

HORNBILL



BOMBAY NATURAL HISTORY SOCIETY

The cover picture of this issue, by our member, Mr. E. Hanumantha Rao, shows a Streaked Fantail Warbler *Cisticola juncidis* feeding its nest young. The bird breeds pretty well all over India and Sri Lanka, keeping itself to low country, and never ascending mountains to any great elevation. The season lasts from April to October depending upon localities — the bird laying during the rainy months.

Selecting either a dense patch of fine-stemmed grass, invariably always in a moist area or a field with standing paddy, the bird starts building its nest. The nest sides are formed of blades and stems of the grass or paddy *in situ*, closely tacked and held together with cobwebs and fine vegetable fibres. The tubular entrance, an inch or two in length, is first worked on, and to this is added the nest chamber with the grass blades and stems again tacked together and reinforced with the binding vegetable fibres and cobwebs. In this chamber is placed the nest, neatly lined with very fine vegetable fibres and downy material, which is worked into a felty substance by the builders perhaps using their saliva. Nest completed, 3-5 pale, bluish white eggs, speckled with red and purple, are laid. Incubation period lasts from 9 to 11 days. When a nest is intruded upon, the member of the pair mounting guard gets greatly agitated and engages in a curious mounting zigzag flight high over the intruder, uttering a sharp *chip ... chip ... chip*, dipping with each *chip*, and rising before the next *chip* commences. Many a nest come to grief during the harvesting season.

Acknowledgement

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The Society was founded in 1883 for the purpose of exchanging notes and observations on Zoology and exhibiting interesting specimens of animal life. Its funds are devoted to the advancement of the study of zoology and botany in the Oriental Region. The Society also promotes measures for conservation of nature.

Membership of the Society is open to persons of either sex and of any nationality, proposed and recommended by one or more members of the Society; and also to persons in their official capacity, scientific societies, institutions, clubs, etc. in corporate capacity.

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Members receive during a year three issues of the *Journal of the Bombay Natural History Society* now in its 83rd volume, and four issues of *Hornbill*, the Society's popular publication.

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J. C. Daniel, P. V. Bole and A. N. D. Nanavati.
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LAY-OUT

CARL D'SILVA

'Traumatic Shock'

One of the major field activities of the Bombay Natural History Society over the last few decades is the large scale banding of birds. Since 1959 when the bird ringing project was started, over half a million birds have been ringed. Substantial by Indian but negligible by international standards, where countries like the U.S.A., U.S.S.R., U.K., Australia etc. ring in a *single* year more than the total ringed by India over several decades.

Bird ringing is a major tool in the study of ornithology whether one is working on the ecology of a particular species when it is necessary to identify individuals occupying a particular habitat, or studying the migratory movements, local or international, of a species or a group of species, or studying the population fluctuation of the avifauna of a particular habitat.

It therefore came as an unpleasant surprise when Dr. Salim Ali was denied permission by the Forest Department, Rajasthan, to continue ringing migrants at Bharatpur on the specious argument that ringing produces 'traumatic shock' in birds. The fact that we had recaptured birds ringed 10 years previously from the same area, and that every year we recapture and release birds ringed in a particular station in a particular year or in previous years, and that millions of birds are ringed and released all over the world

without shock — 'traumatic' or otherwise—has so far fallen on deaf ears and permission has been denied stubbornly all these years.

This is indeed most regrettable for if we had continued banding birds at Bharatpur, we could have advised the authorities whether the stoppage of grazing and the over-growth of grass has had any effect on the migrant birds visiting the Sanctuary as population fluctuations would have been evident from the data available and data collected.

We would like to give one instance of how useful the ringing data can be in the life of the country.

The recovery of Indian ringed birds in Russia over the years has given precise information on the origin of the birds migrating to India from Russia, which is from an area bounded by latitudes 40° and 65°N and longitudes 60° and 110°E. Therefore when the Chernobyl disaster occurred in European Russia, 3000 km. to the west of the area of origin of birds migrating to India we were able to assure Government that there is no possibility of birds coming to India being contaminated. This was confirmed when migrants trapped by us at Bharatpur on behalf of the Department of Environment,

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A tusker in the South Indian wilderness —E. Hanumantha Rao

Success in America: Captive Asian Elephant Breeding

The success of one zoo in America serves as an exemplary lesson to zoologists and animal captivity advocates in the treatment of wild animals in captivity.

That zoo is Washington Park Zoo, in Portland, Oregon, amidst rolling deep-green, wooded hills in America's north-west.

Washington Park Zoo (WPZ) has the best record in the world in Asian elephant (*Elephas maximus*) breeding: 23 calves have been produced there in 21 years. WPZ has become a centre for zoologists interested in elephants as a result, and it was here that breakthrough research was done on elephants' intraspecific communication by American researchers in 1985.

The secret, according to Roger

Henneous at WPZ, is simply that they have taken the trouble and gone to the expense of keeping and maintaining mature bull elephants, and that they allow their elephants to live and breed as naturally as possible.

It is a fact that many bulls in America and elsewhere in the world's zoos are shot when they reach maturity: some are neutered. This is done because a mature bull elephant in *musth* is almost impossible to control without a lot of trouble and risk, and expense for special equipment. *Musth* bulls also injure and even kill handlers in the disoriented and aggressive state that *musth* induces. An example: one of WPZ's three bulls once spent a record two weeks' outside his

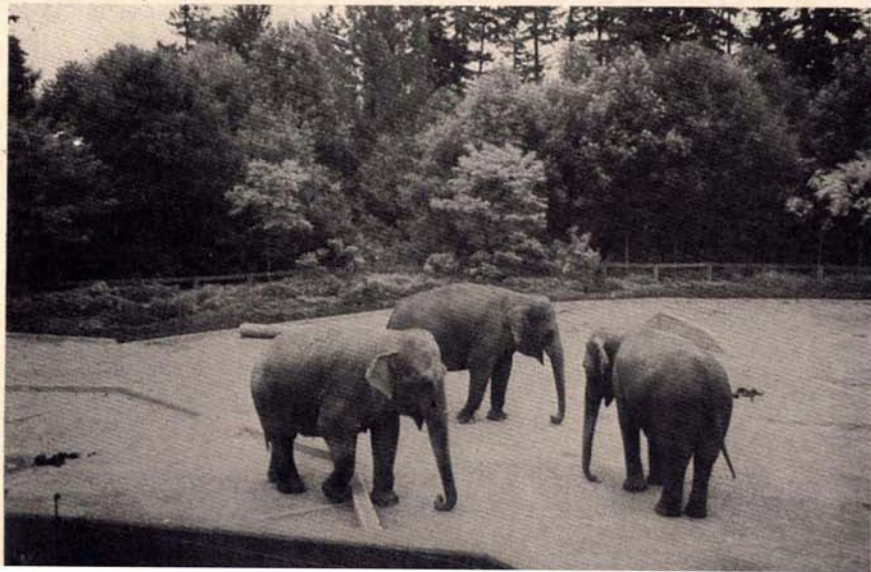
'elephant house' home because he refused to be coaxed or coerced into the building. Eventually he entered because his food supply outside was stopped and he had to enter in order to eat. Other bulls sometimes need to be put in a crush and kept separate from each other and from females. Once a big bull in *musth* took off six inches from the tip of a female's trunk before they could be separated: interestingly, the tip remained coincidentally tapered and normal feeling developed in it.

It is obvious then that keeping mature bulls is a major problem, and WPZ has shown strong commitment to the elephant by keeping them regularly. Out of a present population of eleven elephants, three are mature bulls: out of a total of ten mature bulls in the whole of north America! One of these bulls is the largest Asian elephant in north America, standing 10 ft 2 in. at the shoulder.

After a study conducted in London on artificial insemination of elephants which proved unsuccessful, WPZ has also been trying it nevertheless, but nowhere in the world has artificial insemination worked with elephants so far. WPZ has tried more than half a dozen, but drawn a blank. However, says Roger Henneous, "We are bound to succeed eventually, because the conditions are right". Interestingly, the sperm count of an elephant suffers when it is in *musth*, so it is an unsuitable time even for natural mating when the bull is in *musth*. The *musth* discharge has been analysed and found to be almost pure testosterone.

Temperatures in the enclosure building at WPZ are kept at around 50 degrees with the help of natural gas heating used in winter, which gets cold in Portland, and sometimes during colder summer months. In winter of course, the

Three Asian elephant cows in the outer yard of the WPZ elephant enclosure — Author





A herd of elephants in Kaziranga —the late E.P. Gee

animals stay indoors altogether, while in summer they have a total of one acre in which to have sandbaths and generally wander around.

The elephants' diet consists of half a tonne of hay per day, one and a half gallons of grain per day (mostly as specially formulated pellets), vitamin supplement rich in vitamin E, 40 lb. of lettuce per day, 20 to 30 lb. of carrots, and bananas and apples as special treats.

This seems to be a magic combination, but the main reason for WPZ's breeding success is that they allow their elephants to breed naturally, and take the trouble to keep the mature bulls: no one has been seriously injured or killed by elephants at WPZ so far—Henneous himself has only once been injured, by a cow.

An interesting feature which WPZ has just introduced is the commercial sale of elephant manure. Packaged in 8 oz. tins costing \$ 3.95 each, and just a little bigger than a beer can, it is called "Zoo Doo elephant elixir—nature's most potent fertilizer, guaranteed genuine rotted elephant manure". It is mainly bought by some Portland residents for their gardens and sales for Portland's famous rose-growing centres are catching up. With eleven elephants producing it, the total volume is reasonably large, and the manure itself is described as being close to horse manure. A detailed analysis revealed the composition as follows: nitrogen 3%, phosphorus 1.25%, potash 1%. Cattle manure by comparison revealed nitrogen 0.5%, phosphorus 0.5%, potash

A tusker in Kaziranga —the late E.P. Gee



0.5%. Perhaps there is a lesson in this for Indian zoos and even national parks and logging camps which have large elephant populations in a state of total or semi-captivity. Canning is of course a luxury, but WPZ has set a precedent by utilising elephant manure sales proceeds to augment animal research funds.

Perhaps Indian zoos would benefit from comparing their elephant's conditions, diet etc. and population mix and facilities with WPZ, given the latter's amazing success rate with elephant breeding. Forest Department and logging camp elephant stables cannot be compared, conditions being totally different, with many times more space and exercise and natural forage. But it is true that trained riding-elephant stables in jungles rarely maintain mature bulls, especially in jungles with wild elephant populations: here most domestic calves are sired by wild bulls anyway. However, in a totally captive situation with limited space, WPZ's success has been phenomenal, and deserves a close look by other zoos interested in breeding Asian elephants.

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Multi-headed Palms of Nagao, Raigad district —Author

Occurrence of multi-headed Palms in western India

Palms are mostly non-branching graceful trees having at their summit a tuft of large leaves shaped like the palm of the hand.

A striking exception to this is the genus *Hyphaene* Gaertn. which naturally and normally has a branched or forking trunk. There are about 27 different species of *Hyphaene* growing in North Africa and warmer areas of the Mediterranean region. Occurrence of *Hyphaene* in western India was firstly reported by Graham (1839) in his monumental work entitled CATALOGUE OF THE PLANTS GROWING IN BOMBAY AND ITS VICINITY. He mentioned that Egyptian doum or desert palm (*Hyphaene thebaïca* Mart.) was introduced in western India by Mr Nimmo in 1828 and by

Mr. Macculough in 1837. It was also observed that these multi-headed palms grow well even in great heat, intense light and blowing wind of the coastal denuded areas once their deep roots can find some water. These botanically peculiar palms were mentioned by early botanists as cultigens in Baroda, Bombay and Poona botanical gardens. A few scattered trees were also reported from fort enclosure near Vasai and Nawsari from Gujarat State.

Blatter in 1926 in his treatise on THE PALMS OF BRITISH INDIA AND CEYLON gave Beccari (1908) as the authority and has mentioned that *Hyphaene* species occurring in Div island along coastal region of Gujarat is a distinct new species and



Except the genus *Hyphaene* the branching tendency is totally lacking in palms. There are, however, rare instances where due to accidental injury or at the hands of a skilled craftsman, palms sometimes show branching. Such extremely rare occurrence of the branching habit certainly surprises most people. No wonder that these nature's freaks attract immediate attention of the local population.

Our study group on plant peculiarities is interested in collecting information about the occurrence and geographical distribution of Doum palms and other multi-headed palms from various parts of India.

Very little information is available regarding the geographical distribution of *H. dichotoma* Furtado from peninsular India in general and the western coastal region in particular. During our botanical exploration visits between Revas-Revdanda in Raigad district, we have seen as mentioned by Rao (1964), the enviable grove of doum palm, south of Nagaon. The grove includes more than 20 tall trees of many-headed *Hyphaene*. Formerly there was a small shrine of the local deity of the fishermen in the grove and cutting of such spectacular trees was taboo. Due to rapid urbanization of the neighbouring town of Nagaon and rather hasty plantation of *Casuarina* along the coastal areas by the Forest Department, Doum palm-grove is now-a-days nearly extinct. We have alerted the concerned

referred to it as *H. indica* Beccari. The new species is presumed to be endemic in the coastal areas of the western India such as Okhá, Div, Daman, Dahanu, Shirgaon and Nagao area a few kilometres south of Alibag. The above name was later on changed by Furtado to *H. dichotoma* Furtado, and he reported its luxuriant growth in the island of Div.

The multi-headed palms of India came to light again in 1976 when beautiful photographs of *Hyphaene dichotoma* Furtado, taken by Shri S.K. Seth and *Phoenix sylvestris* Roxb., taken by V.K. Malaviya, were published on the front cover page of the *Indian Forester*.

authorities and hope that they will give due consideration. There are also a few isolated patches of doum palm near Kurul, 2 km south of Alibag and an isolated tree on the way to Rewas.

Regarding multi-headed palms other than the genus *Hyphaene* we have located four-headed *Phoenix sylvestris* Roxb. near Rajur, Akola Taluka, Ahmednagar district. The magnificent multi-headed wild date palm is also situated near a shrine. Unfortunately this fine specimen is on the verge of extinction probably due to old age. Multi-headed coconut trees (*Cocos nucifera* Linn.) are extremely rare. There is a

A freak Date Palm in Ahmednagar district,

Maharashtra — Author



A branching coconut palm in the Sindhudurga

Fort near Malvan— Author

single two-headed coconut tree located in the premises of Sindhudurg Fort near Malvan. It will be economically profitable if one skilled craftsman could succeed in getting the apical growth of coconut palms to branch.

Information regarding precise localities of branched palms from western India will be highly appreciated. This is an appeal to nature lovers in general and forest officials in particular.

V.D. VARTAK

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Peafowl killed in Madhya Pradesh

Yet another unfortunate incident of the killing of the National Bird has occurred on the 31st March 1986 in Kanarhiya village near Indore in Madhya Pradesh.

Three poachers stayed at a farm during the night, made flour tablets mixing rat-poison, and scattered them in the farm. The peafowls came the next morning and died shortly after eating these tablets. The dead peafowl included 4 peacocks and 13 peahens.

One may wonder whether the dead peafowl tainted with poison, are edible. But the poachers intended to sell them, obviously without telling the buyers about the poison.

Fortunately, when the people living in the village saw the poachers collect the dead birds, they captured and handed them over to the police. This was a commendable job on the part of these rural people who, although not very aware of conservation of wildlife and nature, respect peafowl as the vehicle of god Kirtikeya and goddess Saraswati.

...Editorial contd. from page 2

Forests & Wildlife were examined by the Bhaba Atomic Research Centre and found negative for radiation.

The police filed a case against the poachers under *Section 3* of the National Bird (Protection) Act. This is significant because the police seldom file a case under such an Act. So far, such cases were either ignored or filed under other crime Acts. There is a need to include Acts like Wildlife (Protection) Act, Antiquities and Art Treasure Act in the training course of police personnel. By the time of writing this note, the charge-sheet has been presented before the Court, and hearing and judgement are pending.

This incident should be considered in the light of last year's incident which occurred in Madhya Pradesh, in which over 100 peafowl were killed when they took their last meal in a farm which was sprinkled with pesticides. That was the result of importing those pesticides, use of which was banned in the exporting countries.

RAJIV SAXENA

It is a pity that Forest Departments arbitrarily assume expertise which they do not possess.



Fish being collected at low tide along a laid-out wana—B.F. Chhappgar

Methods of collection of live marine fishes and invertebrates

The Taraporevala Aquarium is one of the most popular public aquariums in India, ideally situated as it is, facing the Chowpatty Bay. It exhibits a large number of marine and freshwater vertebrates and invertebrates. The main hall of the aquarium has 9 large tanks exhibiting various Indian and exotic freshwater fishes and prawns. Indian freshwater species are procured from fish farms and ponds managed by the Department of Fisheries, Maharashtra State. Of the exotic varieties some are imported from abroad, some purchased from local dealers, while some others are bred at the aquarium.

The main attraction of the aquarium, however, is the large variety of marine specimens ex-

hibited in 18 large and 2 smaller tanks. About 88,500 litres of seawater circulates continuously through these. Some exotic varieties of marine fishes and invertebrates are also imported from dealers in Sri Lanka and Singapore. These include the beautiful butterfly fishes (*Chaetodon* spp.), trigger fishes (*Balistes* spp.), clown fishes (*Amphiprion* spp.), turkey fishes (*Pterios* spp.), etc. In addition to these many varieties of locally available fish are also collected, mainly by using two kinds of gear — the Pera and the Wana.

Many people are unaware of these methods for collection of live fish for the aquarium. These methods have to be used as other methods (for catching edible varieties of fish)

suffocate them as in the case of gill nets, or damage them very badly as in the case of trawls and purse seines. Fishes so caught are highly susceptible to stress and disease and therefore they do not adjust well to the captive environment in the aquarium. Pera and Wana are such that the fish is subjected to minimum stress and/or injury during capture.

THE PERA

Pera is actually a shore seine. Approximately nine fishermen are required for operating it. One end of the net is held near the shore by 2-3 fishermen in about 3 ft of water while the rest of the net is laid out by 3 fishermen from a dugout canoe (locally called *toni*). The other end of the net is then brought towards the shore thus encircling this area. The length of the Pera (net) varies from 50 to 100 metres and the height is about 2 m. The mesh-size is about 2.5 cm. It has floats at the top and lead weights at the bottom. Formerly these nets were made of cotton but now synthetic material of 1 mm thickness is used as it is lighter and stronger.

When the crew on the canoe finish laying the net in about 1.2 m of water, the fishermen at the other end pull that end into the canoe. Thus both the ends are now on the canoe. The fishermen then begin to haul in the net. One of the fishermen agitates the water inside of the net while 2 fishermen on the outside of the net remove any obstacles and guide it. When the net

is brought very close to the canoe, the fish can be seen easily and collected. Of the fish that are caught the aquarium staff, present at the collection site, select the variety of fish required for exhibition and transfer them from the Pera to large plastic tubs (0.6 m diameter). Fishes which are badly injured or showing distress are not selected. The selected fish are then transferred to a plastic pool of about 1 m diameter and 0.6 m height, containing filtered seawater from the aquarium's circulatory system. This plastic pool is kept in the vehicle belonging to the Fisheries Dept. After the collection is over the vehicle brings the live fish to the aquarium where they are quarantined.

Pera collection of live fish is made at Cuffe Parade and Girgaum Chowpatty area, in south Bombay and Juhu beach in north Bombay. Formerly when plastic tubs and pools were uncommon, use was made of large elliptical galvanised iron tubs 1.2 m length and 0.4 m height. Plastic pools and tubs have made the job of carrying live fish, easier. Fishes caught by Pera include *Drepane punctata*, *Alectis ciliaris*, *Trachynotus ovatus*, *Plotossus arab*, *Therapon jarbua*, *Tricanthus brevirostris*, *Scatophagus argus*, *Megalops cyprinoides*, *Chiloscyllium indicum*, *Silago sihama*, *Echeneis nubrates*, *Tetrodon* spp., *Upenoides* spp., *Synaptura* spp., *Epinephalus* spp., *Dasyatis* spp., *Arius* spp., *Platycephalus* spp., *Panulirus*

polyphagus (lobster) and crabs like *Charybdis* spp., and *Neptunus* spp.

THE WANA

A very large number of marine fishes exhibited at the aquarium are caught by this net. This is a massive barrier net made of rectangular pieces joined end to end and supported by bamboo poles. One Wana may comprise of 12-15 such pieces. Each piece is about 90 feet. (The fisherman's measure being *vavn*, and each *vavn* being 6 feet. Each rectangular piece of net is 15 *vavn* or about 27 m in length.) Since there are 12-15 such nets joined end to end, the total length of the Wana varies from 325 m to 430 m. The height of the Wana is about 2 *vavn* (3.6 m). At every 3 *vavn* (5.4 m) a bamboo 5.4 m in height and 10 cm thick is fixed at the bottom to support the net.

One day prior to *Amavasya* (Newmoon day) or prior to *Poonima* (Fullmoon day) the net is laid at low tide. The net is fixed at its lower end, to the bamboos at intervals, and weighed down by lead weights and large stones. At the third bamboo a slipknot is tied connecting the upper end of the net. About 5 feet of rope helps in releasing this slipknot at high tide. To hold the upper end of the net down, it is weighed down by smaller stones at intervals of half a *vavn* (1 m).

At high tide the slipknot at the third bamboo pole is released by pulling it up from a boat. This causes the upper end of the net to float. The upper end of this net is

then tied to the pole. In a similar way the upper end of the net is tied to the top of the poles in its vicinity, all along the net. Thus a massive barrier is formed which does not allow the fish that have come in with the previous tide to go back. At dawn of Newmoon or Fullmoon day the water starts receding (at ebb tide) and when it is knee-deep, the aquarium staff begin collecting the live fish in hand-nets. When a shoal has to be collected, use is made of a *gholwa* (a large hand-net) or *paag* (cast-net). These fishes are then taken to the plastic pool in plastic tubs and brought to the aquarium in the Department's vehicles.

Wana was used formerly at Colaba lighthouse, a restricted military area, at Jamshet Bunder, Cuffe Parade and Sassoon Docks, at the beach at Raj Bhavan (Governor's residence), Girgaum Chowpatty, Haji Ali, Worli and Bandra. Wana at Haji Ali, Worli, and Bandra have since been discontinued due to pollution and sewage discharged at these points, into the sea. Wana at Raj Bhavan has been discontinued on account of security reasons. The water in the Sassoon Docks area is heavily polluted with oil sludge. Jamshet Bunder and Colaba lighthouse area are the two places which give a good catch of live fish. In addition to the variety of fish collected by the pera, other fishes include *Chaetodon collaris*, *PlatyGLOSSUS* spp., *Platax teira*, *Acanthurus strigosus*, *Dasyatis* spp., *Siganus vermicularis*, *Teuthis*



SCAT FISH
(*Scatophagus argus*)
LIV.



CLOWN FISH
(*Amphiprion percula*)



BLUE-RINGED ANGEL FISH
(*Holacanthus annularis*)



COLLARED BUTTERFLY FISH
(*Chaetodon collaris*)

Carl P. Silva '07

java, *Abudefduf saxatilis*, *Arius* spp., *Aetobatis narinari*, *Monodactylus*, *Drepana punctata*, *Lates calcarifer*, *Sciaena cuja*, and many others. Wana is dependent on tides whereas pera is not. Wana is used from September to May whereas pera can be used even in the rainy season except when the sea is rough.

SOME OTHER METHODS

Gymnothorax spp., (Moray eels), *Holothuria* (Sea-cucumber), *Paracondylactis indicus* (Sea anemone), sea-urchins, octopi, gobies, blennies, crabs, and other invertebrate animals are collected at low tide from tidal pools along the shore. Collecting Sea-anemone is a very tiresome process. If disturbed they withdraw totally into the sand and are as good as lost. On sighting a sea-anemone the aquarium's field collector digs a pit around the sea-anemone (which has to be at least 0.6 m deep). The pedal disc is then dislodged and the animal is scooped out. This requires great patience and alertness on the part of the collector. The collection is then brought to the aquarium in large plastic bags.

CONDITIONING OF THE FISH TO THE AQUARIUM'S ENVIRONMENT

The fishes and other animals that are caught are not introduced directly in the exhibition tanks. They have to be first conditioned to the captive environment in the aquarium. Besides, the fish may also be diseased or may have parasites on their body which may spread to previous

inmates. To avoid this the aquarium has a cement tank of size 6 m × 1.5 m × 1.2 m called the "Conditioning Tank". The fish brought from collections are kept in this tank for a week. This tank is supplied with seawater by an extension from the main supply line (supplying seawater to the exhibition tanks). Similarly the tank has a drainage system connected to the main drainage and connected by a butterfly (Y-type) P.V.C. valve. This valve controls the rate of drainage of water.

After the quarantine/conditioning period, the fish is given a "bath" in fresh water for a couple of minutes to remove ecto-parasites, if any. Fish lice, too, drop off during this process. The fish is then transferred to a tub containing seawater and after this, it is introduced to the exhibit tank. Invertebrates are not given any bath.

Every marine fish that enchants visitors to the aquarium has been carefully selected and cared for, thus making hardy enough to tolerate its captive environment. Due to this many of the exhibits have been able to establish longevity records here.

Pollution and other difficulties encountered have destroyed a large variety of fish once available in plenty along our shores. Examples are the blue-ring angel (*Pomacanthus annularis*), whose life

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INDIAN NATIONAL SCIENCE ACADEMY ANNOUNCEMENT

The Indian National Science Academy invites applications in prescribed forms from deserving scientists for providing them with partial support to participate in International Conferences abroad during 1987-88. The grants operate under three categories:

CATEGORY I. Conferences sponsored by the International Council of Scientific Unions (ICSU) and its affiliated bodies. Scientists invited to deliver plenary lecture/preside over a session or whose paper has been accepted for presentation, and who will also be provided maintenance allowance during stay abroad as also partial travel will be given preference over others. If selected INSA's financial support is limited to a maximum of half international travel, 50% of the maintenance allowance for the duration of the conference and registration fee wherever necessary. Applications to be despatched latest by 31st January each year.

CATEGORY II applies to Non-ICSU sponsored Conferences and covers scientists invited to deliver plenary lecture/preside over sessions, or whose papers are accepted for presentation, and also provided partial maintenance abroad and partial travel. If selected INSA's financial support is limited to a maximum of Rs. 5000/-. Applica-

tions to be received in the Academy three months prior to the date of commencement of the Conference.

CATEGORY III. INSA-COSTED Travel Grant is for partial travel assistance only. Scientists below 35 years holding doctoral degree, whose papers are accepted for presentation, and whose local hospitality and partial travel is borne by organisers or some other agency are eligible. Applications are screened once a quarter during the year. Selected candidates would be supported partially for travel cost, jointly by INSA and the Committee on Science & Technology in Developing Countries.

Candidates interested are requested to apply in the prescribed proforma which could be obtained from:

THE EXECUTIVE SECRETARY
INDIAN NATIONAL SCIENCE ACADEMY
BAHADUR SHAH ZAFAR MARG
NEW DELHI 110 002

MUSTELIDS AND VIVERRIDS

The Zoological Society for the Conservation of Species and Populations are presently collecting data on various mammal species and/or subspecies of the Mustelids and Viverrids given alongside.

The purpose of the information sought is to identify the forms in greatest need of conservation measures. The details sought are: recent sightings, estimates of local abundance, and any other informa-

tion of relevance to conservation. The Society would also appreciate names and addresses of persons with a possible knowledge of, or interest in the animals, references to recent publications, information on captive specimens either in zoos or private collections, as well as photographs. Please communicate with

DR ROLAND WIRTH
CHAIRMAN, Z.S.C.S.P.
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WEST GERMANY

Malabar Civet *Viverra megaspila civettina* — listed in the Red Data Book as possibly extinct, but may survive in the coastal districts of Kerala



Brown Mongoose *Herpestes fuscus fuscus* — South Indian hill ranges

Stripednecked Mongoose *Herpestes vitticollis inornatus* — North Kanara

Stripednecked Mongoose *Herpestes vitticollis vitticollis* — Coorg, Kerala, and Sri Lanka(?).

Nilgiri Marten *Martes gwatkinsi* — Nilgiris, south Coorg, Kerala





Waterfowl recognition—School teachers being briefed at the Prince of Wales Museum, Bombay —I.D. Kehimkar

NATURE EDUCATION WORKSHOP

A two day workshop for biology teachers was conducted on 25th and 26th September under Society's Nature Education Scheme. In all 64 teachers from 40 schools participated in this workshop where the role of Museums and Zoos in education was stressed upon. Apart from lectures, participants were also taken to these places where techniques of instructing youngsters were demonstrated.

JBNHS ON MICROFICHE

The Society's *Journal* (Vols. 1 to 64) is now available on microfiche. Further enquiries may please be made at the addresses mentioned below:

- (a) Inter Documentation Company
Hogewoerd 151-153
2311 HK Leiden
The Netherlands.

- (b) Higginbothams Limited
Post Box No. 311
814 Anna Salai
Madras 600002.

BIOACOUSTICS—A NEW JOURNAL

The first international journal wholly devoted to the study and recording of animal sounds is to be launched early in 1987 by the British Library of Wildlife Sounds in association with the International Bioacoustics Council, subject to sufficient subscribers. Commissioned review articles as well as research papers will be published, and the wide range of topics covered will include:

Animal sound communication; bioacoustic research: sound recording techniques; expeditions and other recording activities; recent

bioacoustic publications; new equipment; IBAC symposia and news; wildlife sound archives.

Subscription rate for institutions will be £55 per volume of four issues, initially spread over two years. For individual subscribers the rate will be only £15 if there is a guaranteed minimum number. So please write to Ron Kettle, National Sound Archive, 28 Exhibition Road, London SW7 2AS (01-589-6603).

SMUGGLED ANIMALS FOR ZOO

A press note in the *Indian Express*, Chandigarh, Saturday, August 9, 1986, makes sad reading to those interested in wildlife and its continuation. The note says that

“After dilly-dallying for long, the Punjab government has finally confessed that smuggled animals were purchased for the Chhat Bir zoo “from private sources from 1978 to 1983”. The list of wildlife animals purchased by the department includes: a pair of golden langurs (for Rs 9, 400/-), a pair of liontailed monkeys (Rs 8000/-), a pair of leopard cats (Rs 1600/-), a pair of slow loris (Rs 1200/-), a pair of marbled cats (Rs 2800/-), one Nilgiri langur (Rs 3000/-) and a pair of ratels (Rs 8000/-).

The press note concludes “... it is surprising to note that the newly constituted purchase committee for wild life animals has one member during whose tenure most of the illegal purchases of animals were made.”

ENCYCLOPEDIA OF INDIAN NATURAL HISTORY

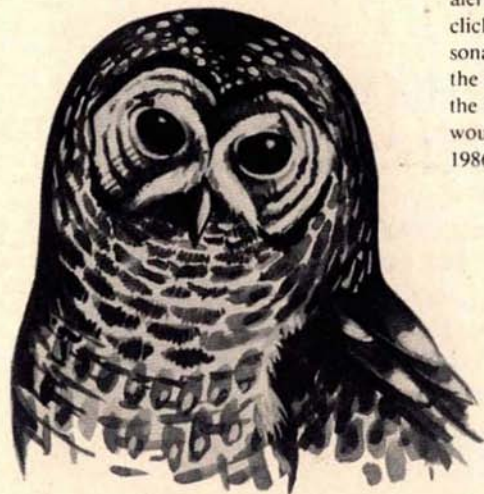
This one-volume encyclopedia is a Centenary effort of the Bombay Natural History Society, and is produced under the General Editorship of Mr. R.E. Hawkins, and is written by experts in the various disciplines of Natural History. It contains an immense amount of information on India's teeming plant and animal life, recorded in the thousands of pages of the Society's *Journal* and elsewhere. Arranged in single alphabetical sequence, the ENCYCLOPEDIA besides India covers Bangladesh, Bhutan, Burma, Nepal, Pakistan and Sri Lanka.

It is available to members of the Society at a special price of Rs 185/- per copy, plus postage.

Spotted Owls and the USA

As more and more mature Douglas fir and redwood forest in California, Washington and Oregon is felled, the future of about 5000 Spotted Owl population in the State is causing added concern. Without such felling it is estimated that there is an annual decline among these owls at the rate of 8 percent. Last year the National Wildlife Federation won an injunction to prohibit timber sales in one of Oregon's national forests until a statement were issued on the environmental impact the proposed felling would have on the owls. The National Audubon Society has named a task force to review the entire Spotted Owl issue. The Federal Government has lent support for such a research at understanding the owl's needs. Owls prefer old growth forests for the cooler summer temperatures such forests afford, better food, and suitable nest sites. A pair of spotted owls require around 1000 acres of old forest which economically means 18 million worth of timber. — *Oryx* Vol. 20, July 1986

Spotted owl



Marine Mammals v fisheries

Thousands of marine mammals are being killed either accidentally or deliberately during fishery operations. Some of their species are on the verge of extinction. They cause a great deal of trouble and damage when they get entangled in the fishing nets in their frantic efforts to escape. This problem is now being looked into by UNEP unit of the United Nations Global Action for marine mammals.

Monofilament nylon gill nets have been found responsible for the deaths of millions of sea mammals, sea birds and turtles. These nets are strong and almost invisible in the waters. Statistics released by the Scientific Committee of the International Whaling Commission reveal that in Sri Lanka alone more than 1500 dolphins are killed each year.

Many fishing communities believe that removal of marine mammals will increase their catch. However, this equation is not as simple as it presents. Marine ecosystems are quite complex; they do not operate so simplistically.

In Sri Lanka the National Aquatic Resource Agency with support from UNEP is working on the problem involved. Devices such as luminescent cable, strobe lights to alert dolphins, or structures like bamboo clicking contrivances to warn animals using sonar for navigation are being tested to make the seas safer. The benefit of the research for the fishermen and for the denizens of the seas would be immense. — *Ecoforum* vol.11, p. 3; 1986

This is the sixth part of the series and is continued from
. p. 27 of Hornbill 1986(3) - EDS.

Frog Shells (Family-Bursidae) live among muddy stones and rocks in shallow water. The shell has two heavy lateral ridges called varices running along the whole length of the sides of the body. Shells often nodulose or with spines and strong anterior and posterior canals.

36. Tuberculated Frog Shell (*Bursa tuberculata*)

Shell moderately high, spired, and with well-developed anterior canal. Body whorls ornamented by transpiral rows of tubercles of almost uniform size. Intervening space of the two body whorls occupied by the fine vertical striae. Shell colour usually light to dark brown; aperture creamish inside; outer lip thickened, showing brown bands on the edge; varices show white markings at irregular intervals. Empty shells common on the Bombay shores, abundant near Dadar seaface

37. Spiny Frog Shell (*Bursa spinosa*)
Large sized shell with pointed apex and canaliculated aperture. A number of spines of varying size along both the lateral varices. Body whorls ornamented by fine spiral striae and a few tubercles. Shell also has a row of small and stubby spines in the middle of each whorl in the spire region. Inside of lip has 12-13 distinct teeth. Shell colour white to

pale cream, operculum brownish. Common along the Bombay shores.

Tun Shells (Family-Tonnidae) are thin, large and fragile shells with short and simple and wide anterior canal. Body whorls sculptured with thick and flat spiral ribs. Operculum absent. Carnivorous inhabiting sandy areas beyond the reef.

38. Tun Shell (*Tonna dolium*)

Shells globose with gaping aperture, short spire and deep suture. Body whorls spirally ribbed. Ribs flat and widely expanded, ornamented by rectangular orange-brown spots, intervening space occupied by thin spiral striae. Umblicus wide and open. Shell colour ranges from white to fawn. Shells often cast ashore by wind and waves. Broken shells are seldom found on the shores

The large Tun Shells were once used as oil lamps.

Fig Shells (Family-Pyrulidae). Sand dwelling molluscs with thin and fragile shells devoid of varices. Spire always short and outer lip thin. The family is represented by a single species.

39. Fig Shell (*Pyrula ficus*)

A little pear-shaped fragile shell up to 4 inches in length. Outer lip delicate and expanded. Columella smooth; canal long and open. Shell body finely, spirally striated. Usual-

ly creamish brown in colour, mottled with dark brown or yellow patches or dots. Aperture stained with violate on the inside. Occur on sandy shores not far beyond the low-tide mark.

Murices (Family-Muricidae) are varied in form. Solidly built shells, often with a shortened spire and wide body whorls. Operculum horny; anterior canal long and narrow in many species. Shells sculptured with prominent ridges and spines. Prey mainly on oysters and bivalves.

40. Venus Comb (*Murex tribulus*) Shells moderately spired, nodulose at intersections. Body whorls spirally ribbed, each whorl has three prominent transpiral varices which give out rows of long, slender and sharp spines similar in appearance to a comb, hence the name Venus Comb. Anterior canal long and almost straight. Shell creamish white; aperture white. Lives buried at moderate depths near the low-tide mark. Occasionally brought ashore entangled in fishing nets. Broken

empty shells with worn-out spines are common along the shore.

41. Adustus Murex (*Murex adustus*) A black, rather large shell, growing to about 2 inches in length. Body whorls sculptured with strong, spiral ridges. Each whorl has three transpiral varices which give out the spines in a manner of a branching fir tree. Mouth small and oval, canal produced is almost covered over. Black colour tends to become brown towards the apex; spiral ridges brown; aperture white in colour.

Besides their generative power, the murices can also dissolve any of their spiny processes when they grow inconveniently long. From some of the murices the Phoenicians obtained their famous Tyrian Purple dye. Wool and cotton dyed with the so-called Royal Tyrian Purple were once much in demand.

MANOJ MUNI
CARL D'SILVA

(To be continued)

LIFE MEMBERSHIP

The life membership of the Society for Indian residents has been raised from Rs.800/- to Rs.1200/- to meet the escalation in costs of the facilities offered to members. However, the Executive Committee decided that ordinary members presently on the rolls should be offered the facility of converting their membership on existing rates within a stipulated period of three months.

It is therefore suggested to consider converting ordinary membership to life membership on payment of Rs.800/- before the 30th of May 1987.



Murex tribulus



Murex adustus



Bursa spinosa



Pyruca ficus



Tonna dolium



Bursa tuberculata

CARL D'SILVA 87



Wastelands under cover of eucalyptus —A. Mohile

Do eucalypts "waste" water?

This article which appeared as Rural Forestry Newsletter No. 3 of the Forest Department, Nairobi, is reproduced here with the permission of the Conservator of Forests (FID), Nairobi—Eds.

Sooner or later, anybody who works in tropical or subtropical forestry (and agriculture) hears the complaint that eucalypts "waste" water. Is there any objective basis to this complaint?

First of all, we must define what we mean by "waste". If by that we mean *using a lot of water*, then there is no question that a 15 m, 50 cm d.b.h. eucalypt growing in a 600 mm rainfall zone is "wasting" water. It obviously takes a lot of water to produce a tree that size, much more than a local shrub or a 3 m indigenous acacia. However, right away we must set aside our

prejudices against eucalypts and exotics in general, and admit that it is a remarkable feat for any tree to grow to that size in such a dry climate. Indeed, when it comes to size (girth and height), eucalypts have few, if any, competitors in semi-arid climates. Which is one of the main reasons why eucalypts spread from Australia to all parts of the semi-arid world in the first place. Thus, whether we like it or not, eucalypts are *efficient users of water* (and possibly of sunlight) under semi-arid conditions. That is, they are capable of producing a lot of biomass by somehow extracting

enough soil water (and nutrients) in dry, hot climates that otherwise only support grasses, shrubs and small trees. Eucalypts are also among the fastest-growing woody plants in the world, as we all know.

We should really use the expression "waste" only if we can prove that a species — and not just eucalypts — *uses more water to produce a unit weight of biomass* than another species *other things* (climate, soil, rooting depth) *being equal*. Under these conditions, agronomists have indeed shown that some crops (including some shrubs) do waste water. For example, the cowpea is an efficient biomass producer; in contrast, U.S. varieties of *Prosopis* have been found to have low water use efficiencies. However, before we throw out the *Prosopis*, selected South American strains of *Prosopis* are believed to have the same efficiencies as annual legumes (500-1,000 kg of water per kg of dry matter produced, as opposed to water use as high as 4,400 kg per kg of dry matter).

We stand to be corrected, but on the basis just described we are not aware of any evidence that shows that eucalypts "waste" water.

In general, clear-cut evidence of differences in water use *on the landscape* exists only in connection with different types of vegetation that have *different rooting depths and other structural differences*. Thus, as countless watershed experiments have shown, grasslands usually extract less water than forest. They

also intercept less precipitation than trees and, hence, cause fewer direct evaporative losses. Consequently, conversion of forest to grassland has generally resulted in increased baseflow (that portion of the discharge contributed by groundwater). The effects of this conversion on storm or peak flows is another matter, a controversial one we should ignore for the moment.

On the other hand, there is also some evidence that reforestation of bare or grassy watersheds has resulted in *higher baseflow*, despite the deeper water extraction and direct evaporative losses (interception) by trees. This anomaly is attributed to *increased infiltration* of rain in the more porous forest soils, which *offsets* the increased evapotranspiration (ET) of forest. In the Shimba Hills of Kenya, for example, forested watersheds yielded more water than grassy ones because tree roots penetrated an impervious layer of clay underlying the superficial sands, thus increasing deep infiltration of rainfall. In Malawi, during the dry season more water was found about 1 m under mature *Brachystegia* woodland (miombo) than under grass, again presumably because more water infiltrated under miombo in the first place. The deep-rooted miombo is usually assumed to be a heavy user of water. These anomalies are cited in order to warn against glib generalisations concerning a subject as complicated as field hydrology.

In general, given similarities in

rooting depths and in above-ground structure, plants tend to use similar amounts of water. There is also no evidence that fast-growing plants use more water than slow-growing ones, again other things being equal. Even desert plants that allegedly "conserve" water have been found to extract as much soil water between the field capacity (soil-water content at maximum capillary retention) and the wilting point as ordinary plants. It is only when the soils are at or near the wilting point that desert plants (so-called xerophytes) are capable of surviving or even growing slightly by preventing irreversible wilting. They do this by various physiological mechanisms (use of stored water, stomatal control, etc.) that, however, have negligible field-hydrological significance. Desert plants also survive by having very deep or extensive roots or both, and thus can tap water unavailable to ordinary plants; presumably that is what eucalypts do in semi-arid climates. Some desert plants (so-called phreatophytes) also survive by reaching the water-table.

The reason why there are no appreciable differences in water use among plants of similar structure is that the loss of water through ET is *largely a physical rather than a biological process*. In the words of an eminent hydrologist, ET is basically a *leakage* process controlled by physical factors rather than active water extraction by biological means. The use of water by plants is

governed by the availability and accessibility of soil water (that is where rooting depth comes in), by the conduction of water within plant tissues, the movement of water vapour in and out of the leaf epidermis, and ultimately on atmospheric conditions such as heat energy, humidity, ventilation and turbulence around the leaves. The soil-water content at wilting (soil water under 15 atmospheres of tension) is essentially the same for all plants, as well as for all soils if this point is expressed as a thermodynamic potential; this fact underlines once again the *predominantly physical rather than biological nature of water use by plants*.

Having said all this, we have an intriguing bit of evidence to deal with. In Madagascar, it was found that, in an area of 2,000 mm annual rainfall, "old *Eucalyptus* forest uses 100-200 mm of water more per year than a natural, mature forest". Unfortunately, we lack the necessary detail to arrive at a judgment: is the *Eucalyptus* forest deeper-rooted? Is the natural forest leafless during part of the year? Are there differences in interception between the two types of forests? Until we have answers to these questions (as well as knowing the respective mean annual increments of the two types of forest) we cannot accuse the eucalypts of "wasting" water. If we want wood and the eucalypts indeed have a higher MAIs, then the eucalypts are "efficient"; if we want higher baseflows, then we may

want to consider vegetation that is shallower-rooted and intercepts less rainfall, without, however, decreasing the porosity of the soils. Again, let us beware of hasty decisions.

A 1970 report to the Australian Water Resources Council concluded:

...All evidence supports the proposition that there is negligible difference in water yield between species of *mature* (underlined by original author) forest...

This Australian work looked at differences in water yield between watersheds with indigenous eucalypt forest and with exotic pine plantations. Similar work in South Africa came to the same conclusion: forests of exotics use the same amount of water as indigenous forest. It is interesting how in Australia, home of the eucalypts, the presumption was again that it was the exotics (pines, in this case) that were the "villains". On their home ground, the eucalypts were the "good guys". There is a lesson in that, something to do with unjustified assumptions or prejudices concerning exotics.

Until we have clear-cut evidence, let us stick to justified prejudices against eucalypts, such as the ecological poverty of pure stands of these trees...

We come back to where we started. Eucalypts are very efficient extractors of water as witness their size even in semi-arid climates. Thus they are more likely to affect crops than other trees, as Kenyan farmers know very well. Other factors (shade; chemical antagonism or allelopathy) may also contribute to the depressing effect of eucalypts on crops. The adverse effect of *E. saligna* on maize (but not of *Calliandra*) at 4 m intervals can be seen quite clearly at the Jamhuri Park Agroforestry Centre in Nairobi. Similar experiments conducted on the Coast with *E. camaldulensis* have shown similar depressing effects on maize. In the ASALs, tap-rooted species with light crowns are the preferred agroforestry species. Kenyan farmers know this when they use *Grevillea* in or near their maize fields...

STUDENT MEMBERSHIP

From the current year Student membership will be Rs.25/- per annum plus an entrance fee of Rs.10/- when enrolled.

Student members may pay their subscription in two instalments of Rs.15 and Rs.10. Student members to note that the last two issues of the four issues of the *Hornbill* for a year will not be posted without receipt by us of the second instalment

Continued from p. 33 of Hornbill 1986(3)



Crested Serpent Eagle—feeding time for the nest young —Author

Some initial remedial steps

1) Some positive attempt should be made to determine the status, population trends and composition of some of our lesser known uncommon species living mainly in moist-deciduous to evergreen bio-types. These birds are specialised to surviving in this environment, which in India, is restricted mainly to parts of the south-west and north-east. Status can only be determined areawise and though no conclusive answers may be forthcoming, we could get some indications regarding population trends, composition and adaptability of these birds to disturbances and interferences

like logging, hunting, etc. This information will be useful in the future if a management plan for their protection becomes necessary. For these birds, however, destruction of their specialised habitat may be the main indicator of a downward curve in their numbers. A questionnaire could also be prepared and sent for this purpose to reliable birdwatchers all over the country about past and present sightings of raptors in their area.

2) Suitable habitats covering a range of bio-types with a good representative breeding density of a variety of raptor species should be identified and protected against all



A Spotted Eagle being mobbed by furious crows —Author
Discomfited, the Spotted Eagle finally leaves its perch —Author



harmful disturbances and activities. As probability of future extinction rises sharply with decreasing isolated areas, protected areas must be large, including as far as possible whole eco-systems. Whatever the size of the reserves, they should be ideally connected by scattered smaller patches of forest to allow faunal exchanges and to prevent in-breeding a real threat to forest eagles.

3) Research on the effects of D.D.T. and other pesticides on breeding success of raptors nesting on and near agricultural land should be initiated. Harmful effects of pesticides to human environment and wildlife should be publicized.

4) Rigidly enforced laws to prevent

trade in Raptors and legislation for total protection from hunting, trapping, and disturbances during the breeding season is required.

5) Tribals and villagers around forest areas should be educated about raptors, especially the species which are found around their habitation as they persecute all Birds of Prey out of ignorance of the vital services they perform for the benefit of a well-ordered natural system as bio-indicators — helpful and essential to the benefit and welfare of man himself. Many raptors including migratory species and owls benefit farmers by hunting vast numbers of agricultural pests like mice, voles, insects, locust, etc.

Pallas's or Ringtailed Fishing Eagle—barometer of environmental health —A.R. Rahmani





Tawny Eagle on a Ghana bund. Is it biding time for a fish to surface up? —Author

6) Migratory raptors in many areas are decreasing and after suitable study migratory routes and raptor wintering sites should be accorded full protection. Along any large migration route birds use favourable bio-types to rest and feed. These refuges vital for normal process of migration need to be protected. An impressive Harrier roost of 500-700 birds was observed during the 1985 winter at the Vellavadar Blackbuck Sanctuary in Saurashtra, Gujarat. A similar roost of 800-1000 harriers, mainly Montagu's (90% of them males), the rest Marsh was observed by Dr. Asad Rahmani of the B.N.H.S. near Rollapadu, in A. P. We could do well to adopt the proposals of the World Working Group on Birds of Prey for protecting migratory raptors. Preliminary studies should consist of:

a) Identification of vulnerable stretches of migration routes for future protection.

b) Counts, if possible, to give us a rough indication of the numbers of birds that use them. This method may not be effective if wintering populations migrate on a broad front.

c) Drawing up an inventory of resting and wintering refuges and calculation of minimum area necessary for the normal functioning of each bio-type.

d) Protection of Wetlands and marshes throughout the country. They are important habitat for wintering raptors.

7) Encouraging study of raptors and creating awareness among people in favour of this spectacular group of birds. These studies could be carried out in collaboration and financial

support of national and international organizations. Emergency conservation measures should be undertaken while there are still hundreds of individuals around thus giving conservationists some time to tackle the problem well in advance as genetic bottlenecking should be avoided at all costs.

We must make a beginning now and create a healthy environment for this declining and sensitive group of birds, and, in the process, for us. We saved the Tiger just in time and in doing so helped to preserve the habitat of some of our raptors. To preserve the diversity and a viable population of our raptor species, we have to protect them outside the national parks and

reserves where most of them survive — their future vulnerable like the habitat they live in. We still have the required habitat to preserve our breeding species in the wild. Let us not sit back till it is almost too late to save their environment — the only fool-proof method to ensure their long-term survival. Captive breeding is usually carried out as a last-ditch measure when a species is reduced to a small remnant unviable population in the wild. This has been necessary in the progressed west where some countries have just 3-4 breeding pairs of some species necessitating captive breeding. Also, habitats must exist for the return of captive-bred birds to the wild the whole process which in itself is ex-

A female Bonelli's Eagle with a monitor lizard for her squabs — Author





Montagu's Harrier *Circus pygargus*—A.R. Rahmani

pensive, time-consuming and results often uncertain. If we do not extend our protection to them now, some species may disappear for ever. They are among the most complex, rich and interesting of all ecosystems. Understanding the ecology and biology by holistically studying the natural history of our diverse raptor populations would provide not only a valuable addition to our scientific knowledge and help us to take effective measures to protect this magnificent and finely tuned group of birds in the wild, but also throw light onto intricate ecological problems, which in the long run will eventually prove beneficial to man!

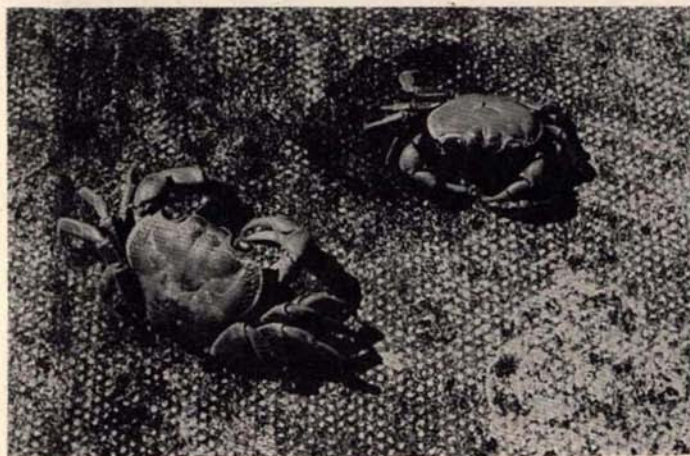
Rajpipla Forests — a vital raptor habitat is in imminent danger of being wiped out due to severe uncon-

trolled commercial exploitation, mainly clear-felling in all areas. Plans and proposals for its preservation have been sent to the Prime Minister and the Gujarat Government. The Prime Minister has promised to look into the matter and Dr. Salim Ali has also communicated his anxiety to him. So far the Gujarat Government has shown scarce inclination to take the first step and we now feel that only public awareness and pressure will save what is left of this unique and savable area. Readers who are concerned, are requested to write to the Chief Minister and Forest Minister, Gujarat and to the Prime Minister.

RISHAD NAOROJI

(Concluded)

Continued from p. 38 of Hornbill 1986(3)



Baluchistan Freshwater Crab Potamon gedrosianum has adapted itself to harsh and dry habitats—Author

It is believed that all the more primitive forms of animal life (including crabs) evolved first in the sea and those crabs which have adapted to live in freshwater streams, inland swamps or on dry land are considered as later evolutionary developments among the BRACHYURA. The commonest freshwater or swamp dwelling crab in Pakistan is *Paratelphusa spinigera* (see photo), which has adapted to become a ricefield dweller in lower Sind, particularly in Thatta district. This crab must survive from the end of October up to the end of June early July in fields which lie fallow and are bone dry and devoid of any irrigation water. Judging from the size of adult specimens collected at the beginning

of the rice transplanting season, it does so as an adult, either in a state akin to hibernation or prolonged torpor, in sealed underground chambers safe from desiccation. If they survived only as encysted larvae of fertilized ova, this would necessitate abnormally quick growth and development during the short summer season during which the rice fields are flooded.

Males of this species, like the Ghost Crabs, construct conspicuous conical towers or cone-shaped funnels out of globules of mud near their burrows, which may serve to advertise their presence to females. These look a bit like rodent burrows to the uninitiated, but in fact the fierce Rice Rat (*Bandicota bengalensis*) which is highly adapted

to exploit rice as a food crop, predates upon this crab in the early weeks after transplanting the rice paddies when vegetable food is scarce. Professor Qadri claimed that this crab inflicted great damage to the rice crops, but during 7 years study of rice crop pests in lower Sind the author found no evidence of significant harm to rice crops from crabs.

There is a large family of freshwater crabs belonging to the family Potamidae, some of which have adapted to live in small mountain streams, often at high elevations where the water in winter is frozen for prolonged periods. In north central Baluchistan, with its very cold dry climate, there is hardly any water, either in the form of natural swamps or perennial streams, yet a crab is widespread in the Quetta and Pishin valleys and even on the slopes of Wam and

Philgar. This is *Potamon gedrosianum* (see photo). It is a relatively small but active olive-brown crab which burrows into the banks of small streams, preferably just below water level. Most streams in this region, such as the Pishin-i-Lora, emerge from springs in the higher slopes of bare rocky mountain ranges, only to disappear a few miles further on beneath the soil of the surrounding plain or broad valley. How did this crab reach such places? In one narrow canyon near Wam, inhabited by a pair of Choughs (*Pyrrhocorax pyrrhocorax*) there was plenty of evidence that these crows had learned how to catch the freshwater crabs and include them as an important item of their diet.

Finally in the southern escarpment of the Punjab Salt Range (at Choa Saidan Shah) and in the streams of the southern flanks of

Murree Hills Freshwater Crabs Potamon kooloense (?), or is it something as yet unknown to science —Author



the Murrey hill range, freshwater crab occurs. This is closest in appearance to *Potamon kooloense*, but according to the world authority Dr. Turkey (*in litt.* to author, April 1986), who is now studying specimens from Pakistan, it differs in important anatomical details and appears to be a new species hitherto underscribed. I have found them in the Margalla hills as low as 1500 feet (460 metres) and at Tret, where the effluent from poultry farms has in some localities provided them with a new and rich source of food, but the strangest location was in a tiny streamlet at Burbhan, nearly 7000 feet (2300 metres) above sea level, in a region which is blanketed by snow for 3 or 4 months of every year and more than 1000 miles (1600 kilometres) from the nearest sea.

It is hoped that this note will indicate how little is still known or understood about the life cycle and adaptations of the commoner crabs

found in Pakistan, especially those species adapted to survive inland away from the sea, and that some students of zoology and physiology will be stimulated to conduct more research into their methods of respiration during periods when fresh flowing water is not available.

I wish to thank Dr Michael Turkey of the Natural History Museum, Frankfurt, for kindly identifying freshwater crab specimens, Major Amanullah Khan (Retd.) for help in collecting Murree hills specimens and Nic Van Zalinge of the FAO Coast Fisheries Development Project for kindly providing me better photographs than my own of the Yellow Crossed and Blue Swimming Crabs.

T.J. ROBERTS

"CAE GORS", RHOSCEFNIHIR

NR. PENTRAETH

ANGLESEY GWYNEDD, LL75 8YU

UK

(Concluded)

...Marine fish—contd. from page 15

history (from juvenile to adult) has been recorded in our aquarium, the sea-horse (*Hippocampus kuda*) and many others.

To reduce stress in the transport of live fish from collection site to the aquarium, I have suggested the use of an aerator pump which would run on electric supply from the car's battery (12V, D.C.). This aerator will aerate the water in the plastic pool in which fishes are to be

brought to the aquarium. Plans are afoot to implement this suggestion and when this is done it will go a long way in solving the problem of overcrowding in transport of live fish.

V.N. HEGDE

Asst. Fisheries Development Officer,
Taraporewala Aquarium,
Netaji Subhash Road, Bombay
400002.

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