find any evidence that it predated upon *P. emblica* seeds though it was observed to damage seeds of *Z. mauritiana*.

*P. emblica* appears to be dispersed mainly by deer aided by langur. Further research into this plant-animal interaction is needed to evaluate the effectiveness of these frugivores as dispersers of *P. emblica*. This could be done by quantifying the proportion of fruit-crop removed by each frugivore species and examining the fate of seeds swallowed by deer and hoarded by rodents.

8. Kar Gupta, K., Leaf chemistry and food selection by the common langur (*Presbytis entellus*, Dufresne 1797) in Rajaji National Park, UP India, Saurashtra University, Rajkot, 1991.

**ACKNOWLEDGEMENTS** We thank the Director, Wildlife Institute of India; K. Ullas Karanth and Wildlife Conservation Society – India Programme for funds and Wildlife Institute of India and Uttarakhand Forest Department for providing facilities for this work. We thank Ajith Kumar, Aparajita Dutta, Divya Madappa, Jayashree Prasad, A. J. T. Johnsingh, Meherban, Meghranj Saini, H. N. A. Prasad, Raman Kumar, Ramsharan, Renee Borges, Richard Corlett, Roopali Raghavan, Salvador Manjado, Shomen Mukherjee and Smitha Badrinarayan for help, information and ideas.

Received 18 March 2004; revised accepted 15 June 2004

**SOUMYA PRASAD**

**RAVI CHELLA**

**JAGDISH KRISHNASWAMY**

**S. P. Goyal**

---

**Conserving the breeding habitat of the near threatened Oriental White ibis *Threskiornis melanocephalus***

The nesting colonies of Ciconiiform and Pelecaniform waterbirds, popularly known as heronries or egrets, are spatio-temporal aggregation of nests at favourable locations during the breeding season. A wide variety of waterbirds breed during monsoon, when food resources are abundant. Nesting colonies could be of multiple species composition and varying size. Waterbirds in their nesting colonies defend type-C territories, which are small defended areas around the nest containing no resource other than the breeding site. These biologically active regimes are important due to the presence of a great number of nests and individuals in a limited space and many rare as well as IUCN-listed species. Failure to protect at-risk species is likely to result in an accelerated loss of biodiversity at a regional perspective. Knowledge on the distribution of at-risk species should be a key factor in selecting sites for species conservation. Colonial waterbirds may choose a nesting site after careful assessment of the prevailing safety conditions at the site. Extensive foraging areas are required for breeding Ciconiiforms. In unmanned areas, the nesting colonies are severely attacked by natural predators and late nesters are more susceptible to predation by driving nestlings, the birds thus tend to form nesting colonies near human habitations. The vulnerability of small feeding habitats to anthropogenic alterations and their management problems, and availability of quality feeding habitat in proximity are important aspects governing the general health of the waterbird colonies. Local populations are critically vulnerable to the loss of breeding habitat and nomadic species pose special management and conservation challenges due to the large area they occupy and their unique population dynamics.

Oriental White ibis (*Threskiornis melanoccephalus*) is a near-threatened resident, uncomnon and nomadic Ciconiiform waterbird of the Indian subcontinent, generally frequenting shallow wetland habitats. It roosts and nests in colonies situated in and around wetlands, often in association with other Ciconiiform as well as Pelecaniform waterbirds (Figure 1). The nest of Oriental White ibis is a platform of twigs and sticks, usually unlined and built on tops of bamboo, trees and emergent shrubs. In mixed species colonies, Oriental White ibis tends to form a separate core group and avoids the interspersed nesting pattern of other species of waterbirds. An attempt was made to understand the species composition and conservation priorities of a nesting col-
Figure 1. Oriental White ibis nesting at Panamaram.

Table 1. Number of active nests of Oriental White ibis and other waterbirds in the nesting colony at Panamaram during 2000–03

<table>
<thead>
<tr>
<th>Study period</th>
<th>Oriental White ibis</th>
<th>Other waterbirds</th>
<th>Total</th>
<th>No. of species</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>0</td>
<td>92</td>
<td>92</td>
<td>4</td>
</tr>
<tr>
<td>2001</td>
<td>0</td>
<td>89</td>
<td>89</td>
<td>4</td>
</tr>
<tr>
<td>2002</td>
<td>1</td>
<td>123</td>
<td>124</td>
<td>5</td>
</tr>
<tr>
<td>2003</td>
<td>6</td>
<td>150</td>
<td>156</td>
<td>7</td>
</tr>
</tbody>
</table>

Ony of waterbirds of a riverine island at Panamaram, Wayanad district, Kerala, which is also the first known record of nesting Oriental White ibis in the state. Though Zacharias and Gaston¹⁴ had mentioned a nesting colony of waterbirds at Panamaram they did not record breeding of ibises here. Breeding waterbirds of the colony were identified and documented during the southwest monsoon period of 2000–03. Observations were made from vantage points on either banks of the stream opposite to the nesting island. Canoes were employed for close observations.

Panamaram (76°05’E, 11°45’N) is a rural township in the northeastern part of Wayanad, Kerala, situated 650 m a ms. A small natural island of approx. 0.25 ha area, formed by the bifurcating flow of ‘Panamaram puzha’, a tributary of the river Kabani; is opted by the colonial waterbirds to establish nesting colony. Vegetation of this island is dominated by bamboo (Bambusa sp.) on which waterbirds build their nests and rear nestlings. The nesting site is safely elevated from the level of flooding. Waterbirds showed fidelity to this nesting colony after each consecutive breeding season since 2000. Median egret (Mesophoyx intermedia), Little egret (Egretta garzetta), Night heron (Nycticorax nycticorax) and Pond heron (Ardeola grayii) were present in this colony during 2000–01. In 2002, one pair of breeding Oriental White ibises joined the colony and remained there till the end of the breeding season and successfully raised two juveniles.

Figure 2. Distribution pattern of waterbirds and ibises during 2000–03.

Both members of the breeding pair shared the nest-construction duties. Dry twigs were collected from nearby areas and nest-building was completed by the fourth day of arrival at the nesting colony. Nesting location within the colony was not the same between the two consecutive years of 2002 and 2003. Probably the search for a better location within the colony might have caused the intracolony shift of the nests of Oriental White ibis. Intra-colony parasitism or competition among the inhabitants was not observed even at the peak of the breeding season. Harassment by crows (Corvus sp.) and Brahminy kites (Haliastur indus) was observed, but no loss of adults to the pre-

dators was found. Nocturnal predators are to be investigated separately. The ibises never fed from the stream or its banks. Prior to the hatching of eggs, the parent birds fed at faraway wetlands. Food for the nestlings was procured from nearby areas.

The number of nests in the colony and the species diversity increased in the successive years with a high degree of positive correlation (r = 0.98; Figure 2, Table 1). In addition to the regular nesters, little cormorant (Phalacrocorax niger) and Cattle egret (Bubulcus ibis) were nesting in this colony during 2003.

The average nest height for ibises (7 ± 0.45 m) was more than that of other species (4.65 ± 0.9 m) from the ground level, and could be advantageous in alighting from flight¹⁵. Since Oriental White ibis was a late entrant to the colony, and nests are clustered separately, competition for nesting habitat was not observed.

Key factors involved in selection of nesting site by waterbirds at Panamaram are yet to be investigated in detail. The present nesting site is a natural area uninhabited by human beings and commercially unimportant. The chances for bird–human conflict, as detailed by Balakrishnan and Thomas², are apparently less here. Due to their peculiar breeding requirements and nidification behaviour, ibises prefer nesting colonies in islands¹³. The ability of nomadic waterbirds to adapt to available habitat depends upon the mosaic of peripheral wetlands and persistent colony sites¹⁸. The existing feeding grounds nearby this colony cater to the needs of the breeding waterbirds. The spacing pattern adopted by birds within a colony is the result of various conflicting selection pressures¹⁹. But Oriental White ibis seems to exert least competition pressure upon other nesters of the colony, since it is a late nester and in the subsequent breeding seasons the total number of nests as well as species
diversity increased in the colony. The waterbird nesting colony of Panamaram is of great significance, being the only known record of the IUCN listed Oriental White ibis nesting and should be prioritized for breeding habitat conservation. Habitat management should include active protection and manipulation of colony sites and feeding grounds with emphasis on species-specific investigations. Conservation and close monitoring of nesting sites like Panamaram are recommended, since breeding members of the local deme of nomadic species like the Oriental White ibis will be clumped at the nesting site during the breeding season and population estimation becomes cost effective.


ACKNOWLEDGEMENTS. We are grateful to the Council of Scientific and Industrial Research, New Delhi, for providing financial assistance through their Senior Research Fellowship (SRF-NET) programme. We thank the volunteer residents of the study area for help rendered during the study. We thank the anonymous referee for constructive comments on an earlier version of this manuscript.

Received 17 May 2004; revised accepted 7 July 2004

MANOJ BALAKRISHNAN*
SABU K. THOMAS

P.G. & Research Department of Zoology,
St. Joseph’s College, Devagiri,
Calicut 673 008, India
*For correspondence.
e-mail: greyff@hotmail.com