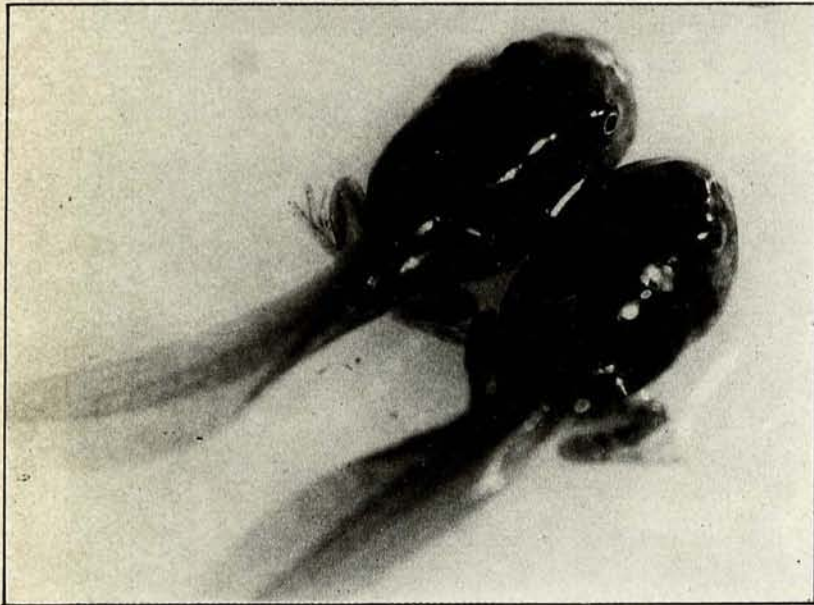
Sunjoy Monga

GROWING UP



The Malabar gliding frog is distributed in evergreen and moist deciduous forests of the Western Ghats, from Kerala to Goa. Adults are totally arboreal, almost never descending to the ground. Spreading their extensive toe webs, they can glide over 10 m from one perch to another as they forage or flee from predators. Like most amphibians, the species is nocturnal. It spends the day, camouflaged and immobile, practically invisible among the leaves, stirring only at night to hunt for insects. The stages of the species' development from tadpole to adult had not been studied, until the author collected a mating pair from Goa, and watched them grow. Photos : Aloysius Gnanasekar

The first step (above) ...in almost all species of frogs, males are smaller than females.



Tadpoles 10 days old. About 18 mm long, and partial to chopped-up earthworms.

About 50 days old. 40 mm long. The hindlimbs and body colouration have developed. The forelimbs have not, but are visible through the translucent ventral skin.



Ten days later. The limbs are more or less fully developed, and only a 5 mm long rudiment of the tail remains. Once metamorphosis is complete, the froglet will live on the ground till it reaches adulthood, and then take to the trees.

our knowledge, damage the health of a population or a habitat; rare species are obviously not collected. Taxonomy—the science of species classification—is built on the examination (sometimes, dissection) of animals. Their loss is more than offset by the information gathered, not only on the species examined, but also on closely related species. Such information, collected over years by wildlife biologists, forms the basis for conservation programmes. What makes a particular species unique? How has it adapted to make more efficient use of the resources for which it must compete with other species? How, and at what point along the evolutionary road, did the paths of species diverge? Such questions are hard to answer; without study specimens, answering them would be quite impossible.

At Dabolim airport on our way home, we faced the inevitable problem of confirmation of reservations. Fortunately the officials were helpful, and the problem was soon resolved. In a burst of gratitude, Mr Abdulali offered to show our new friends the tree frogs. Waving aside my note of caution he opened the lid of the box with a flourish. The frogs saw their chance, and took it. One jumped straight onto an official's shoulder and thence onto the top of a cupboard, where it was presently joined by two of its companions. There was pandemonium for the next fifteen minutes. Several office staff were pressed into service to help recapture them, clambering onto stools and upsetting huge piles of files that had been stored on top of the cupboards. Eventually order was restored, but I do not think the tree frogs gained any new admirers that day.

WE MANAGED to bring the animals back to Hornbill House (the BNHS headquarters) in good health. Once in residence they were fed with flies (I kept moist jagery in a bowl to attract flies, which were then collected with a net). They continued to be active, in contrast with some of our earlier experiences with captive frogs. Having heard so much of the frog's gliding abilities, we decided (quite cruelly, in retrospect) we had to see it for ourselves. So one animal was taken up to the second floor and dropped down vertically.

Even veteran field scientists were amazed by its skill in the air. The moment it was dropped the frog suddenly seemed to expand. Web fully extended, it

Amphibians (from the Latin *amphi* = both, *bios* = life) lead double lives; they are equally at home in water and on land. They evolved from lung fishes (Dipnoi) and lobe finned fishes (Crossopterigians). Over 3000 species have been recorded worldwide, 206 of them in India. Half of these are found in the Western Ghats, another one-third or so in the eastern Himalayas, and the rest distributed throughout the country, including the Andaman and Nicobar islands.

Indian amphibians can be divided into three groups. (1) Tailed amphibians (Order Caudata), which have elongated bodies, two pairs of equally developed limbs and a long tail. The Himalayan newt (*Tylototriton verrucosus*), found in the foothills of the eastern Himalayas, is India's only tailed amphibian. (2) Limbless amphibians or Caecilians (Order Apoda), which are distributed in eastern and south-western India. This fossorial (burrowing), limbless group is the most primitive. They are snake-like in appearance, with a series of transverse bands on the body. The eye may or may not be visible externally. They live in very damp soil, like earthworms, and are therefore rarely seen and difficult to study. We know very little about how they feed, breed and behave. (3) Tailless amphibians or anurans (Order Anura), which include frogs and toads, are by far the most widely distributed group. They can be classified according to their habitat as aquatic, semi-aquatic, fossorial, torrential and arboreal. Among the commonest anurans are the skipper and cricket (*Rana limnocharis*) frogs, and the common toad (*Bufo melanostictus*), vast numbers of which can be seen at small ponds and marshes throughout the country. There are rare species too, such as the black microhylid (*Melanobatrachus indicus*), which was recorded in 1878 but has not been seen since.

In all anurans the breeding season coincides with the monsoon. The humidity triggers their breeding activity. Male frogs gather at a pond or stream and begin calling in chorus. This attracts not only females, but also other males who arrive at the site to join the congregation, which may number several hundred. Since many anurans have similar requirements of breeding habitat, a number of species will be found gathering at such breeding sites, each species in a separate cluster. There is often intense fighting between males for a female, particularly in the common toad. A male, in the process of mounting a female, is often set upon by five or six rivals. The female is buried under a mass of ardent males, each intent on dislodging the other.

In all Indian frogs and toads, fertilization is external. Eggs in most species take a few days to hatch. The time taken to complete metamorphosis, from tadpole to froglet, varies widely, depending on the availability of food, oxygen content and pH of water etc. Tadpoles are generally herbivorous, feeding on freshwater algae, whereas adult amphibians are carnivorous.

glided down at a slight angle rather than falling vertically. When about a metre from the bottom and nine metres from the point of release it suddenly reversed direction and 'flew' upwards, gaining half a metre or so. The experiment was repeated several times with very similar results: the animal never landed flat on the ground but invariably 'flew' upwards when about a metre above the ground to land on a vertical surface.

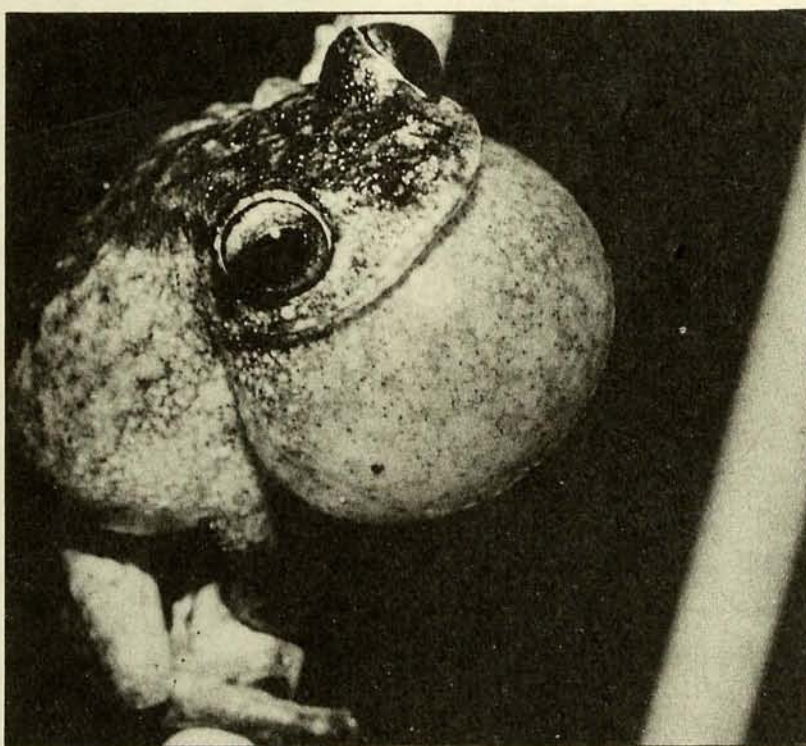
THE DEVELOPMENT of tadpoles has been studied in some frog species, but not in the Malabar gliding frog. Keen as I was to take up this study it took me another two years before I could begin. Vithoba Hegde (a field assistant at BNHS) and myself visited Volpoi again in August 1989. Though it was the height of the monsoon, over two months after the beginning of the breeding season, we were lucky enough to be able to collect a pair in the process of mating. The frogs as well as the nest they had constructed were put into a dry five litre plastic jar and brought back to Bombay.

Nest building in tree frogs is a remarkable process. Mating or amplexus takes place on a tree branch or rock face overhanging a pool of water. The female releases a sticky fluid into which a few eggs are deposited. The male astraddle the female fertilizes these eggs; whereupon the female stirs eggs and fluid into a frothy mass which adheres to the branch or rock face on which the pair is perched. She continues to release the fluid and add eggs; the male continues to fertilize them. And all the while she churns the mixture with her hind legs so that the eggs are distributed more or less evenly throughout the 'foam nest'.

After the mating pair separate and go their respective ways the nest remains stuck to the branch or rock for a few days. The white or cream-coloured

nest is roughly spherical, spongy and rather slimy to the touch. It varies in size from about 6 to 10 cm in different species. 'Our' female built a nest 9 cm in diameter, containing perhaps 150 eggs.

The eggs develop within the nest. Once they hatch, the tadpoles wriggle their way towards the surface of the nest, and finally drop down into the water below, where they continue the process of development which will in three to seven weeks or so take them to adulthood. Though the foam nest is completely exposed the eggs are apparently not predated upon. Tree frog populations are controlled by mortality in tadpoles and adult frogs, not so much by loss of eggs.



Bride wanted — bush frog calling, with its vocal sac fully expanded. The more resonant the call, the better the chances of finding a mate.

Isaac Kehimkar

IN BOMBAY, the foam nest built by our captive Malabars was transferred to another jar containing dechlorinated water (which we changed every day). Three days later the tadpoles hatched and settled at the bottom of the jar. They were then shifted into an aquarium tank containing water at room temperature (28°-35°C). By the time they were 10 days old the tadpoles, brown in

colour, were very active and swimming gracefully.

They were voracious feeders and decidedly carnivorous, in contrast to most other species whose tadpoles feed almost exclusively on microvegetation. I offered them a wide choice of food: algae, chopped cabbage, non-spicy sausage, pieces of mutton, white of boiled egg, chopped earthworms, crushed snail flesh and pieces of bread. The earthworms were a favourite, closely followed by sausage, mutton, and snail flesh. Boiled eggs were eaten occasionally but algae, cabbage and bread, almost never.

After a three day gap when they were not fed I noticed that their tails had shortened by a few millimetres. It was obvious what had happened — the

hungry tadpoles had turned cannibal, biting off each other's tails. Another day I found two tadpoles dead. The cause of death was unknown, but the bodies were fed upon by the others. Cannibalism in tadpoles is not unusual, as I have found to my cost while rearing them in captivity. In 1983 I put a big tadpole of the skipper frog (*Rana cyanophlyctis*) in the same container as two small tadpoles of the common tree frog. Seconds later the skipper had swallowed one of the smaller tadpoles. Tadpoles of the Indian bull frog (*Rana tigerina*) too fed on dead conspecifics (though they do not kill them).

Fumes of naphthalene and spirit permeate most rooms where specimens are preserved, and the BNHS collection room was not the ideal place to rear tadpoles. I decided to keep the tank in the watchman's room. He objected strongly at first, but soon got into the spirit of the thing. In fact he soon became an avid tadpole fan, describing in great detail the development of his charges to anyone who would listen.

The tadpoles sprouted hind limbs when they were 43 days old and just over 4 cm long. By the 56th day there was no more increase in length, but the forelimbs had grown; the characteristic frog-like snout developed a little later. Along with a change in colouration (from brown to yellowish-brown with dark brown dots), there were changes in behaviour too. They were appreciably quieter and fed less often. Nine days later their tails were reduced to rudiments: the tadpoles had become froglets. They now spent much of their time outside the water, clinging to the wall of the tank. By the 68th day nothing remained of their tails. Except for size and colour they were replicas of the adult.

THE COLOURATION in the gliding frog is particularly interesting. Though metamorphosed froglets resemble their parents to

some extent, their colouration is quite different. Adults are green, while the froglets are yellowish brown with black spots. This colouration, common in most adult ground frogs, matches that of the substratum, providing excellent camouflage against predators. Tree frogs in contrast would need green camouflage colouring. It is therefore likely that Malabar gliding frogs live on the ground for a short period before they reach maturity, when they become arboreal and acquire the green body colour of the adult.

By this time the froglets no longer needed a pond. I emptied the water from the aquarium tank and put in green, leafy branches. The tank was covered with



A frog in your bathroom? Chances are it's the common tree frog. The digits of the toes are adapted for climbing and gripping a perch.
Isaac Kehimkar

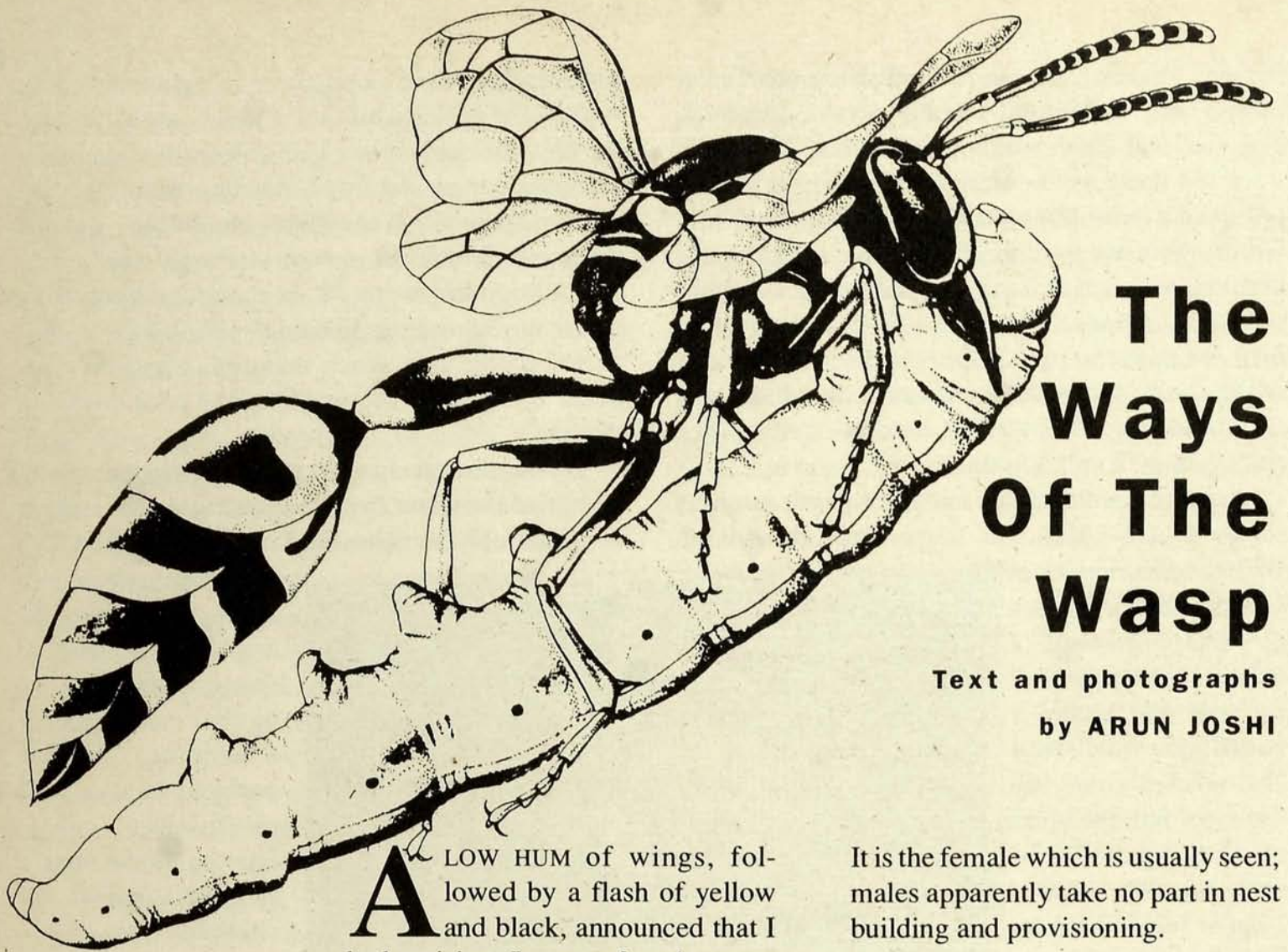
a polythene sheet containing tiny holes for aeration. The froglets seemed quite at home in this makeshift environment. The problem of food was easily solved. I placed banana skins inside the tank. These attracted fruit flies, which the frogs deftly captured by flicking out their folded tongues. The frogs soon became the star attraction at the BNHS; their tank was placed just at the entrance to the building, and most visitors would linger

around the tank until they were told firmly that too much attention was bad for the frogs.

UNFORTUNATELY, their reign was short-lived. Perhaps the climate did not suit them, perhaps their diet was monotonously unhealthy... there is a great deal that we still do not know about the biology of most amphibians. About a month after they arrived at the BNHS they passed on, leaving behind a host of memories and a desire to visit Goa once more and make a closer acquaintance with this fascinating species.



Aloysius Gnanasekar is a herpetologist at the BNHS, with over ten years' experience in the field. He is a member of the Amphibian & Reptile Specialist Group of the IUCN.



The Ways Of The Wasp

Text and photographs
by ARUN JOSHI

A LOW HUM of wings, followed by a flash of yellow and black, announced that I had a visitor. It was a female potter wasp, reconnoitering my bedroom for a suitable nest site. And in the weeks to follow, I was to witness one of Nature's most enduring wonders in all its intricate detail.

The slender-waisted potter wasp (genus *Eumenes*) is not uncommon. There are a number of potter species in India, the most common and widely distributed one being *Eumenes conica*. Nest building can be seen throughout the year, frequently in houses, especially in older buildings where wood has been lavishly used in the construction.

Seeing potters is one thing; actually watching them at work is quite another. Watch, but keep your distance — the female has a formidable sting with which she can paralyse prey and discourage inquisitive naturalists with equal felicity.

It is the female which is usually seen; males apparently take no part in nest building and provisioning.

Once she arrived in my bedroom, the potter wasted no time. She settled down in one corner and hours later, I saw the evidence of her labours — a 1.5 cm long pot-like clay nest cell, moist to the touch, indicating that it was freshly built.

It took 15 moist clay pellets to build the cell. These she brought in one at a time from a mud quarry nearby. Her craftsmanship was immaculate: first spreading the wet clay evenly to build up the walls, and finally adding a rim around the mouth of the nest cell.

She took the utmost care to ensure that no pores remained in the nest-walls. Even hair-thin crevices in the wall behind the nest were meticulously filled up, perhaps to guard her eggs against predation by ants.

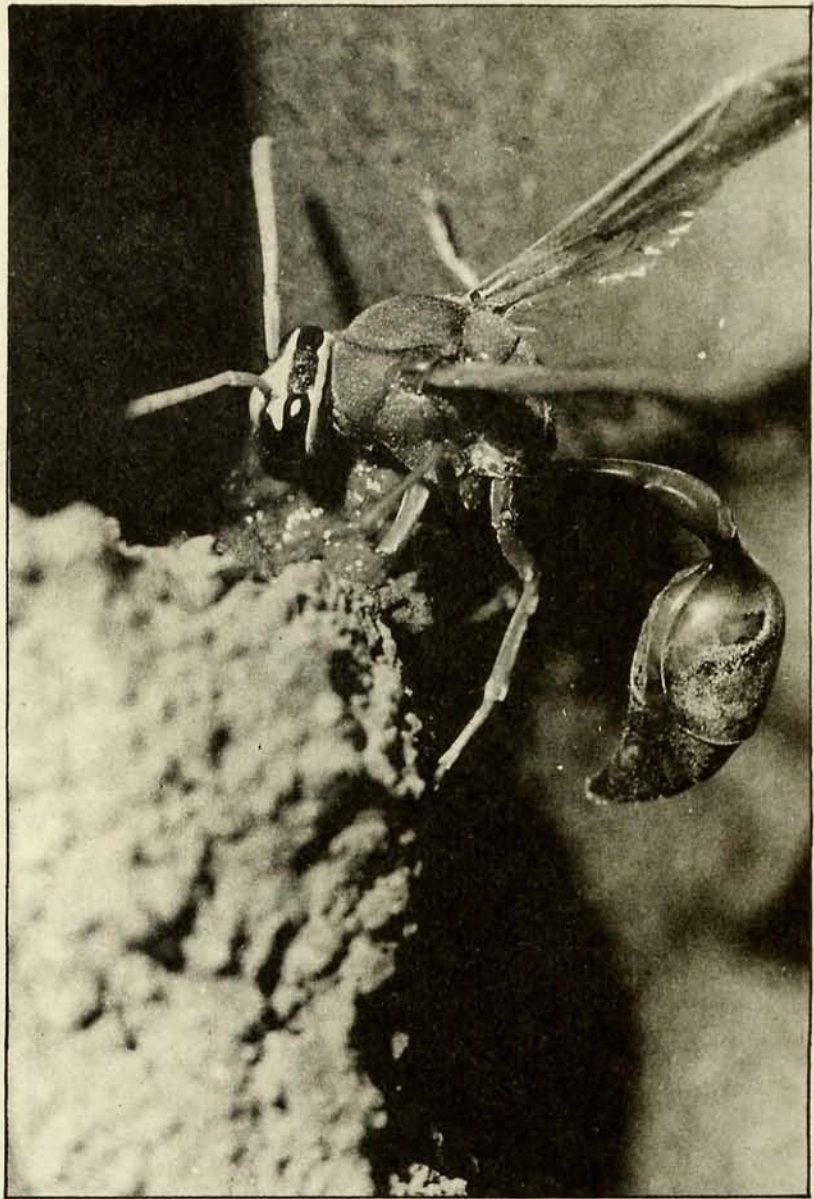
The rim of each cell gave it the appearance of an earthen pot (the Marathi name for the wasp is *kumbhar maji*, literally potter fly). The rim seemed to serve at least two purposes. She rested her hind legs on it during egg laying. And when she brought a caterpillar for her larvae, she would balance it on the rim while she adjusted her grip and forced the caterpillar into the cell through the narrow opening.

Once the cell was stocked, the rim, presumably having served its purpose, was demolished and the cell sealed. Another cell was then begun directly above the first, and so on. When the nest was completed, she coated the entire structure with a layer of mud.

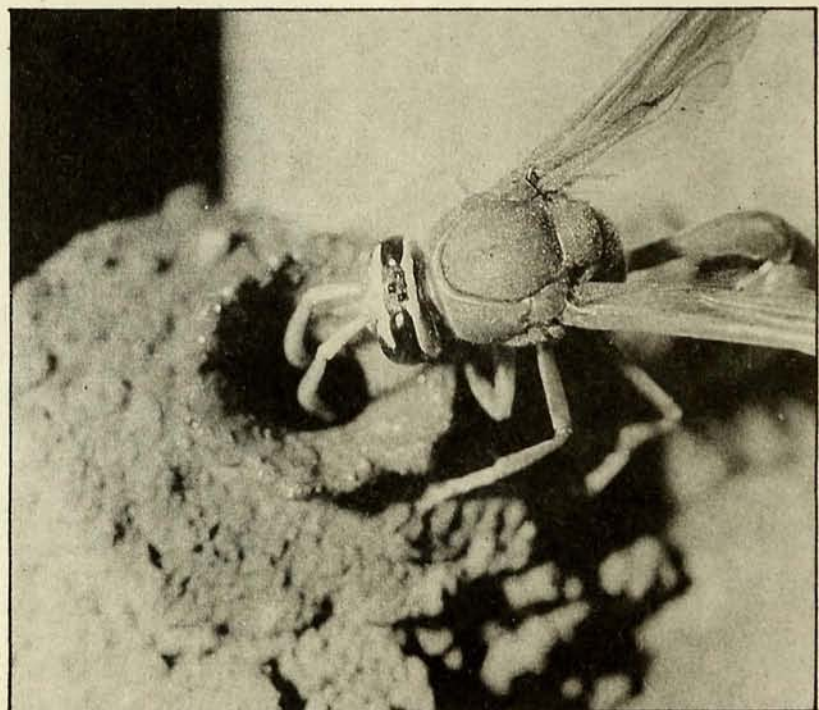
Potter wasps are sensitive to disturbances and readily abandon their nests. However, if a cell is partially demolished but subsequently left undisturbed, the wasp will often repair the cell and complete egg-laying. If a cell is more than half stocked, the transformation from larva to adult still takes place, though the wasp that emerges is much smaller than normal.

When a cell was completed the female would thrust her ovipositor into the cell and attach a tiny egg (about 4 mm long) to the ceiling by a thin filament. She would then proceed to stock the cells with caterpillars on which her larvae could later feed. Most other species of wasps, in contrast, lay their eggs only after the cells have been stocked with food.

I frequently saw her bringing greenish caterpillars, probably *Acontia* species, from a guava tree just outside my compound wall. As I



The site is selected, and construction begins. Using her antennae and forelegs, the wasp deftly shapes the mud pellets, first building up the walls (above), and finally adding the rim (below).





The completed cell; the shape of the nest cell, particularly the rim at the entrance, gives the potter wasp its name.

ascertained later, she used to paralyse the caterpillars before carrying them to the nest. This ensured that her larvae got live food and not putrefying meat.

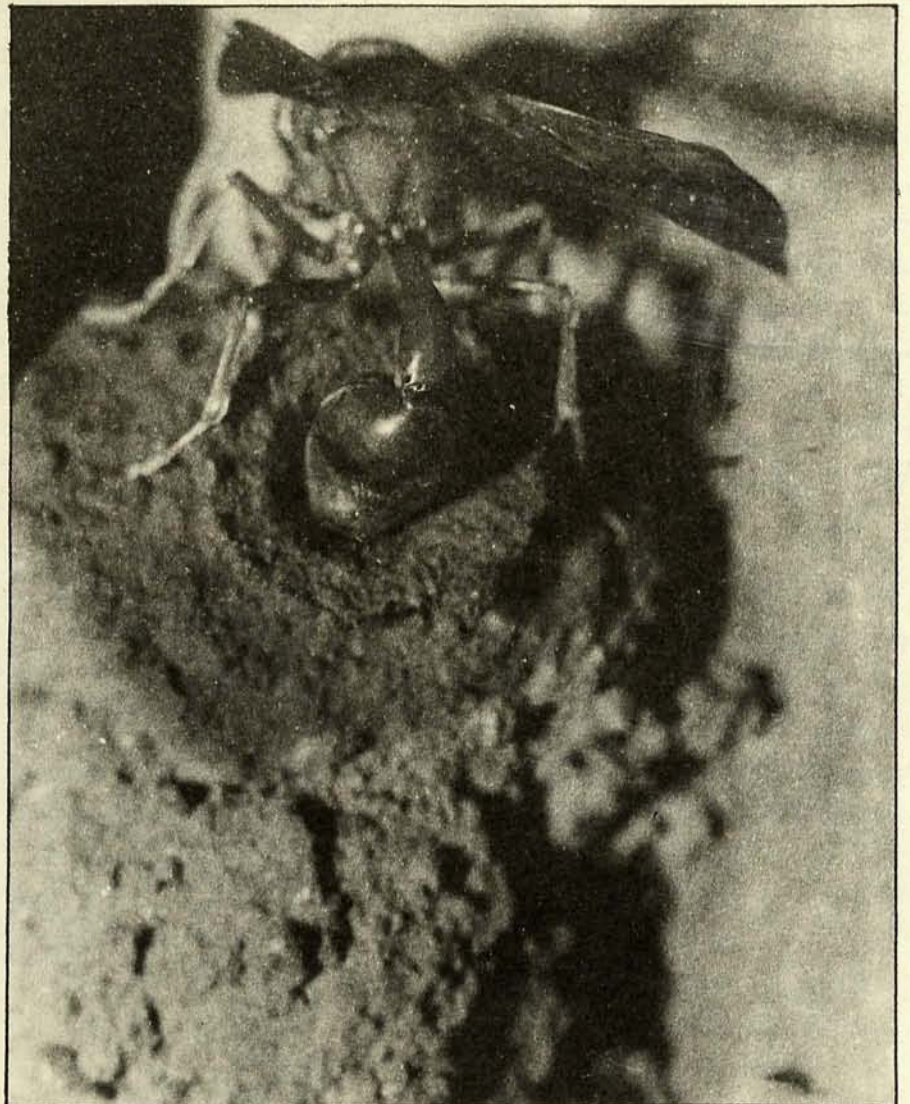
When a sufficient supply of food had been laid in (three to five large caterpillars, or up to eight small ones), she would seal the mouth of the cell with wet mud. Then would begin the construction of the next cell... and the next, a cell every two days, 17 cells in all, till the nest was complete.

One egg per cell is normal, but the sixteenth cell had two. It was completed at the fag end of the day and the female wasp immediately laid one egg and brought one caterpillar before calling it a day. The next day she did not turn up at all, but reappeared on the morning of the third day to add another egg by the side of the first. Only one egg, however fertilized and grew to maturity.

On fertilization, a wasp larva would emerge from the egg. Still clinging

on to the filament, it would start feeding on the paralysed caterpillars. The caterpillars are only partially paralysed and can still wriggle about; if the newly hatched larva were to lie in their midst, it might be crushed. For the first few days the larva's life quite literally hangs by a thread. Its tail-end still in the egg-shell, it can reach food but is out of the way of the wriggling caterpillars. And if its food wriggled too violently, the larva would at once climb up the 'rope'.

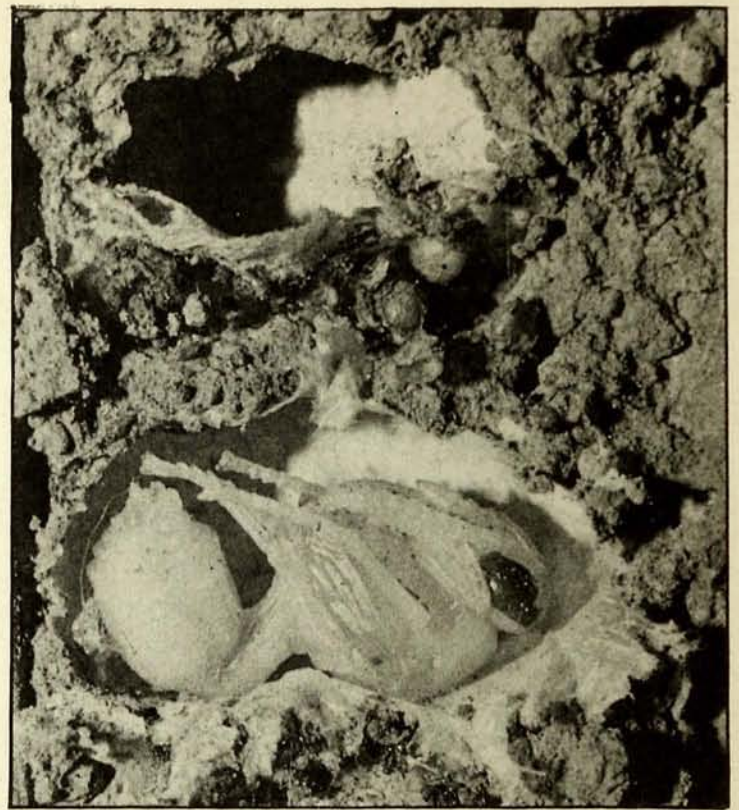
Once the larva became large enough to cope with the wriggling caterpillars, and to avoid getting crushed by them, it would drop from the thread. Within one week after its birth, the larva would start spinning a silken



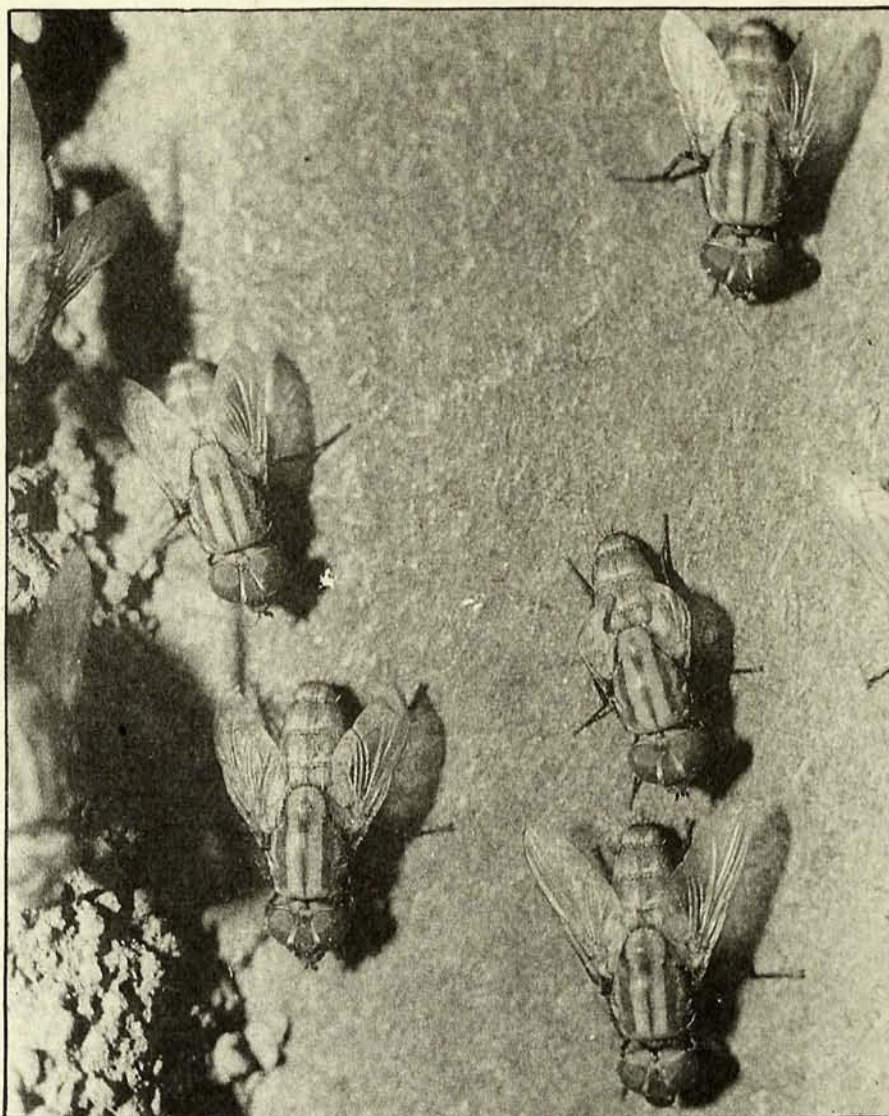
Egg laying — the female thrusts her telescopic ovipositor into the cell, attaching the egg (usually only one per cell) to the ceiling with a thin filament.

cocoon for itself. The silvery-white sac is glued to the cell walls, leaving a gap just above the floor where excreta will be deposited. Another week, and the wasp is fully developed physically, except for colouration. It is still yellowish white, and assumes the adult colouration of reddish brown only in the fourth week. Within a couple of days thereafter, the now adult wasp punctures the cell (curiously, not at the original mouth but to one side of it) and flies out into the world to ensure propagation of its own species.

Not all nesting efforts are successful. Enemies lie in wait, sometimes in the most unexpected places. When the fourth cell was punctured, what



Three weeks after hatching, the wasp is almost fully developed. Another week, and it will break free of its cell.



The cell wall is punctured — not by the wasp but by parasitic flies that feasted first on the caterpillars, then on the wasp larva.

emerged was not a potter wasp but ten tachinid flies. The parasitic fly had presumably deposited its eggs into one of the *Acontia* caterpillars with which the female wasp had stocked the cell.

One can only guess at the high drama that must have taken place within the cell. By the time the wasp had come out from its egg, the tachinid larvae had probably emerged from their host caterpillar, and begun feeding on the remaining caterpillars in the wasp's larder. They must have made short work of the wasp as well.

The month passed all too quickly. Soon the last cell was punctured, the last wasp winging its way into the future. The nests have long since crumbled away, but their markings are still visible even years later, a constant reminder of the mysterious ways in which Nature works her magic.



Dr Arun Joshi has a Ph.D. in history and a passion for birdwatching. He teaches at M.H. High School, Bombay.

LETTERS

Mr Ajay Desai's account of a python, over 5 m long, swallowing a near-adult chital hind at Theppakadu in the Mudumalai sanctuary (*Hornbill* 1990 (4)) made interesting reading. This part of the river flanks the turbulent Moyar, which is fordable in places and also holds some rock-girt pools, and is a favoured resort of the almost amphibious *Python molurus*. Decades ago, arriving at Theppakadu in mid-September, I was told that a very large python ('not less than 18 feet long' — i.e., also over 5 m) had killed and swallowed a deer (unspecified) here. It had lain gorged and immobile on the forest floor for days, and a path had been cleared through the vegetation to enable visitors to see the giant snake bulging with its late repast: I was shown the path and the spot where the python had been lying inert. Presumably this was *not* Mr Desai's python.

I write this for a different reason. On the afternoon of April 10, 1976, I was proceeding on elephant

back towards Amla Sot in the Corbett Tiger Reserve, along the Ramganga. The river here is about 30 m across, shallow in summer and with a bed of rounded whitish stones and pebbles. Suddenly Basheer (the mahout of Malankali, the elephant we were on) halted our mount and, whispering something excitedly, pointed ahead. There was a large bush in front with interlacing twigs, and looking through this trellis, I saw what looked like four white sticks flailing the air above the ground beyond the bush. Rising to my knees on the pad to gain height, I saw that a python had thrown almost two coils (the second incomplete) around a young chital hind, and was rocking it violently in its coils, which were being wound farther and retracted rhythmically and at speed — it was the legs of the upside-down prey that were thrashing the air, not in any death throes but by the muscular action of the coils. The chital was obviously already dead. The python seemed



The abandoned kill — the python's bite marks are visible on the abdomen.

M. Krishnan

only half-grown, and at its thickest was not thicker than my calf beneath the knee. What surprised and intrigued me was not that it had overpowered so large a quarry, but that it was biting repeatedly and in a frenzy at the deer's abdomen, at about the level of the diaphragm — the white coat here was ragged and pink with the bites. I told Basheer to move the elephant very, very slowly two paces to the left, to get clear of the bush and photograph the action. Malankali squealed and thudded heavily up the bank, and the python uncoiled in a flash, abandoned its prey, streaked into the river and was lost to view. Basheer explained that in spite of his efforts to control her, the elephant had panicked — only the good god can tell when and at what an elephant will take fright, as I know well from personal experience.

Even the largest snakes do not have the dentition to rend and cut up skin and flesh, and kill by biting. I could not understand why this python was biting so furiously at its victim after constricting it to death. Chital come big in Corbett park, and though this hind was not full grown I thought she must have weighed around 70 kg. I had noticed that as the nose of the python entered the water, its tail-tip was just clear of a herb (some Labiate) on the bank, and since its flight was rectilinear, the distance between this herb and the river along the visible trail of its passage would give the snake's length to within a few centimetres. After photographing the dead chital, I dismounted and measured this distance with a steel inch-tape. It was 8 feet 2 inches (2.5 m).

We went far away, hoping the snake would return, but two hours later when we came back furtively, only the dead chital, now flyblown, was there. Next morning the carcass had disappeared mysteriously. Basheer said a tiger or hyena must have taken it, but the moist, impressionable earth around held no footprints beyond my boot marks.

I consulted reputed herpetologists and ethologists here and abroad, and also wrote about the incident in my column in *The Statesman* and invited comment, but no one provided any explanation. My own view is that this compulsive and non-lethal biting was some innate reflex accompaniment to violent, aggressive action (the actual killing of the prey by constriction), analogous to the snarls and growls a tiger indulges in at times when commencing to feed on its kill — something that impels effective action though it is no part of the action itself. The blood-curdling yell of a karate expert launching

himself at his adversary seems also analogous, though clearly that is no conditioned reflex (as this biting also is not, not being conditioned but instinctive) but voluntary. I am well aware of the almost incredible stretch that a snake's jaws and gastro-intestinal tract are capable of, but still thought that the comparatively small python might not have been able to swallow its kill. That does not, of course, make any difference to its killing prey it cannot ingest. Predators do not always kill to feed.

M. Krishnan
Madras

Sir,

It is distressing to read Renee Borges' article on Bhimashankar in *Hornbill*. Too many ecologically valuable beauty spots in India suffer the same fate: over exploitation, ending in murder.

The Americans have devised a good strategy called 'Built in friction'. Give the motorist a good tarred road, with a restaurant at the end, and 99% of the tourists do not leave the main road. Only the 1% truly interested in nature will walk into the jungle; the wilderness is thus not abused. A Master Plan on these lines could be devised by the BNHS/Tourist Department for our sensitive areas. Why not make a start with Bhimashankar? The plan, of course, will have to be imaginatively and scientifically designed. Limiting numbers by advance booking (as is done in some of the national parks in Sri Lanka) is one cumbersome alternative which could be tried.

Vivek Menon's article on the animal trade requires careful response by the BNHS/WWF. People who for generations have been catching birds and animals must know their subject better than most Ph.D.s. Use them in the various research programmes.

Zafar Futehally
Kodaikanal

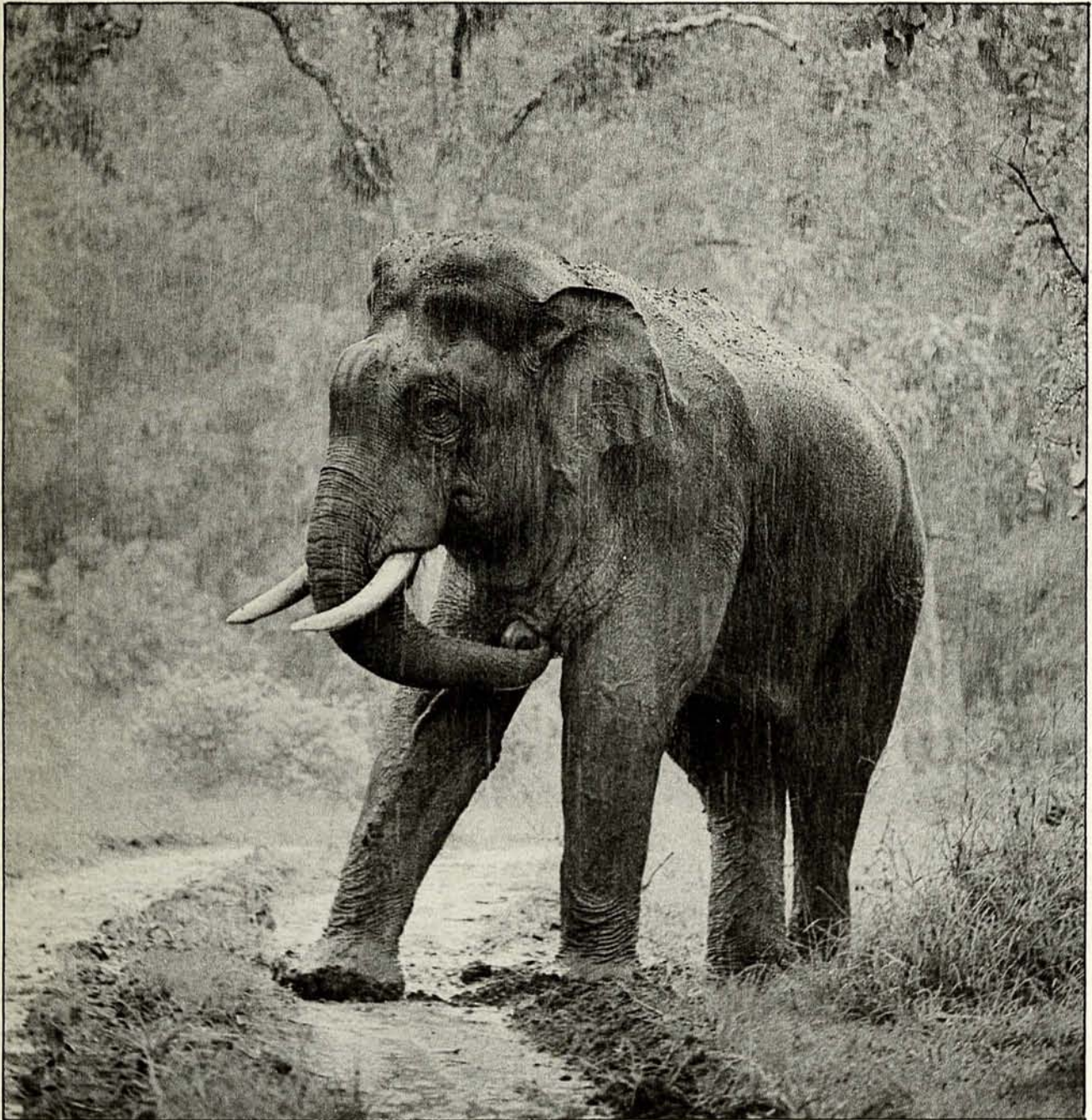
**BNHS calendars
and greeting cards
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Photo: Isaac Kehimkar

THE CONFLICT

Man v/s Animal



*B*arely 3 per cent of India's land area is protected for wildlife. But even this limited space is under pressure, because a growing human population needs more land. Man and animal compete for space; conflicts arise. Crops are raided, and sometimes people are killed. Dr M.K. Ranjitsinh, Additional Secretary in the Ministry of Environment and Forests, Govt. of India, spoke to Sunjoy Monga and Ashutosh Gogate about the problem. Very few bureaucrats are as at home in wilderness areas as they are in the corridors of power. Dr Ranjitsinh is an exception. A dedicated wildlifer for several decades, he has been an effective spokesman for the conservation movement. His recently published book on the blackbuck was well received by both the lay public and the wildlife fraternity.

FOR QUITE SOME TIME now the habitat of wild animals, especially of the larger mammals, is getting circumscribed, hemmed in from practically all sides. The ecological linkages have been severed or impeded and therefore there is a syndrome of animal populations being boxed in, with human population all around. Simultaneously, within these circumscribed habitats as they exist today, there is a continuous ingress of human and cattle populations. The result is that there is depredation of livestock by carnivores.

In many of the tiger reserves and some other parks and sanctuaries as well, we are reaching, and in some cases may have already exceeded, the optimum population level of of an individual species. Discounting the slightly inflated figures that I do not mind admitting are coming from national parks and sanctuaries (despite our continuous caution to park managers, they keep on quoting higher figures than perhaps are really applicable), many of these places are reaching fairly stable and saturated populations. The surplus animals, the new crop of tigers and leopards and the rest, have to spread out and when they do so, they have to take their chances in sub-optimal habitats where there is hardly any natural prey, forcing them to prey on livestock. Hence the man-animal conflicts, which will probably increase in the future.

The same applies to an animal like the elephant, which, being a bulk feeder, must move from place to place. Since the linkages and corridors are being interfered with, and in some cases destroyed, they are unable to do that. On the other hand, people are planting succulent, attractive crops like sugarcane etc. just outside the parks and sanctuaries. What then are the elephants expected to do? They will naturally raid the crops. You have a similar situation with pigs and blackbuck.

Karera is a good example. When we established a bustard sanctuary there in 1981 there were hardly any blackbuck. The chinkara too were very rare. Now the chinkara have come back and multiplied and the blackbuck have mushroomed. The people there say they have no quarrel with the bustard, but they want the blackbuck and chinkara removed, because they are destroying the crops. Today, this kind of conflict is almost inevitable.

Crop raiding by elephants is growing; and in Bihar and Bengal, marauding herds take over 60 human lives every year.

M.Y. Ghorpade

EARLIER, THERE WAS a situation where there always were wild animals feeding on crops; they were an accepted hazard and there were not many objections. But then we had a period in which there were no animals due to excessive hunting or habitat destruction. Now the animals have come back in some places and the people feel the difference.

There is an interesting side to this. Previously, there used to be mainly monsoonal crops because irrigation was not available. In the monsoon, luckily there is enough natural food for the animals and they normally do not raid very intensively. But now many of these areas have become double-cropped. You are growing one more crop in winter when there is a dearth of other green fodder and therefore there is greater depredation. This is the genesis of the problem.

Besides the grazing lands, the grasslands particularly have decreased and in forest areas there is an increasing competition from grazing livestock. As far as livestock and the carnivores are concerned, I would also say that in the last 15-20 years, there have been more controls, leading to an increase in the number of carnivores in some parts. I think in many places they have lost the fear of human beings. They have become a little less nocturnal, a bit bolder, resulting in a greater conflict.

There are reasons for this loss of fear of man. For one thing they are not being persecuted so much. Carnivores are no fools. They are not being shot at — poison is a different thing altogether, because they don't realise what hit them — but this business of being driven in beats or being shot at or disturbed, has either greatly reduced or stopped altogether. So you see more animals in daylight, and animals coming out of their usual habitat and closer to human habitation in some places. And because the animals have become bolder and are losing their fear-psychosis, there is a general feeling of their getting out of hand, which is really not the case in most places.

BUT WHAT DO we do then? Make the animals run scared once again? I am not talking about man-eating. I have always been clear in my mind about man-eating or confirmed, deliberate man-killing. Whether it is an elephant, a wolf or a crocodile, it has to be destroyed. I don't think we can take any chance with that kind of animal. I do not

subscribe to the view of keeping them in zoos, because what do you do then? You keep such an animal in a cage and put a board there saying this animal has killed 22 human beings. Is that good publicity for the tiger? Neither do I believe in capture, because you can't release a man-eater anywhere. Our zoos do not need them, so you might as well get rid of them.

You have to have some areas where human ingress just does not take place. If you do that, I think you would solve much of the problem. If the animals go out and raid, there would still be a problem. But at least the problem of conflict *within* the protected areas or on the very edge of the protected areas then would not arise. You have a *sanctum sanctorum* or a core area where there is no human ingress and a buffer area where ingress is limited. I think if you have fairly good control over these buffer areas you can reduce the problem there as well. One very good example is the Sunderbans, where the entry of the fishermen and others into the national park was stopped and the percentage of human kills — the man-eating — dropped dramatically.

When you have the problem of animals going out to raid or for a kill, one method is to ensure linkages and corridors between protected areas and to safeguard these corridors, whether they are for the elephants or tigers or whatever, so that the animals don't become isolated and there is a funneling or channeling of the surplus animals to other areas. This is extremely important. I would even suggest that in some cases these corridors be fenced off with electric fencing which would serve a dual purpose of preventing cattle from coming in and wild animals from going out.

The problem will arise when their population in that 'pocket' goes up and the surplus will have to go to some other place. It does not work out very well

in the long run unless you can shift a whole herd. It is easy to get hold of a lone tiger or half a dozen nilgai and take them away. But we now have to evolve systems of capturing whole herds of say nilgai. They can be knocked out by tranquilizers. But you can't get more than a few because they get wary and you can't go near them. So we must evolve systems of driving them in. Because when you do a translocation, it has to be of a social unit; poorly planned translocations are as bad for wildlife as they are for human beings.

When we were resettling human populations in the past, the irrigation department would just pay

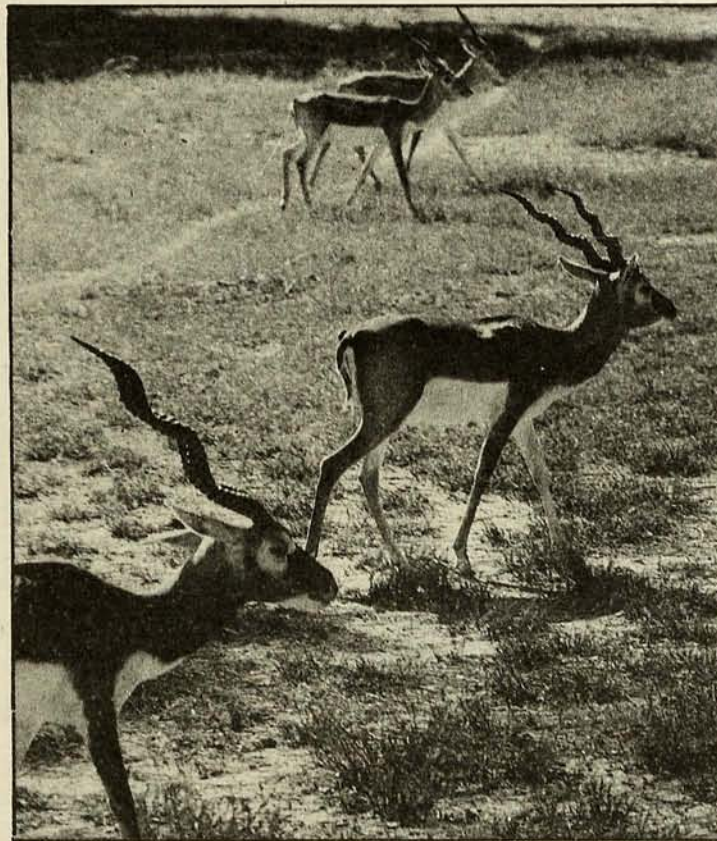
compensation money and ask the people to fend for themselves. When villagers were resettled from Project Tiger areas, we moved a whole village as a single social unit. Unless this is done, they cannot maintain their identity and the whole society falls apart.

It is the same with animal herds. But that is not easy. We have to have some places where you can put them in to start with. And elephants? Where do we put them? You can't move a whole herd to a different area across human habitation unless you do a *khedda* operation.

That too can be done.

If you identify and pick up the matriarch who is actually leading the herd and take her away, the remaining herd animals change their methods (sometimes for the worse).

But there always will be man-animal conflict as long as there is a substantial, healthy and growing animal population surrounded by human population putting unnatural constraints on the animals. We must provide buffer areas and regulate them and simultaneously provide alternatives to people so that they do not go in. This is easier said than done. We have to provide alternatives that will reduce the pressures on the land.



Food for thought—the blackbuck's penchant for crop raiding is fuelling local opposition to conservation schemes.

E.P. Gee



The Tiger In Bombay

J.S. SERRAO



M. Krishnan


THE BOMBAYMAN thrills at the word 'tiger'. He makes pilgrimages to the various tiger reserves to get a glimpse of the animal. As he does so, he forgets that the tiger, not so long ago, was a part of the mammalian fauna of what is now Greater Bombay. The animal was held in reverence, and we have Vaghoba's mandir standing on the southern periphery of the Sanjay Gandhi National Park. The inscription on the carving depicts Narasimha slaying a tiger.

The last official record of a tiger in the Salsette goes back to January 22, 1929. On that night one Mr Sutar, sitting up for game, shot a tiger on the southern side of Vihar lake. The animal had possibly arrived from the mainland, swimming across Thane creek.

Among the earlier records, the Italian traveller Gemelli Cavari who visited the Kanheri caves on horseback in 1698 found that his route was infested with tigers. Anquetil du Peron, in the introduction to his translation of *Zend Avesta*, states that during his visit to Mandapeshwar (Mt. Poinsur, Borivli) on November 29, 1760, he learnt from the inhabitants of the place that a few days prior to his visit, tigers had devoured some oxen and a child from the area.

In 1861, the Governor and gentry of Bombay visited Salsette for a tiger shoot. This became an annual feature for some years thereafter. In 1806 two tigers were seen in Kurla, and two villagers were killed a little to the north of the village.

A tiger from Malabar Hill came to drink at Gowalia Tank on February 9, 1822, and when disturbed ran uphill between the Hermitage and Prospect Lodge — perhaps these two landmarks still stand. The *Bombay Courier* of December 1829 reported a tiger landing at Mazagaon Fort, possibly swimming across the harbour.

On March 6, 1858, the crew of the ship Aden killed a tiger swimming across to Mazagaon from the opposite shore. In May the same year, one was killed in the Mahim jungles, followed by another on January 26, 1863, which mauled a bullock cart owner at Mahim. In 1891, a man-eater carried off a local Tungar (one of Bombay's adivasi tribes) about 35 miles from Bombay city. And in 1907 one was brought to book at Pir Pau in Trombay. 

J.S. Serrao retired last year after nearly 40 years at the BNHS. He is now revising the classic 10-volume Handbook of the Birds of India and Pakistan, written by Salim Ali and Dillon Ripley.

Nature Alive



Loke Wan Tho

THE SPOONBILL (*Platalea leucorodia*) is quite unmistakable—large, spoon-shaped bill, long black legs, and a snow-white body. It grows even more resplendent in the breeding season with a long, flowing nuchal crest frequently erected in display. There are both resident and migrant populations in India, the latter flying in from central China and parts of the U.S.S.R. to stay the winter.

Spoonbills move and feed in flocks, wading into shallow water in marshes, river mudbanks and estuarine mudflats. Sweeping in a half circle from side to side, they rake up the mud with their mandibles to unearth fish, tadpoles, frogs, molluscs and vegetable matter. Where food is plentiful, a compact, eager, jostling group will advance almost at a run, working methodically back and forth over a particularly rewarding patch.

The nesting season shifts with local rainfall and latitude: July to October in north India, November

to January in the south, and December to April in Sri Lanka. They breed in colonies which they share with several other species of waterbirds, mainly herons. The nest is a platform of sticks, lined with grass and leaves. Medium-sized trees, especially those partly submerged in water, are favourite nesting sites. Often there are many nests on a single tree, almost touching each other.

Spoonbills are not born with spoon-shaped bills. Gradually, the bill thickens and become more bulbous at the tip, assuming the characteristic shape by the time the chick is fully fledged.

Adults are normally silent, except for an occasional grunt or a clattering of the mandibles when excited. Nestlings, like those of any other species, are extremely noisy, particularly while begging for food. There is no definite information about longevity, but some birds have lived for at least 28 years.



Doctors in the house

Over the years the BNHS has been setting standards in field research on natural history. Our biologists have collected valuable data, both on endangered or little-known species and habitats, and on unusual aspects of the behaviour of common species. Six of them have qualified for Ph.D.s during the past few months, and several others have either submitted their theses or are wrestling with the final drafts.

The crow pheasant (*Centropus sinensis*) is a fairly common ground bird in most parts of the country. However, details about its ecology and habits are poorly known. V. Natarajan of the Avifauna Project



Rita Ganguli

team based at Pt. Calimere studied the southern crow pheasant (*C. s. parroti*) under Mr J.C. Daniel's guidance. His thesis also deals with the (frequently exaggerated)

toll that the bird takes of birds' eggs and nestlings.

Damage to aircraft by birds, by impact or ingestion into the engines, is a serious problem worldwide. Over 20 per cent of such accidents in India are caused by the pariah kite (*Milvus migrans*



Rita Ganguli

govinda). S.M. Satheesan of the Bird Hazard Research Cell studied their ecology and behaviour, particularly communal feeding and resting, which makes the species particularly dangerous to aircraft. The study (guide: Mr J.C.

Daniel) also involved analysis of, and species identification from, the bits and pieces of bird victims.

The dispersal of many plants, especially those with fleshy fruits, is effected by mammals and birds that feed on them. Such relationships are an essential part of the network of any ecosystem. P. Balasubramanian of the Pt. Calimere Ecology Project (guide: Prof. P.V. Bole) worked on plant-animal interactions at the sanctuary, and in the

process recorded several instances of frugivory (fruit-eating) in species earlier believed to be exclusively insectivorous.

S. Balachandran, also of the Pt. Calimere Project, studied the coastal birds of Mandapam and neighbouring islands in Tamil Nadu under the guidance of Prof. R. Natarajan. A large number of migrant species either winter in the region or use it as a springboard for their migration further south. Apart from population studies, the study also focused on conservation aspects, essentially habitat degradation, which has already caused considerable damage to the area's suitability as a bird refuge.

With natural grasslands in India being either heavily overgrazed by domestic livestock or steadily converted into crop fields, the prospects for grassland fauna

appear bleak. Ravi Sankaran of the now-completed Endangered Species Project (he is now with the Grasslands Project) worked on two of India's most endangered grassland birds, the lesser and Bengal floricans. His thesis (guide: Mr J.C. Daniel) deals with their courtship and breeding behaviour, and the role of environmental factors such as rainfall and grassland burning.



Carl D'Silva

The Keoladeo National Park, Bharatpur, is perhaps India's finest habitat for migratory waterfowl. In addition to a rich avifauna, the Park also harbours moderate populations of mammals, including four species of larger ungulates. Md. Nayerul Haque (guide: Prof A. Musavi) worked on these for his doctorate, studying their ecology and habitat requirements, with special emphasis on their role in maintaining Bharatpur's wetland ecosystem.



NEWS NOTES COMMENTS



Taming the tsetse

The tsetse fly (*Glossina morsitans*) has been Africa's scourge for centuries. It is a carrier for trypanosomiasis — known as 'sleeping sickness' in man and 'nagana' in cattle. The disease is caused by protozoan parasites which reside in mammalian hosts (wild species, particularly buffaloes and some antelopes, are a major reservoir of infection), and are highly resistant to immune defences. The tsetse ingests blood — and with it, parasites — from the hosts, and later passes it on to human victims. About 50 million people in Africa are at risk, and over 20,000 new cases are reported every year.

The infection is signalled by bouts of high fever. As it invades the central nervous system, victims turn listless, and speech is impaired. Daytime somolence is characteristic of the disease (hence the term 'sleeping sickness'). Then comes coma, and finally death. In one particularly virulent form, sleeping sickness can kill in a matter of weeks.

The first serious attempts at tsetse fly control in Africa began in the 1940s. But the methods used (widespread game destruction and bush-clearing) caused severe environmental damage. With the advent of insecticides such as DDT and Dieldrin in the 1960s, ground spraying became possible. This proved very effective in limited areas and was also safer environmentally than previous methods, as only the specific resting sites of tsetse fly concentrations were sprayed. However, the areas most affected were remote and inaccessible; a more effective, large-scale control method was needed.

In the early '70s, aerial spraying was introduced, using a new insecticide called Endosulphan, which degrades rapidly, and could be used in very small quantities. Environmental monitoring of the spraying programme suggested that it had a negligible impact on most organisms, though there were doubts that the dosage imbibed by fish could be dangerously high. Further refinements in insecticide formula-

tion increased the effectiveness of spraying, and reduced the number of sprayings required per year. But fish were still being killed under certain conditions, especially during the drought years of the '80s.

In July '89, the WWF, in conjunction with other conservation bodies in Africa, set up a research programme in the Okavango Delta in Botswana. The objective was to evaluate the ecological impact of tsetse control procedures as well as the long-term prospects for the delta when the fly is brought under control or eradicated. Before the WWF study, the effect of environmental factors, such as water depth and temperature during spraying operations, on the effectiveness and toxicity of an insecticide had not been studied.

The project resulted in a better understanding of the factors involved, and led to major changes in spraying methods, increasing effectiveness while simultaneously reducing damage to the environment. The spraying has now been switched to the cooler months in order to protect fish and other organisms which were vulnerable to the insecticides. It is safer to spray when the water temperature is lower because oxygen levels are then higher, and fewer fish spawn. The tsetse fly is just as vulnerable to the spray at this time, and the dispersion of aerial spraying is also more effective.

But there are fears that the environmental side-effects of controlling the tsetse fly may be as damaging as the fly itself, and that successful control would lead inevitably to human interference and severe damage to wildlife in the delta. This 15,000 sq km wetland system, fed by the Okavango river (which drains not into the sea but into the Kalahari desert), harbours an extraordinarily rich diversity of wildlife, some species in their highest concentrations in the continent.

In most parts of Africa, the primary aim of tsetse fly control is to release land for settlement or pastures. The situation in the Okavango Delta is different. Tsetse control in the centre of the delta is done



Blackfooted ferret, clawing its way back from near-extinction.

Carl D'Silva

primarily to avoid a re-infestation of the now tsetse-free areas along its perimeter. Most of the area is a declared cattle-free zone, surrounded by a veterinary cordon fence. This is to avoid an outbreak of foot and mouth disease, which could cripple Botswana's beef exports. The virus is easily transmitted from wild buffalo to cattle, and therefore strict regulations by the Botswana government and the European Economic Community, which buys most of Botswana's beef, prohibit the intermixing of these two animals.

The government has tried to maintain a balance between the need for tsetse control and the long-term environmental protection of the Okavango, and hopes to stop using insecticides fairly soon. Whether they will be successful will depend largely on how quickly neighbouring countries like Namibia and Zambia manage to reduce *their* tsetse fly populations.

Ferrets to run free

The black-footed ferret (*Mustela nigricipes*) once ranged over most of North America's Great Plains. Prairie dogs constituted 90 per cent of the diet of this highly specialized carnivore, which also inhabited prairie dog burrows. As its main prey species declined in numbers, so did the ferret. In 1985, the last known wild population was decimated by canine distemper. Extinction would have been inevitable, but for a successful captive breeding programme run jointly by the Wyoming Game and Fish Department, the U.S. Fish and Wildlife Service and the Captive Breeding Specialist Group of the IUCN. The next step in the ferret's recovery is a

reintroduction to the wild of captive-bred animals, scheduled for autumn 1991.

Reintroduction can be a chancy affair: captive-raised animals, unable to adjust to natural conditions, often suffer high mortality rates. Captive-bred ferrets would find it hard, for instance, to locate and kill prey as large as a prairie dog and not be killed by a larger predator in the process. The more the knowledge of a species' behaviour in the wild, the better the chances of successful reintroduction.

A two-year research project was therefore instituted to anticipate and solve some of the problems. The study focused on the hunting effectiveness and development of predator avoidance abilities, methods of preparing ferrets for release, and different release techniques. Hunting patterns (ability to both locate prey in a burrow and to dispatch an adult prairie dog) were studied in a 200 sq m mock prairie dog 'town'.

Using black-footed ferrets for the experiment was out of the question. Instead, the Siberian ferret (*Mustela eversmanni*) was used as a surrogate, with the results being appropriately extended to its endangered cousin. At three months, the ferrets were fairly capable of taking care of themselves. Naive juveniles would react to a predator (dummy birds and live dogs were used in tests), with their responses improving significantly after a single nasty experience. They could locate prey and bring it down, and this ability too improved rapidly with practice.

Last year, captive-raised Siberian ferrets were released experimentally to glean more information applicable to black-footed ferrets. Two release techniques were employed. In one, ferrets were raised in

mock prairie dog colonies that simulated conditions in the wild, from three months of age till release (design problems prevented raising them in the colonies from birth). In the other method, there was no such pre-release conditioning, but a cage on stilts was built at the release site, inside which they could take refuge in case of an attack by a predator. Both groups were supplementary-fed for a short period after release. The first group survived significantly longer than the second, though translocated wild ferrets released in the same areas fared better than either group.

There are inherent difficulties in any study of this sort. Results obtained with another (even a closely related) species can be applied to the target species only to a limited degree; and the lack of complete knowledge about the species' biology could be dangerous when very small populations are involved. But for many species that face extinction in the wild, captive breeding and release techniques are the only solution. And as experimental data builds up, the element of uncertainty in reintroduction programmes can be gradually reduced.

Saunders' gull

The Saunders' gull (*Larus saundersi*), with an estimated total population of 2000, is the world's second rarest gull. It is known to breed in only three sites in China, two of which are slated for destruction as part of reclamation projects. The third site contains a mere six nests.

A coastal salt marsh in Yancheng Nature Reserve which holds six colonies has been earmarked for a major shrimp farming project, and the gulls will probably be forced out of their breeding area. 130 nests were discovered in salt marshes in the Shuangtaizihekou National Nature Reserve recently — in fact only after the areas had been impounded and reclamation begun. Even if parts of the reserve are set aside for the birds to breed, suitability of the habitat is likely to be significantly reduced due to changes in the vegetation, some of which are already evident.

Unfortunately for the species, it favours rapidly accreting coastal areas for breeding, and such areas are otherwise ideal choices for reclamation. New breeding sites, if and when they are discovered, may also be reclaimed. Very few suitable salt marshes remain, and unless the existing ones are preserved, there will be little hope for the species.

Himalayan blunders

The Himalaya encompasses a diverse range of habitats—swamps in the foothills, tropical broad-leaved forests at lower altitudes, juniper and pine forests higher up, and snow-bound deserts above the tree-line. For the past 80 years or so, the region has been subjected to a remorseless process of habitat degradation. Commercial forestry operations came first, then large scale deforestation and encroachment, and conversion of natural areas into farmland (often for settlers). As a result, local people who traditionally depend on forest produce have become impoverished. Wildlife populations have fallen to alarming levels (many endemic species are now threatened). Water tables have been dropping both in the sub-Himalayan belt and in the plains of northern India, whose rivers originate in the Himalaya and depend on its forests to sustain a year-round flow of water.

The BNHS has been trying to build up public opinion to a degree that would ensure that conservation of the region is taken more seriously. Ulhas Rane and Dr Renee Borges toured Sikkim recently. In conjunction with forest department officials, they gave lectures and slide shows on the Himalayan ecosystem and its wildlife, and the effects of drastic, man-induced habitat changes on the soil and the forests.

A special attempt was made to address army officers on current conservation problems in the region. The army, which lacks neither commitment nor manpower, has done commendable work on conservation in the Himalaya. Both NGOs (several are active here) and the army have their limitations, but their areas of expertise are frequently complementary. Closer cooperation would considerably strengthen the environmental movement, making it possible to launch and administer sustained, long-term programmes on awareness and ecological rehabilitation.

The tour evoked an excellent response, with several groups assuring support. Local groups have been working, with varying degrees of success, in many parts of the country. With a very active education and awareness wing, the BNHS is in a position to interact with such groups, initiating conservation action and helping to channelize efforts into areas where they can be most effective. And as the number of member-volunteers increases, our conserva-



Lesser panda —denudation and fragmentation of its forest habitat in the Himalaya seriously threatens the survival of this endearing species.

E.P. Gee

tion and education programmes can be expanded both in scope and in the area they cover.

Troubled times for the tragopan

The western tragopan (*Tragopan melanocephalus*) is a threatened species — less than 5,000 birds, perhaps even less than 2,000, remain. It occurs in small, isolated populations, few of which are large enough to be viable. All are seriously threatened by loss of habitat, and none is adequately protected.

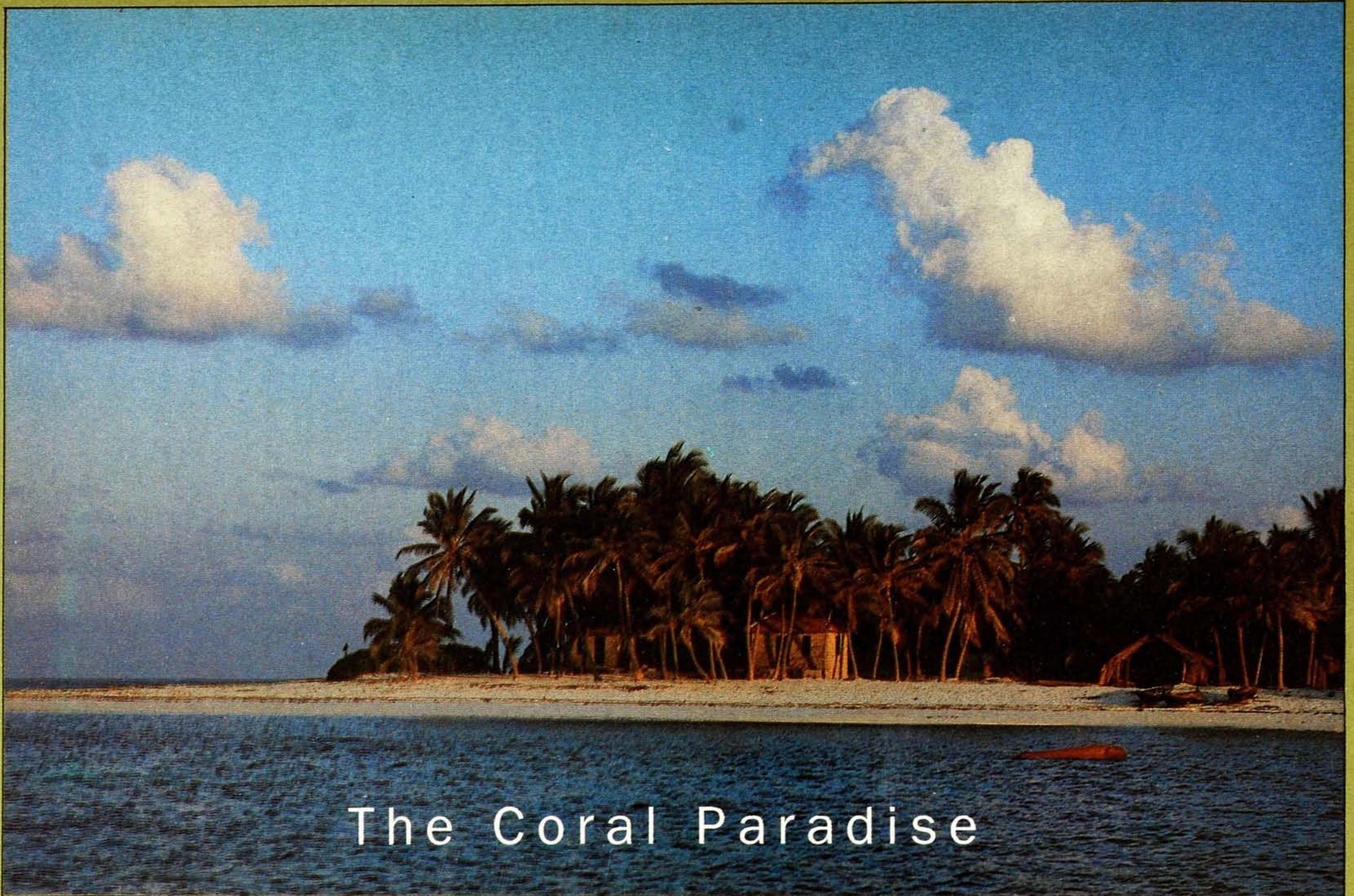
In 1989, a population of over 400 tragopans was discovered in a 20 sq km forest patch in the remote Mid Palas valley in Pakistan's North-west Frontier Province. The only other known viable population of Western Tragopan (estimated at 100 birds) occurs in the Machiara Game Reserve in Pakistan-occupied Kashmir. Both forests are also home to Himalayan musk deer, brown bear, wolf and leopard cat. However, both are under pressure from rapidly growing local populations. The Mid Palas forest is in fact scheduled for commercial felling in 1993-4.

This April, an ICBP team began work on the Pakistan Himalayan Jungle Project, co-sponsored by WWF, U.S. Fish and Wildlife Service, USAID and the World Pheasant Association, aimed at

protecting this bird and its forest habitat. One of the primary aims of the project is to gain protection for the forests in both areas and to establish wildlife sanctuaries in sites critical to the species' survival.

Developing sustainable use of forest resources is another key element of the project. Pakistani social scientists will help conduct detailed socio-economic analyses of local communities, with a view to developing an integrated land management plan. Planting of trees specifically for firewood and fodder, the provision at subsidised rates of alternatives to wood for construction, and the promotion of low-impact forest-based activities are being considered.

Wildlife conservation in most of the developing world must go hand in hand with economic development of the area in question. Without a financial incentive to conserve wildlife, there will be little or no local support for conservation programmes. The morel mushroom offers promise as just such an incentive. Native and abundant in the primary forests of Mid Palas and Machiara, it is a valuable delicacy in western cuisine. The development of a local cooperative for export of these mushrooms could provide local villagers with much-needed income, and eventually tip the scales in the tragopans' favour.



The Coral Paradise

LAKSHADWEEP

Parvish Pandya

A COOL BREEZE fanned our faces, beating back the tropic heat, as we stood clutching the railing of *Tipu Sultan's* top deck. The waves, sliced by the ship as it ploughed through a choppy sea, shimmered in the glow of the setting sun. Nothing, not even the muted throb of the engines, could tear our thoughts away from the day's thrills. And what a day it had been!

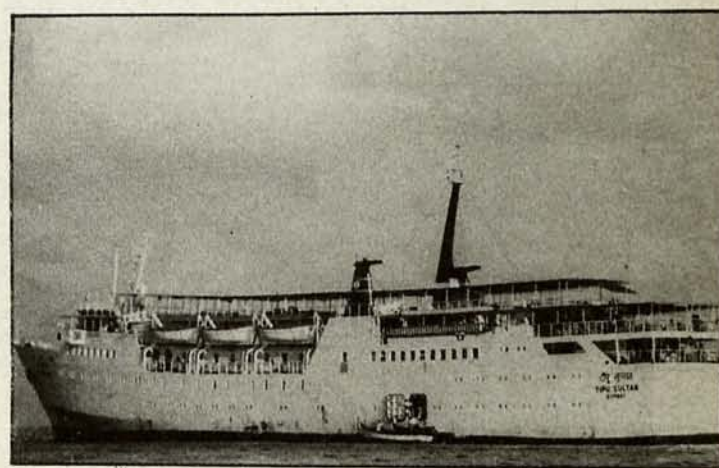
We had just returned to the ship from Kavaratti, the capital of the 36 islands that form the Lakshadweep archipelago. Lying between 220 and 440 km off the west coast of Kerala, the Lakshadweep islands are the only coral atolls in India. (The Andaman and Nicobar islands have fringing and barrier reefs.) It had taken half a day and a full night to steam from Cochin, and we were all keen to experience the uniqueness of the isles. Thoughtfully produced circulars had described the various features of this coral paradise; but what we saw considerably exceeded our expectations (and they were very high).

Few of us had seen live corals before, and the abundant marine life seen through the glass-bottomed boats moving slowly in very shallow, crystal-clear water only whetted our appetites for a closer look. The opportunity came after lunch, when we visited the small but well maintained marine aquarium and museum. The fishes we had earlier glimpsed briefly as they flitted among the coral heads, tinted blue by the water and the glass bottom of the boat, now revealed themselves in all the brilliant hues of a rainbow.

In contrast to the abundant undersea life, birds were scarce. While passing the several buoys that marked a safe passage through breaches in the atoll rim, we invariably found a seagull or a grey heron perched on top. But that was all. Even crows, so ubiquitous on the mainland, were absent in Kavaratti, though we saw plenty of them in Kalpeni and Minicoy. In 1900, Gadow and Gardiner had observed that crows were present on every inhabited island of the Maldives, but, curiously enough, absent in Minicoy.

Atolls are fragile ecosystems, and only 10 of the 36 islands in the archipelago are inhabited. To preserve this delicate balance, and to minimise external influence on local customs, only four islands (Kavaratti, Kalpeni, Kadmat and Minicoy) are open to Indian tourists; in addition, the uninhabited Bangaraman isle is open for international tourism.

You can visit Lakshadweep only on a package tour, not on your own. This obviously restricts your itinerary. We especially missed Pitti, an uninhabited island famous for its seabirds, in particular the sooty tern (*Sterna fuscata*, locally known as *tharathasi*) and the noddy tern (*Anous stolidus*, local name *karifetu*). But we were pleasantly surprised to learn that students, research scholars, and ornithologists or naturalists could visit the bird sanctuary if they brought "an authorisation from a recognized society like the Bombay Natural History Society..."! On our return home, we found that even BNHS office bearers were unaware of this privilege. They were as surprised as we had been to know that not only could our members visit the islands, but the Society was empowered to recommend others!



The *Tipu Sultan* served as a floating base camp during the trip.

Manuel Fernandes

OUR ROUTINE for the three islands was almost the same. After breakfast on board the ship, we would transfer to small motor launches and head for the island. The ship would remain outside the lagoon. When we disembarked, we would be ushered to the tourists' bathing hut, for a coconut each (on the house). Then, while the other tourists went for a swim, we would walk along the beach or wade into the shallow lagoon for a closer look at the marine life. Kayaks, pedal boats and even yachts were available on hire, and the adventurous tourist can go scuba diving or water skiing.

After lunch, the programme varied. Kavaratti had glass-bottomed boats and an aquarium-cum-museum. At Kalpeni and Minicoy are lighthouses, from the top of which we had a bird's-eye view of the island. At Kalpeni we were treated to what was described as a folk dance. This was rather an anticlimax: the local menfolk 'danced' dressed in vests and shorts, wearing trendy wristwatches!



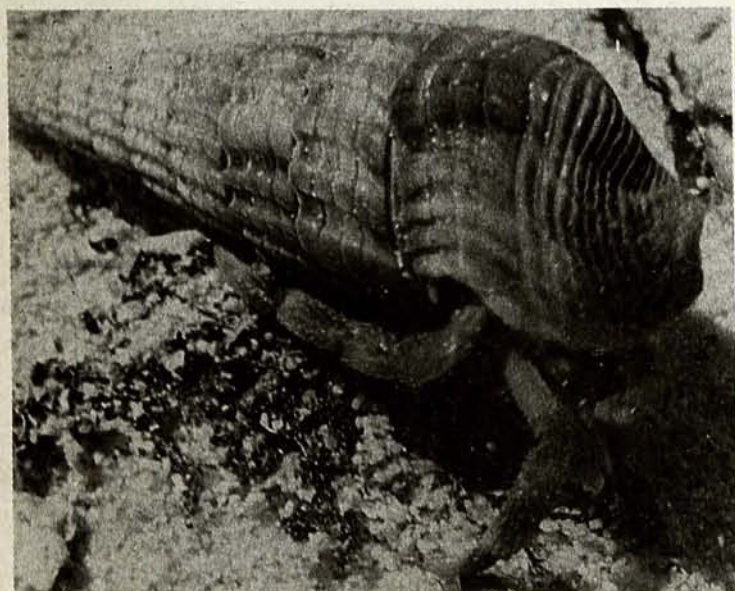
Minicoy, 232 km from Kavaratti and 398 km from Cochin, is the southernmost of the islands, and culturally quite distinct from the others. While Malayalam is the language in the rest of the archipelago, the Minicoyans speak Mahl (written in the Divehi script), a language they share with the Maldives islands. We spent an afternoon in an *athari* (Mahl for village). The nerve centre of the village is a large, beautifully decorated house where the womenfolk gather in the evening. The islands of Lakshadweep have a fairly uniform topography. Each has a lagoon, extensive on the west but hugging the shore to the east. Kavaratti is shaped like the leg of a chicken; Kalpeni like a barbed hook, with three smaller islets, Cheriyam, Tilakkam and Pitti, enclosed in a shallow but extensive lagoon.

The marine alga *Velonia microphysa*. Looking somewhat like a cluster of grapes, it is easily confused with the egg mass of the cuttlefish.

Manuel Fernandes

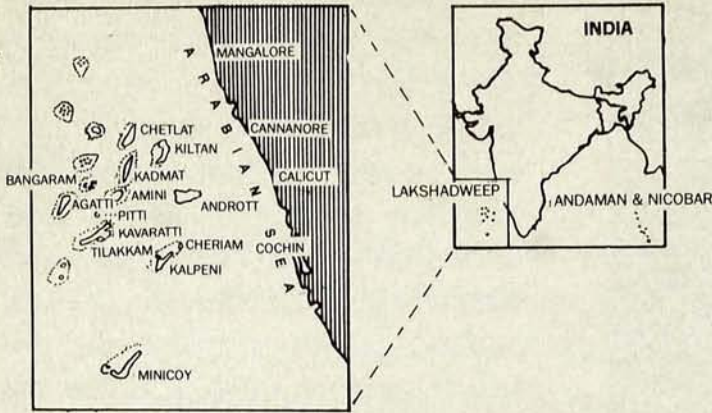
Hermit crabs take up residence in empty snail shells, which they carry around with them wherever they move. Sometimes the shell is much larger than the crab.

Manuel Fernandes



It has a huge storm bank of coral boulders and debris along its eastern and south-eastern shoreline, the aftermath of a storm that struck the island in 1847. Minicoy is shaped like a crescent moon, and has within its vast lagoon a small, uninhabited island named Viringili. The marine life varies a little from island to island, but this will not be obvious except to a marine biologist; if you've seen one island, you've seen them all.

THE LOCAL FAUNA has been well documented; perhaps the most comprehensive account is a 1903 treatise, 'The fauna and geography of the Maldiva and Laccadive Archipelagoes', edited by J. Stanley Gardiner. We saw sponges and towel sea anemones among the corals, the latter invariably accompanied by clown fish. A pair of these fish will hover near the sea anemone, not venturing far from it. At the least sign of danger, they will nestle snugly amongst the sea anemone's tentacles, which can paralyze and kill other fish (the clown fish are immune to its venom).



After a tropical forest, a coral reef has the largest density of plant and animal life, both in numbers and in diversity. Among this multitude are a number of very curious ocean dwellers. The multi-coloured parrotfish contribute to the build-up of the fine coral sand found on the lagoon bottom. They bite off and ingest pieces of live coral. The organic portion of the coral is digested, and the crushed coral skeleton defaecated. The trigger fish has a spine on its back which, once erected, can be locked in position, thus wedging it firmly in a coral crevice from which it can be extricated only with difficulty.

Some wrasses prepare a blanket at night by secreting slime from the skin. The fish sleeps cosily within this cocoon, which is discarded in the morning. One kind of wrasse actually serves as a doctor to sick coral fish, nibbling away at festering wounds or picking off parasites. Surgeon fish have two sharp spines at the root of the tail. Normally these are folded inside grooves on the body, but when the fish feels threatened, they open out like the blades of a pen-knife and can cut like a surgeon's scalpel. Then there were moray eels, which look, and swim, like snakes but are really fish with scaleless, slippery skin. As we steamed between islands, our ship was frequently escorted by dolphins, and once by a fairly big hammerheaded shark.

SEVERAL SPECIES of cone shells (*Conus*) were common, and we also came across a couple of giant clams (*Tridacna*). One particularly rewarding sight — our marine biologist had not seen anything similar during his 40 years in the field — was what looked exactly like the cluster of eggs of a cuttlefish. Vivid green, shaped like a bunch of slightly elongated grapes, it was actually *Velonia microphysa*, a marine alga. Equally intriguing was the egg mass of an *Uber* snail, symmetrical and beautifully sculpted, and quite unlike the washer-

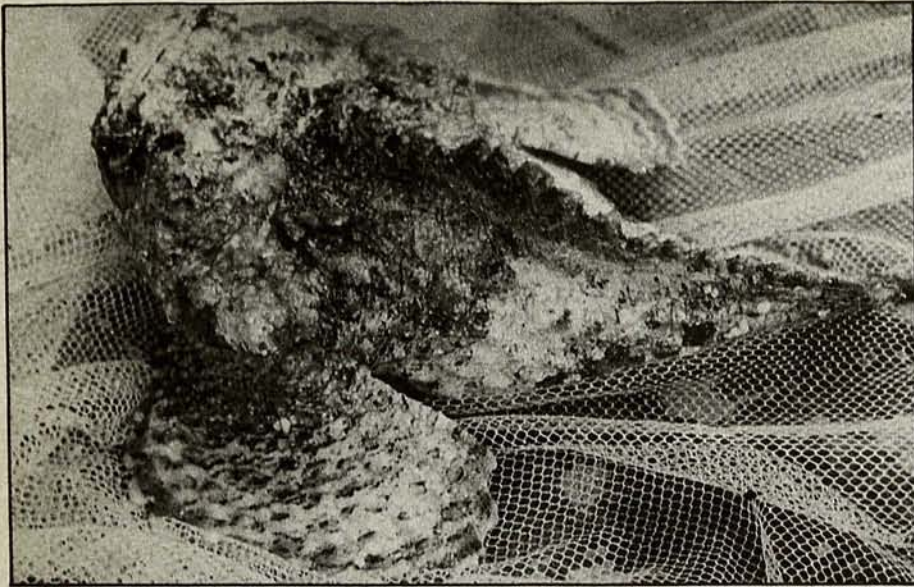
LAKSHADWEEP — FACT AND FANCY

The early history of the islands is a mixture of fact and legend. King Cheraman Perumal, after his conversion to Islam, slipped out of his capital Cranganore (present day Kodungalloor) for Mecca. When his disappearance was discovered, search parties were sent out. It was these search parties that discovered and colonized Lakshadweep. One group was shipwrecked on Bangaram. When they eventually found their way back to the mainland, (Hindu) sailors and soldiers sailed to Amini, where they established a small settlement. Gradually, more of the archipelago was colonized; first Kavaratti, Andrott and Kalpeni, and later, Agatti, Kiltan, Chetlat and Kadmat.

A more interesting version concerns one Saint Ubaidullah. One day, while praying at Mecca, he fell asleep and dreamt that Prophet Mohammed wanted him to go to Jeddah and take a boat from there. His ship was wrecked in a storm, but he managed to cling on to a plank till he was swept ashore at Amini. He started propagating Islam, but this angered the village headman, who asked him to leave. Meanwhile, Ubaidullah fell in love with a local woman and married her. The islanders decided to kill him, but they had underestimated this man of religion. When they surrounded him they all turned blind. The saint fled to Andrott, where he converted the local people to Islam. He died there, and his tomb is still visited by tourists.

Although the people of the islands were Muslims, sovereignty remained in the hands of a Hindu raja of Chirakkal, but later passed to the Muslim house of Arakkal of Cannanore around the middle of the 16th century. The king of Cannanore was a tyrant, and in 1783 some islanders from Amini beseeched Tipu Sultan to take over the Amini group of five islands. He agreed, and the islands were administered from Mangalore until 1789, when the British East India Company annexed them after the battle of Seringapatam.

In 1847, a cyclone hit Andrott. The raja's finances would not stretch to cyclone relief, and he had to take a loan from the British. When they demanded their money back, the raja, unable to oblige, handed over all the remaining islands of Lakshadweep in lieu of repayment. This happened in 1854. Till 1956, the islands formed part of Madras State. The administrative headquarters were shifted from Calicut to Kavaratti in 1964.



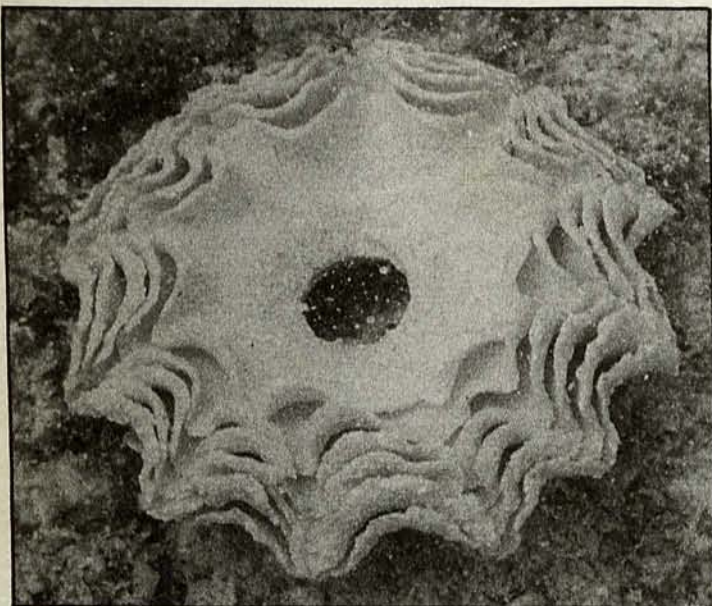
Handle with care — the stone fish, lying still and perfectly camouflaged on the sea bottom, is easy to tread on. Its venom, injected through spines, can be fatal.

C.M. Nadkarni

shaped egg mass of the common moon snail (*Natica*).

The commonest animals in the lagoons were the sea cucumbers. The most abundant was a black variety growing up to 40 cm, probably the same species that is found near Karwar, 400 km away on the mainland coast. The species is familiar to any zoology graduate, being used for dissection in laboratories all over the country. A rarer form had prickles scattered all over its body, looking somewhat like a prickly pear, but jet black and only up to 15 cm long.

But the species that enthralled us most was a brown, 30-cm long variety, which looked somewhat



Snail or sculptor? The egg mass of an Uber snail. Exactly why it is shaped in this fashion is not known.

V.K. Paralkar

like a rolled-up masala dosa. When disturbed, it let out a long stream of white fluid that stuck to our hands, gradually hardening to the consistency of chewing gum. Only after it had fully hardened, half an hour later, were we able to scrape it off. This fluid is an effective defence against predators, which are entangled and immobilized while the sea cucumber crawls away to safety.

Next in variety and abundance were crabs and hermit crabs. At Kavaratti a local boy brought us a hermit crab, a massive 12 cm long and maroon with blue speckles all over. We have seen these animals at Bombay, but never of this size.

Then there was a small hermit crab peeping out warily from a huge scorpion shell (*Lambis*). We wondered how it managed to saunter along the sea bottom weighed down by a shell several times as large as itself. But that was just one of the many mysteries that these enchanting islands hold.

THE AUTHORITIES have taken measures to preserve the ecology of the atolls, by banning the collection of corals and imposing stiff penalties; but rules are made to be broken. With us on the ship was a group of botany students. As botanists, their collecting seaweeds could perhaps be justified. But they went much further. First they broke off massive pieces of live coral to take home as souvenirs. Then, tired of lugging the heavy pieces around, they left most of them behind to rot on the beach. The easy-going local authorities rarely bother to search anyone for contraband souvenirs, and the students managed to smuggle several pieces onto the ship. The truth came out only when our sleeping quarters began smelling strongly of rotting coral.

Vandalism by tourists is not unheard of. But when the disease spreads to 'students' of natural history, the day cannot be far off when the magic of these islands remains only as a footnote in history books.



Dr B.F. Chhapgar, former director of the Taraporevala Aquarium in Bombay, is one of India's leading marine biologists. Manoj Muni is a researcher at the BNHS, currently working on the taxonomic classification of mammals.

Support Conservation

JOIN THE BNHS

The Bombay Natural History Society was formed 108 years ago, as a forum for exchanging information on natural history. Over the years, its members and scientists have helped document India's diversity of wildlife, studied little-known and highly endangered species, providing critical data for conservation projects, and produced a series of books on natural history, many of which have become standard works of reference. Today, the BNHS is Asia's premier conservation organisation, with members in over thirty countries and an international reputation as an authority on Indian wildlife.

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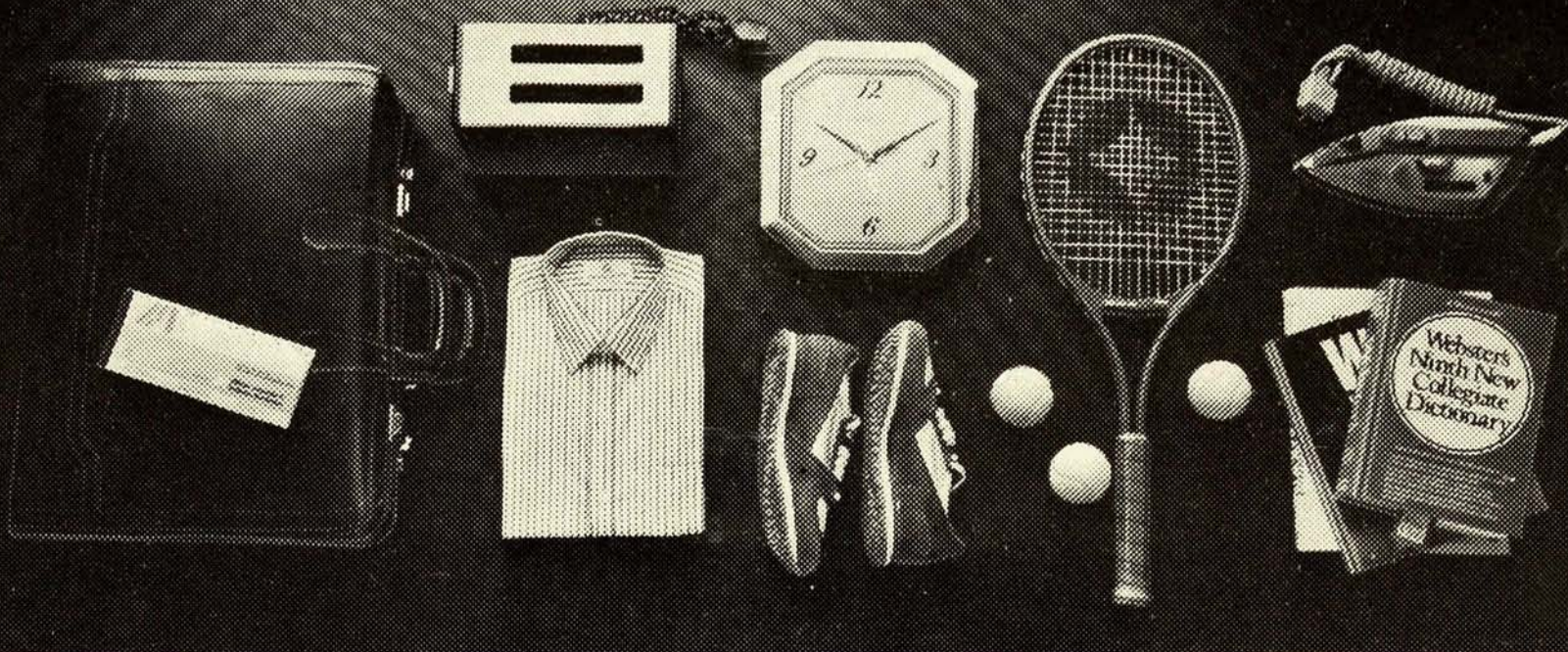
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