BVG Trust

J. Sci. Trans. Environ. Technov. 2007, 1(2): 77 - 83

Scientific Transactions in Environment and Technovation

# Nest-site selection by colonial waterbirds at Vedanthangal Waterbird Sanctuary, Tamil Nadu, India

**C. Venkatraman***

Zoological Survey of India, Marine Biological Station, 130, Santhome High Road, Chennai-600 028.

## Abstract

Nest-site selection of Little Cormorant (*Phalacrocorax niger*), Little Egret (*Egretta garzetta*), Cattle Egret (*Bubulcus ibis*), Grey Heron (*Ardea cinerea*), Asian Open-bill-Stork (*Anastomus oscitans*), Eurasion Spoonbill (*Platalea leucorodia*), Black-crowned Night Heron (*Nycticorax nycticorax*) and Oriental White Ibis (*Threskiornis melanocephalus*) was studied at Vedanthangal waterbird Sanctuary (VBS), Tamil Nadu, India. A total of 242 nests were identified. Data were collected on the nest-site variables *viz.,* nest plant species, total number of nests on the tree, nest height from the water level and ground level, gbh of the tree species, canopy width, bole length and distance to the nearest water spread area for each bird species after successful fledging. All the above parameters were also collected for randomly selected trees without nests. Total number of nests on a tree was highly correlated with tree height, tree girth at breast height (GBH) and canopy area of the tree. In general, these colonial waterbirds selected age-old and thick canopied trees regardless of plant species in the Vedanthangal lake.

**Keywords**: Vedanthangal, nest-site selection, cormorant, egrets, herons, openbill stork, spoonbill, white ibis.

## INTRODUCTION

Colonial nesting in water and other sea birds is widespread, but it is relatively rare in other birds (Lack, 1966). About 13% of the birds in the world are colonial nesters. This is probably because they use the safe nesting sites provided by islands and cliffs (Lack, 1967).

Wetland is a unique habitat type and thus many bird species evolutionarily modify their morphological and perceptual traits to exploit particularly this habitat. However, throughout the world, wetlands are the least protected natural ecosystems (Dugan, 1990) and have been threatened by urban, industrial and agricultural expansions with a consequent reduction in the population of waterbirds. For conservation and management of a wetlands a through understanding of the ecological requirements of the waterbirds exploiting it is required. In this regard, knowledge of nest-site selection is a crucial factor for conserving the species of birds, that come to wetlands for breeding.

Selection of breeding habitat by birds probably takes place on several levels (Burger, 1985). Among colonial birds, nest site selection at two major levels is frequently studied (Birkhead and Harries, 1985). Social and physiognomic factors have been reported to affect nest-site selection in temperate marshland birds (Burger, 1985). Nest and nest-site provide protection for developing young from predators and adverse climatic conditions during the breeding season, the most vulnerable period in a birds life cycle. However, very few studies on nest-site selection of birds especially relating to heronries are available in India (Singha *et al.,* 2002; Ishtiaq *et al.,* 2004).

*Corresponding Author
email: *cvramanmbs@yahoo.com*

The Vedanthangal Waterbird Sanctuary (VBS), Tamil Nadu, South India is known for its attraction to several colonial bird species for centuries. These birds arrive at this lake in the winter season (October - March) of every year in enormous numbers. They continue to nest in this lake even though there have long been habitat disturbances and changes in climatic factors. So it is imperative to know which factors influence the nest site selection of water birds in this sanctuary. The present study discusses the nest-site selection of Little Cormorant (*Phalacrocorax niger*), Little Egret (*Egretta garzetta*), Cattle Egret (*Bubulcus ibis*), Grey Heron (*Ardea cinerea*), Asian Openbill-Stork (*Anastomus oscitans*), Eurasian Spoonbill (*Platalea leucorodia*), Black-crowned Night Heron (*Nycticorax nycticorax*) and Oriental White Ibis (*Threskiornis melanocephalus*) at VBS.

## STUDY AREA

Vedanthangal Waterbird Sanctuary (VBS) is one of the oldest sanctuaries in South India attracting birds for last two centuries. Vedanthangal is a small village located (12′ $32^0$ N and 79′ $52^0$ E) in the North-Western part of the Madhuranthagam taluk in Chengalpet district of Tamil Nadu (Figures 1 & 2). It is 86 km South-West of Chennai and is situated 122 m above sea level and about 50 $km^3$ inland from the Bay of Bengal. In this village there is a lake supplying water for 250 acres of agricultural land having an *ayacut* area of about 74 acres. On the western and southern sides of the lake there is a long bund which impounds water. Northern and eastern sides of the lake are sloppy and extend in to agricultural fields. Every year the lake is filled during north-east monsoon (October-December) and it is almost dry during summer (April-June). Input of water in to the tank is through four small canals. Maximum depth of

the lake is 5m near the bund. The countryside surrounding Vedanthangal lake is flat, comprising primarily of rocky plains. There are frequent low-ridged denuded small hillocks around the lake. Common herbaceous plants of the lake include *Chrozophora rottleri Bartingtonia acutongula Cleome chelidonii* and *Phyla nodiflora*, and *Acacia nilotica* and *Alangium salviifolium* are the common trees along the bunds. This region receives an average rainfall of 1000 mm per annum mostly from the north-east monsoon. The temperature varies from $25^0$ C to $40^0$ C in year.

## METHODS

A boat was used to cover the entire lake to search for nests. When a nest is located, name of the bird species nested and name of the tree species used for nesting were noted and water level at nest-tree trunk was marked with paint. Other variables, namely, total number of nests on the tree, nest height from the water level and ground level, gbh, canopy width and bole height (the height from ground to where the branch started) of the tree species and distance to the nearest water spread area were collected after successful fledging in a nest. The criteria employed for determining nest-site selection is similar to already established nest site selection studies (e.g., Bechard *et al.*, 1990; Hullsieg and Becker, 1990). Maximum care was taken not to disturb nesting activities of birds while data collection.

### Statistical Analysis

Pearson correlation co-efficient was calculated to find out the relationship between the total number of nests in a tree and other parameters. The first three highly correlated parameters were again entered into multiple stepwise regressions with the total number of nests as the dependent factor and the selected parameters as independent factors. Principal Component Analysis (PCA) was performed on the nesting data to determine the important factor(s) responsible for the nest site selection of waterbirds. Students t-test was used to test significance between nesting and non nesting trees of waterbirds. All analyses were performed using SPSS 6.1 software (Norusis, 1990).

## RESULTS

### Nest-site characteristics of waterbirds

A total of 242 nests of eight bird species namely Little Cormorant (30), Little Egret (30), Cattle Egret (30), Grey Heron (31), Asian Openbill Stork (31), Eurasian Spoonbill (30), Black-crowned Night-Heron (30), and Oriental White Ibis (30) were located in Vedanthangal Waterbird Sanctuary. All the nests were found either on *Acacia nilotica* or *Barringtonia acutangula.* A total of 31 nests were counted in a single *Acacia nilotica* tree with a canopy width of 15.17m.

Among the birds, comparatively, Black-crowned Night Heron used shorter trees (3.75 m ±1.43 m) while Cattle Egret preferred taller trees (7.11m ±1.17m) for nesting (Table 1). Eurasian Spoonbill preferred comparatively younger trees (i.e., with lowest mean dbh of 0.5 m ± 0.16 m) while Asian Openbill-Stork mostly selected matured trees (i.e., with the highest dbh of 1.68 m ± 6.67 m) for nesting. Cattle Egret showed a high level of preference towards thick canopied trees (i.e., with high canopy width of 6.17 m ± 3.27 m and height of 6.09 m ± 1.33 m) while the nests of Black-crowned Night Heron were found on lesser canopied trees (with canopy width of 3.25 m ± 2.64 m & canopy height of 2.83 m ± 1.52 m). Nests of Asian Openbill Stork (1.34 m ± 0.57 m) and Eurasian Spoonbill (1.25 m ± 0.56 m) were found on trees with taller boles while the nests of Black-crowned Night Heron and Little Egret were on trees with shorter boles. In general, nests of Cattle Egret, Little Egret, Grey Heron and Little Cormorant were placed higher from the ground and water levels while Oriental White ibis, Asian Openbill Stork, Eurasian Spoonbill and Black-crowend Night Heron constructed their nests close to water and ground levels (Table 1). In general, nests of all the height preferring bird species were found close to the bank of the lake (close to water and ground level) while nests of other bird species were found in the interior of the lake.

Among the nest-tree variables, canopy width and tree dbh showed positive correlations ($r = 0.5312$ and $0.5341$, respectively; $P<0.001$) with the number of nests found in a tree (Table 2). The stepwise multiple regression procedures delineated tree height and canopy width as crucial factors that influenced most the nest-site selection of waterbirds in Vedanthangal (Table 3).

### Nest-site selection by waterbirds

The PCA resulted in the extraction of three main components (Table 4). The first component (PC-I) which accounted for 51.447% of the total variance, correlated highly with tree height, nest height from the water level, nest height from the ground level, canopy height and distance to the nearest water spread area. All these factors are directly related to tree structure; hence the first principal component can be considered an important component with regard to waterbirds, nest site selection. The second principal component (PC-II) accounted for an additional 14.968% of the total variance correlating highly with bole height of the tree in the nest-sites. The third principal component (PC-III) accounted for 12.606% of the total variance and correlated highly with tree gbh. Together, the first three principal components account for 79.021% of total variations, and thus represent most of the realized nesting niche space of the waterbirds (Table 4).

**Table 1.** Nest-site characteristics of waterbirds in the Vedanthangal sanctuary (values are $\bar{x} \pm$ S.D.)

| Nest-site variables | Bird species | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Little Cormorant | Little Egret | Cattle Egret | Grey Heron | Asian Openbill Stork | Eurasian Spoonbill | Black-crowned Night Heron | Oriental White Ibis |
| Tree height (m) | 6.88±1.19 | 6.96±1.24 | 7.11±1.17 | 6.95±0.91 | 4.71±0.97 | 4.86 ±0.85 | 3.75 ±1.43 | 5.25 ±1.2 |
| Tree dbh (m) | 0.78 ±0.37 | 0.72±0.29 | 0.73±0.26 | 0.76±0.23 | 1.68±6.67 | 0.50±0.16 | 0.91±3.23 | 0.56 ±0.23 |
| Canopy height (m) | 5.86 ±1.21 | 5.98±1.19 | 6.09±1.33 | 5.90±0.94 | 3.42±1.05 | 3.70±1.01 | 2.83±1.52 | 4.12 ±1.25 |
| Canopy width (m) | 6.60 ±3.90 | 6.02±3.47 | 6.17±3.27 | 6.48±3.19 | 3.95±1.49 | 4.48±1.25 | 3.25±2.64 | 7.86 ±4.28 |
| Bole height (m) | 1.03 ±0.35 | 1.00±0.44 | 1.04±0.49 | 1.03±0.67 | 1.34±0.57 | 1.25±0.56 | 0.91±0.41 | 1.14 ±0.54 |
| Nest height from the ground (m) | 5.79 ±1.34 | 4.74±1.61 | 4.62±1.37 | 5.91±1.05 | 3.50±0.81 | 3.12±0.39 | 2.68±0.69 | 3.79 ±1.09 |
| Nest height from the water level (m) | 4.81 ±1.30 | 3.75±1.14 | 3.67±1.30 | 4.63±1.19 | 1.24±0.83 | 0.79±0.48 | 0.78±1.04 | 1.63 ±0.77 |
| Distance to nearest water spread area (m) | 150.00±0.00 | 142.00±23.00 | 143.00±21.70 | 120.00±24.60 | 200.00±0.00 | 200.00±0.00 | 195.00±15.20 | 200.00±0.00 |

**Table 2.** Correlations between total numbers of nests per tree with nest tree parameters

| Parameters | Tree height | Tree GBH | Canopy length | Canopy width | Total number of nests per tree |
|---|---|---|---|---|---|
| Tree Height | 1.000 | | | | |
| Tree GBH | **0.3163** | 1.000 | | | |
| Canopy height | 0.357 | -0.0211 | 1.000 | | |
| Canopy width | **0.2828** | **0.9433** | -0.0282 | 1.000 | |
| Total number of nests per tree | 0.1486 | **0.5312** | -0.0082 | **0.5341** | 1.000 |

Significant correlation values were indicated by bold letters and are underlined ($P < 0.001$)

**Table 3.** Multiple regression equation predicting waterbird nesting (total number of nests per tree) at Vedanthangal waterbird sanctuary based on tree parameters.

| Dependent Variable | Regression equation | $R^2$ | p |
|---|---|---|---|
| Total number of nests per tree | -2.86 + 1.24 Tree height + 0.34 Canopy width | 0.30 | 0.000 |

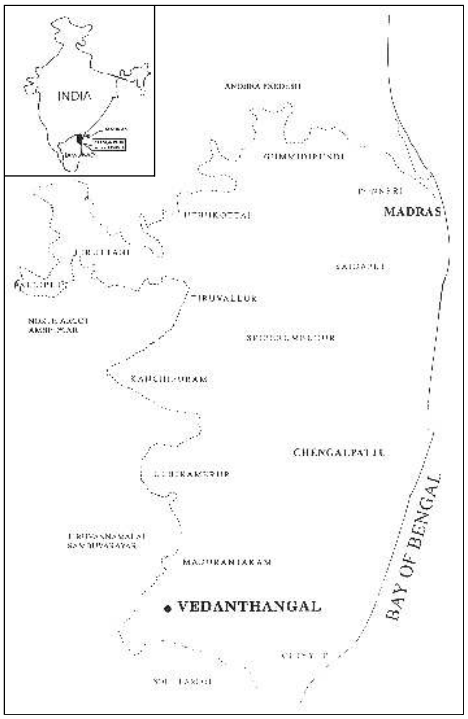


**Figure 1.** Map showing the location of Vedanthangal Waterbird Sanctuary

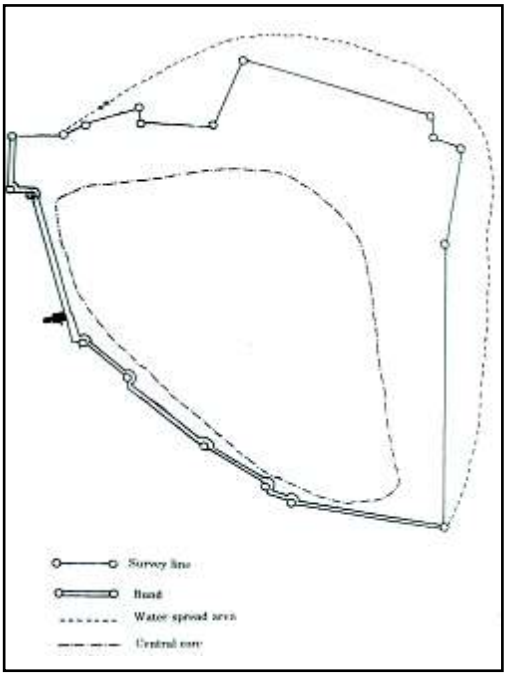


**Figure 2.** Sketch map of Vedanthanal Waterbird Sanctuary

**Table 4.** Principal Components derived from the nest-site variables of waterbirds at Vedanthangal bird Sanctuary

| Variables | Principal Components | | |
|---|---|---|---|
| | I | II | III |
| Tree height | 0.937 | 0.104 | 0.061 |
| Nest height from the water level | 0.935 | 0.047 | -0.026 |
| Nest height from the ground level | 0.912 | -0.001 | 0.020 |
| Canopy height | 0.884 | 0.358 | 0.034 |
| Distance to the nearest water spread area | -0.741 | 0.033 | 0.110 |
| Bole height | 0.053 | -0.912 | 0.085 |
| Tree gbh | -0.039 | -0.014 | 0.972 |
| Canopy width | 0.441 | 0.472 | 0.194 |
| Explained variance (%) | 51.447 | 14.968 | 12.606 |
| Cumulative percent variation explained | 51.447 | 66.415 | 79.021 |

**Note:** Underlined values represent high correlations with the respective principal components

**Table 5.** Comparison of characteristics of nesting trees of waterbirds with non-nesting trees at Vedanthangal Waterbird Sanctuary

| Tree variables | Nesting trees | | Non-nesting trees | |
|---|---|---|---|---|
| | Mean ± SD | Range | Mean ± SD | Range |
| Tree height* (m) | 5.38 ± 1.65 | 2.12 – 9.07 | 5.47 ± 0.82 | 3.51 – 7.11 |
| Tree Gbh (m) | 0.75 ± 2.86 | 0.12 – 1.83 | 0.55 ± 0.39 | 0.23 – 2.16 |
| Canopy height (m) | 4.29 ± 1.69 | 1.64 – 7.69 | 4.57 ± 0.87 | 3.41 – 6.12 |
| Canopy width** (m) | 5.27 ± 3.44 | 1.07 – 15.17 | 4.24 ± 1.10 | 2.55 – 6.51 |

* Significant difference at $P<0.05$ level (t-test)

** Significant difference at $P<0.01$ level (t-test)

**Differences between nesting and non-nesting trees of waterbirds**

The nesting trees of waterbirds had comparatively higher gbh and canopy width than non-nesting trees; however, the nesting trees had lesser canopy height and tree height (Table 5).

## DISCUSSION

Opportunities for foraging, breeding, nesting and successful rising of young chicks are always high and rich at Vedanthangal and thus several breeding and non-breeding migratory birds of different species congregate each year in a compact area of the lake. The selection of nest site is an important task in colonial breeders. They have different strategies for avoiding risk of predation and thus selection of safe nesting sites is important for successful breeding (Frederick and Collopy 1989). All the breeding birds select any one of the two plant species, namely, *Acacia nilotica* or *Barringtonia acutangula* for nesting in the lake. As only two tree species are available, no preference was apparent among the bird species in the selection of plant species for nesting. As such, the major factor for selecting the nest sites was found to be tree height and canopy width (vide table 3) i.e., all the trees selected for nesting were tall with large GBH and canopy spreads which provided protection from predation.

Water level was found to be another significant factor in determining the nest site selection. One pair of Painted Stork was observed attempting to nest in the central part of the lake. As soon as water was drained for agriculture purpose, the pair abandoned the nest (Venkatraman, 1996a). Presence of water around the nesting tree reduces risk of predation by ground predators like mangoose. It also reduces the accessibility to locals who frequently visit the lake for cattle grazing, wood cutting and fishing. Krapu *et al*.(1979) also found that nesting success was high during wet periods, when a water barrier is present but this diminished during other periods.

Habitat selection appears to be a hierarchical procedure with landscape features playing a crucial role at a regional scale, and vegetation quality at the site (Wiens and Rotenberry 1981). In a finer scale, Martin and Roper (1988) highlighted the importance of nest cover in determining the nest-site selection of birds while canopy closeness was highlighted by Sakai and Noon (1991). Similarly in the present study also, structural characteristics of nest-tree species were found to be crucial in the nest-site selection of birds at Vedanthangal. In particular, matured trees (thick canopied and with broader girth class) had more nests. The matured trees are suitable for nest placement as their size and geometry of branching produces an acceptable fork/place within the preferred vertical range of the bird species to place their nest. Further more, matured trees provide greater space and nest-site availability for the birds that are colonial by nature. Moreover, apart from colonial nesting, nest on a tree that contains many potential nests may also be a strategy to reduce the predation as suggested by Martin (1988). So, it may be concluded that nest-site selection of Little Egret, Cattle egret, White ibis, Little Cormorant, Asian Openbill Stork, Grey Heron, Black-crowned Night Heron and Eurasian Spoonbill are shaped by the age-old and thick canopied trees regardless of plant species in Vedanthangal lake.

**Suggestions for management**

The Vedanthangal bird sanctuary is mainly dependant on water resources from four small temporary canals. Of them, the Valayaputtur canal contributes more water. But this happens only when the Valayaputtur

lake gets filled up and overflows. As such it needs heavy rains to feed the lake fully. The people of Valayaputtur are reluctant normally to provide water to VBS, at times of poor rains during many years in the past. This sanctuary lake was filled only partially at those times. This hampers the arrival and roosting of birds. The farmers of Vedanthangal and other farmers in the adjacent areas divert the water illegally to their fields. The Tamil nadu Forest Department has to take measures to prevent this and to get water from Valayaputtur lake by convincing the villagers. The results of study of Venkatraman and Muthukrishnan (1993), Venkatraman, (1996a and b), Venkatraman *et al.* (2007) clearly show that water level is crucial factor determining waterbird populations. Hence, the water level has to be maintained full up to the end of the breeding seasonof birds insiting this sanctuary. Maintenance work should be done in all the canals and the lake periodically, in order to allow free flow of water.

Cattle grazing, fishing, hunting and trapping of waterbirds are other major problems in VBS. They should be totally banned. Number of forest guards in this sanctuary area is not sufficient. Employing more guards is one of the ways to overcome many of these problems. Patrolling force also has to be maintained in surrounding places to check the illegal hunting. Educational and awareness programme should be conducted with the help of NGO's as people's participation is vital in the conservation of this lake.

## ACKNOWLEDGEMENTS

This paper is part of the Ph. D. thesis of the author (CV). The author (CV) is highly thankful to the Chief Wildlife Warden, Wildlife Warden, Chennai and Staff of VBS, Tamil Nadu Forest Department, for their permission to carryout this work in VBS.

## REFERENCES

Alatalo, R.V. 1982. Multidimensional foraging niche organization of foliage-gleaning birds in northern Finland. *Ornis Scand*. 13: 56-71.

Bechard, M.J., Knight, R.L, Smith, D.G. and Fitzner, R.E. 1990. Nest sites and habitat of sympatric Hawks (*Buteo* spp.) in Washington. *J. Field Ornithol*., 61: 159-170.

Birkhead, T. and Harries, M.P. 1985. Ecological adaptations for breeding in the atlantic Alcidae. *In:* Nettleship, D.N, Birkhead, T.R. (Eds.), *The Atlantic Alcidae*, Academic Press, New York, P. 205-231.

Burger, J. 1985. Habitat selection in temperate marsh-nesting birds. *In:* Cody, M.L. (Ed.), *Habitat selection in birds*. Academic Press, New York, P. 253-281.

Cody, L. 1985. Habitat selection in the Sylviine Warblers of Western Europe and North America. *In: Habitat selection in birds.* M.L.Cody (Ed.), P. 86-129. Academic Press, New York.

Dugan, P.J. (Ed.). 1990. *Wetland Conservation: A review of current issues and required action*. IUCN-The World Conservation Union, Gland, Switzerland.

Frederick, P.C. and Collopy, M.W. 1989. The role of predation in determining reproductive success of colonially nesting wading birds in the Florida Everglades. *Condor,* 91: 860-867.

Hogstad, O. 1987. It is expensive to be dominant. *Auk.,* 104: 333-336.

Hullsieg, C. and Becker, D.M. 1990. Nest-site habitat selected by Merlins in southeastern Montana. *Condor.,* 92: 688-694.

Ishtiaq, F., Rahmani, A.R., Javed, S., and Coulter, M.C. 2004. Nest-site characteristics of Black-necked Stork (*Ephippiorhynchus asiaticus*) and White-necked Stork (*Ciconia episcopus*) in Keoladeo national park, Rajasthan, India. *J. Bombay. Nat. Hist. Soc.,* 101: 90-95.

Krapu, G.L., Talent, L.G. and Dwyer, T.J. 1979. Marsh nesting by Mallards. *Wildlife Soc. B.,* 7: 104-110.

Lack, D. 1966. *Population studies of birds*, Clarendon Press, London.

Lack, D. 1967. Interrelationships in breeding adaptations as shown by marine birds. *Proc. Int. Ornithol. Congr.*, 14: 3-42.

Martin, T.E. 1988. Process organizing open-nesting bird assemblages: competition or nest predation? *Evol. Ecol.,* 2: 37-50.

Martin, T.E. and Roper, J.J. 1988. Nest predation and nest site selection of a western population of the Hermit Thrush. *Condor.,* 90: 51-57.

Morse, D.H. 1978. Structure and foraging patterns of tit flocks in an English woodland. *Ibis*, 120: 298-312.

Norusis, M.J. 1990. SPSS/PC+: advanced statistics 4.0. SPSS Inc., Chicago.

Rolando, A. and Robotti, C.A. 1985. Foraging niches of tits and associated species in north-western Italy. *Boll. Zool.,* 52: 281-297.

Sakai, H.F. and Noon, B.R. 1991. Nest-site characteristics of Hammond's and pacific Slope Flycatchers in Northwestern California. *Condor,* 93: 563-574.

Singha, H., Rahmani, A.R., Coulter, M.C. and Javed, S. 2002. Nesting Ecology of the Greater Adjutant Stork in Assam, India. *Waterbirds,* 25: 214-220.

Szekely, T. 1985. Foraging structure of the foliage-gleaning and bark-foraging guild in winter and spring. *Proc. Fifth Nordic Ornithol. Congr.*, 140-146.

Venkatraman, C. 1996a. Studies on the colonial waterbirds and the characteristics of the lake of the Vedanthangal Bird Sanctuary, Madras, Tamil Nadu. Ph.D thesis submitted to University of Madras, India.

Venkatraman, C. 1996b. Human disturbance – A major factor for nest desertion. *Newsletter for Birdwatchers.* 36: 33-34.

Venkatraman, C. and Muthukrishnan, S. 1993. Density of waterbirds at Vedanthangal waterbird Sanctuary, Tamil Nadu. P.55-60. *In*: *Bird conservation strategies. Ninetees and beyond.* (Eds.) Verghese, A., Sridhar, S. and Chakravarthy, A.K. Ornithological society of India, Bangalore.

Venkatraman, C., Thiyagesan, K., Nagarajan, R. and Jothinayagam, J.T. 2007. Factors influencing waterbird populations at Vedanthangal bird Sanctuary, Tamil Nadu, India. *In. Wildlife Biodiversity Conservation in India*. Proceedings of the National seminar on "*Wildlife Biodiversity Conservation*" conducted by Dept. of Ecology and Environmental sciences, Pondicherry University, Pondicherry, on October 13-15th, 2006.

Wiens, J.A. 1989. *The ecology of bird communities*. Vol. 172. Cambridge University Press, Cambridge.

Wiens, J.A. and Rotenberry, J.T. 1981. Habitat associations and community structure of birds in shrub steppe environments. *Ecol. Monogr*., 51: 21-41.