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Influence of Narmada Water Inundation on the Duck Populations of Wadhvana Irrigation Reservoir.

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ABSTRACT

Human Development, from nomadism to settlement has brought with it the development of agricultural practices and constructions of water reservoirs, often inundated with water from some major reservoirs. These manmade water bodies have developed into unique ecosystem in them. With the initiation of Ramsar convention (1971) followed by the waterfowl counts from and the Important Bird Area programme, importance of Birds as indicator of health is further recognized. Even after declaring 446 wetlands of India as IBA, more than 100 wetlands are expected to be included in the revised list. One such site is Wadhvana irrigation reservoir, near Vadodara (Gujarat). The duck populations in specified area were surveyed yearly in Mid Winter Water Fowl Census. The ducks are divided into four groups: 1. larger ducks, 2 – diving ducks, 3 marsh ducks, 4 Resident ducks.

On the basis of variations in density, species richness and diversity indices, the 13-year data have revealed the fact that the Narmada water inundation has increased both the diversity and the density of the ducks. Moreover, The population of comb duck (*Sarkidiornis melanotos*) has shown a highly significant increase exceeding the 1% population level of IBA /Ramsar criteria which makes the wetland to be an Important Bird Area. With other species of birds the site also bears a potential to be declared as an Important Bird Area.

Keywords: Narmada Inundation, Semi arid Zone, Anatid Population.

INTRODUCTION

With development of human civilization, when man left the nomadic life and started settlements near the riverbanks, he initiated agricultural practices. These were followed by constructions of smaller water reservoirs, and then the mega reservoirs which started feeding the smaller reservoirs, giving rise to the formation of perennial water bodies as well as temporary wetlands.

Wetlands are considered to be the second most productive ecosystem next to the Tropical rain forests (Ramchandran *et al.*, 2002). Ecologically wetlands are patchy ecosystems within the terrestrial landscape (Brown and Dinsmore, 1986). Moreover, in drier areas of the world; sometime major long-distance diversions of water have taken place in order to provide water for agriculture use, to achieve flood control and to generate hydroelectric power. These diversions start supporting biodiversity including waterfowls. According to Owen and Black (1990) though these human actions have positive effects at global scale, it has also led to the fragmentation and loss of area that negatively affect the fauna, specially the water fowl. However, wetlands are significantly altered, either directly or indirectly, because of several activities like agriculture, sewage treatment, hydro electric power station, etc. carried out by human beings; (Milder and Moyle, 1992).

With the initiation of the Ramsar convention the waterfowls are given due attention and importance, and considered as major criteria to categorize the wetlands as Internationally or

Nationally important or as Important Bird Areas (IBA). (http://www.ramsar.org/key_criteria.html). The waterfowls are useful as health indicators of wetlands as they represent wide array of feeding strategies. Standardized methodologies are also available for the monitoring of these birds. (Adamus *et al.*, 1991) The bird population parameters such as species richness, relative density and diversity of birds are frequently used as indicators of habitat quality (Nilsson & Nilsson, 1978; Weller, 1978; Sampath & Krishnamoorthy, 1990; Nagarajan & Thiyagesan, 1996). The Waterfowl especially the ducks are given due importance since ancient time wherein they either served as domestic birds or they were used as the indicators of the biological system (Moser *et al.*, 1993).

With the initiation of Asian midwinter waterfowl census many small and large water bodies are surveyed regularly for the census of local and migratory birds. One such water body is an irrigation reservoir located near village Wadhvana (22° 11'N, 73° 29'), Taluka Dabhoi of Vadodara district in central Gujarat. In recent years, inundation of this reservoir with Narmada water has brought about significant change in the composition of avifauna of this water-body. The reservoir is being visited every year since 1995 for mid winter waterfowl census. The observations of past midwinter waterfowl census shows that the reservoir supports thousands of waterfowls and has a potential to be declared as IBA or even a Ramsar site.

STUDY AREA

Wadhvana is irrigation Reservoir (WIR) that is about 50 kms. from Vadodara (Fig. 1) and was constructed about 100 years ago in the year of 1909-1910 by Shrimant Maharaja Sir Sayajirao Gaekwad III of erstwhile state of Baroda, with the purpose of providing water to the agricultural fields. The area falls in Semi Arid Zone of central Gujarat and the average rainfall received by the area is comparatively less and fluctuating (with minimum of about 341mm in the year 1999 and maximum of 1986mm in the

year 2005) (Fig 2). After the construction of the famous Sardar Sarovar dam on Narmada River in Central Gujarat, many smaller irrigation dams in the area are regularly inundated with Narmada water which leads to the water logging in the reservoir. This attracts huge aggregations of migratory as well as resident birds. Wadhvana irrigation reservoir is one such place. The site is inundated with the Narmada River water and the effects of these inundations on the Avifauna (specially the Anatidae) and the wetland are discussed in the present paper.

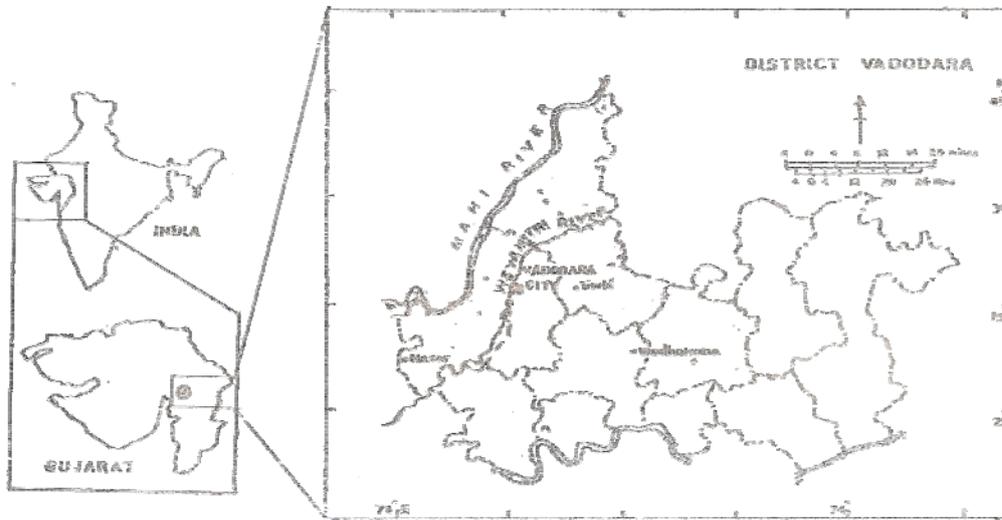


Figure: 1 Map showing the study area.

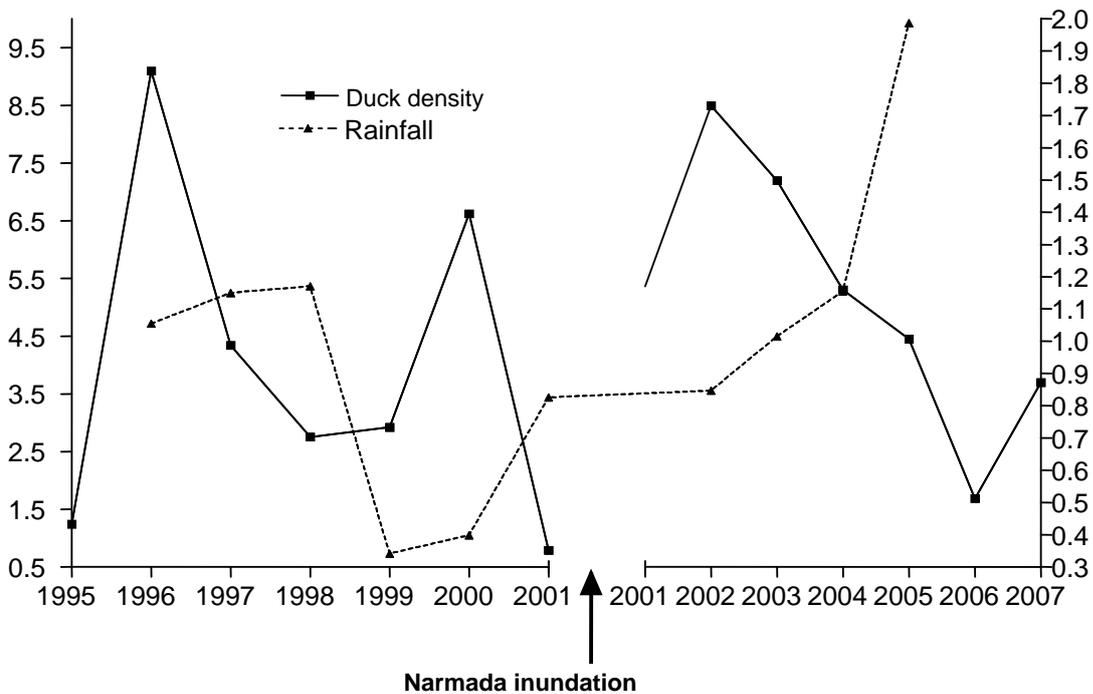


Figure 2: Variation in species density and rainfall from 1995 to 2007 at wadhvana irrigation reservoir

METHODS

The area is visited every year for mid winter waterfowl census since 1995. In the initial years only the West Side was visited while in latter years the whole wetland was surveyed for the bird count. Waterfowl census is carried out during each visit. The birds are identified using standard books (Ali and Ripley, 1983; Grimmit *et al.*, 2001; Sonobe and Usui, 1993). For the convenience of analysis, ducks are divided into 4 groups depending on whether migratory or not and also on the basis of feeding habits. (Snobe and Usui, 1993). These groups are - **I.** Larger ducks: the Geese (Grey lag geese *Anser anser*) and the Shell ducks (Rudy shell duck – *Tedorna ferruginea*) which are regularly seen in water as well as grazing out on the land near water. **II** - Diving ducks: mainly the pochards (Common Pochard -*Aythya ferina*, Ferruginous Pochard-*Aythya nyroca*, Tufted Pochard- *Aythya fuligula*). **III** Dabbling ducks or the Marsh ducks: the Northern Shoveler (*Anas clypeata*), Northern Pintail (*Anas acuta*), Common Teal (*Anas crecca*), Garganey (*Anas querquedula*) and Eurasian Wegion (*Anas penelope*). **IV** - Resident species; Lesser whistling teal (*Dendrocygna javanica*), Spotbill duck (*Anas poecilorhyncha*), Cotton Teal (*Nettapus coromandelianus*) and Comb duck (*Sarkidiornis melanotos*). Shannon weaver indices (H'), evenness (E), species Richness (R) and the density is calculated for each visit (Rogers, 1991). The data is statistically analyzed with the help of Prism 3 soft ware.

RESULTS AND DISCUSSION

Extreme fluctuations in the water levels of irrigation reservoir are known to occur and their water regimes are determined by seasonal agricultural demand for irrigation. (Dimalexis and Pyrovetsi, 1997). Wadhwana falls in the semiarid Zone of India which depends on the monsoon type of climate. The area frequently faces drought like conditions too. This results into regular fluctuations in the water levels of all reservoirs; with filled to full capacity during monsoon and full dryness to semi dryness during summer. These fluctuations increase and decrease the area of wetland, further influencing alterations in the availability of habitat which finally influences the variation in the diversity of water dependent birds (Sillen and Solbreck, 1977; Brown and Dinsmore, 1986; Opdam, 1991; Andren 1994; Turner, 1996; Paracellos, 2006). The changes/reduction in water level can influence the population size of many species especially ducks due to the alterations in the prey base (Gosselink, *et al.*, 1994; Hart and Newman 1995; Doherty *et al.*, 2000).

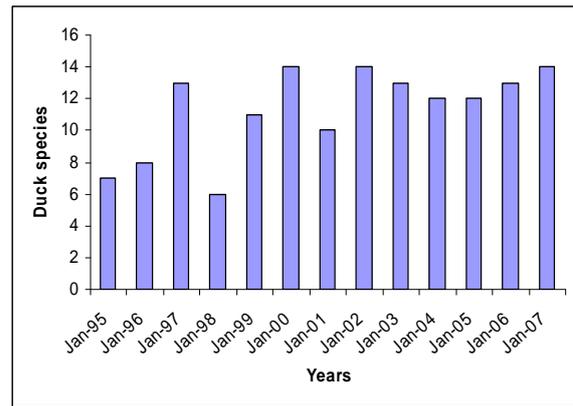


Figure 3: Variation in the species richness from 1995 to 2007 at Wadhwana irrigation reservoir.

In recent years at Wadhwana, the hydro period is maintained artificially by the regulation of the inflow and the outflow. The water spread is maintained for longer duration due to Narmada inundation and water is present throughout the year. The duck density, over the period of 13 years has increased in years after Narmada inundation (Fig 2). Exceptionally low density was noted in the year 2001, *i.e.* in the winter succeeding a poor monsoon of the years 1999 (341mm) as well as 2000 (398 mm) (Fig 2) which resulted in to low water levels. The bird density has been reported to differ in the wetlands at different time because of changes in lake-levels (Douglas *et al.*, 2002). In relation to the duck density the species richness was also low in the year 2001, but it was lowest in 1998 (*i.e.* prior to Narmada water inundation) fig.3. This indicates that more species started visiting the area after Narmada inundation. The reservoir is also used for fish cultivation and thus has developed in to a rich ecosystem in its own. Presence of water in the reservoir for longer duration, results in food abundance and also less competition which in turn results in high duck diversity (Mckinney, 2006). Because of the favourable conditions at WIR some rare visitors have also been reported (Red Crested Pochard *Rhodonessa rufina* – 2007 and Barheaded geese *Ansar indicus* 2006 & 07). Out of 27 species of ducks reported in India (Ali and Ripley, 1983) and 28 in Gujarat (Parasharya., *et al* 2004) 19 have been observed at Wadhwana irrigation reservoir.

Over the period of 13 years, the evenness fluctuated during peak migratory season from minimum 0.3 to maximum 0.7 (mean 0.54 ± 0.23) (Fig. 4). The Ducks are more evenly distributed when the species richness is low and vice versa as less evenly distributed when the species richness and the density both are high. Shannon wiener index fluctuated between minimum 0.54 January 2005 to maximum of 1.9 in January 1999 (Fig. 4.) Being the grazers the Group 1 ducks (Grey Lag Geese GLG and Ruddy Shell Duck RSD) are seen not only in the grasses in the shallow waters but frequently observed

in the agricultural fields around the reservoir. An interesting observation emerges from Fig. 5. The GLG shows a regular hike in the population every 4th year at Wadhvana. Significant increase has been observed in the number of GLG and RSD in the month of January after Narmada inundation (year 2001). The rare grazing ducks also include the Bar headed Geese (*Anser indicus*) which made their appearance (7 in No) in the December 2005. Prior to the Narmada inundation this species was not observed in the area.

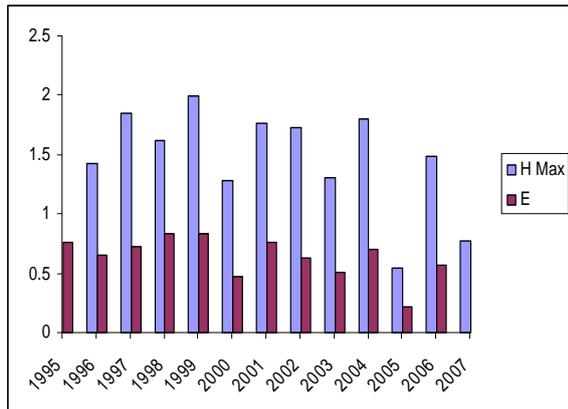


Figure 4 : Variation in the Shannon weiner and Evenness from 1995 to 2007 at Wadhvana irrigation reservoir.

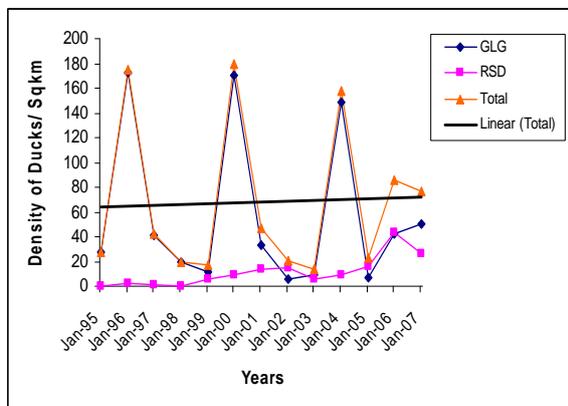


Figure 5: Variation in the ducks of Group 1(Grazers) from 1995 to 2007 at Wadhvana irrigation reservoir.

Group: 2 Pochards, the diving ducks, are known to feed at a greater depth, (Green, 1998) and hence prefer deep water to shallow water. This is apparent from Fig 6 wherein the population of Pochards is highest in the year 1999, which was a succeeding migratory season after a good rainfall (monsoon 1998) which had filled the reservoir completely, making it favourable habitat for Pochards. The rainfall in the monsoon of 2005 (1986 mm) was also heavy and as a result the water level in the reservoir

was also high. The high water level proves to be a favourable condition for the diving ducks (Green, 1998) and hence the Pochards population is higher in the succeeding migratory period.

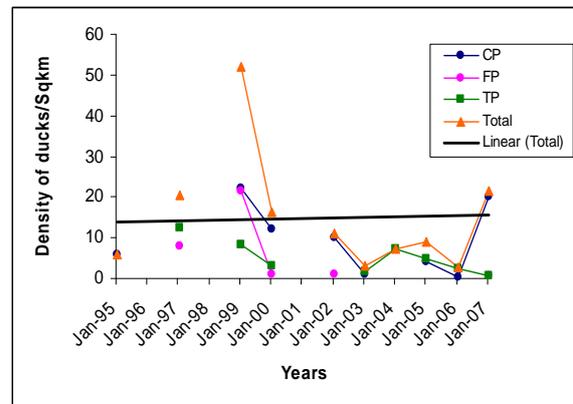


Figure 6: Variation in the ducks of Group 2 (Pochards) from 1995 to 2007 at Wadhvana irrigation reservoir.

The Density of Group 3 *i.e.* the Marsh ducks and Dabbling Ducks also shows an increase in the years succeeding the Narmada inundation (Fig.7) highest numbers of Pochards were seen in the year 2002 which is probably the first migratory season after Narmada inundation. However regular inundation of Narmada water seems to have adversely affected Marsh Duck population. Marsh ducks need shallow water compared to diving ducks. They do visit the reservoir but when water level increases due to inundation they move away to other water bodies. The marsh ducks (Dabbling ducks) are reported to prefer shallow man made ponds created even by sewage water for breeding which has higher benthos density and presence of emergent vegetation. (Belanger and Couture 1988).

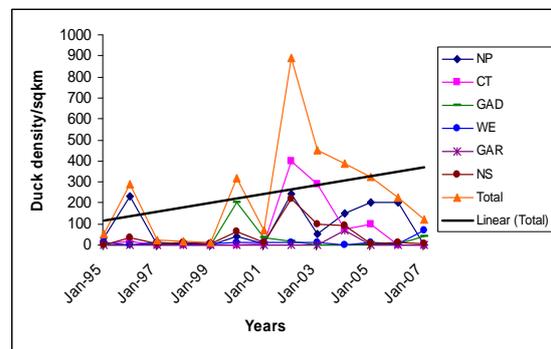


Figure 7: Variation in the ducks of Group 3 (Marsh Ducks) from 1995 to 2007 at Wadhvana irrigation reservoir.

As far as the resident species of ducks are concerned *i.e.* Group 4, a highly significant increase

is noted after Narmada inundation. After the Narmada inundation even if the surrounding smaller water bodies dry off this reservoir has the presence of the water and hence all the ducks of the surrounding areas visit this irrigation reservoir leading to the increase in total density of ducks. During May 2007 more than 800 Nakta and more than 300 Lesser Wistling Teal have been observed at Wadhwana (unpublished record).

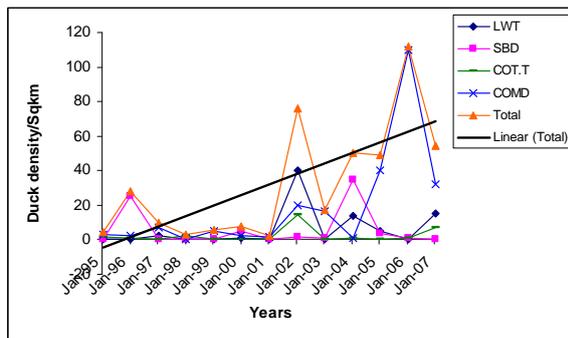


Figure 8: Variation in the ducks of Group 4 (Resident Ducks) from 1995 to 2007 at Wadhwana irrigation reservoir.

According to Andren's Sampling hypothesis (1994) that "the increase in the water spread may increase the number of some of the water fowls species" holds to be true in the present study too. The water spread area is also having direct and significant partial correlation with number of species in the pond. (Parcuellos & Telleria, 2004). Thus the increase in the wetland area may increase both the diversity as well as the density of the birds particularly the ducks.

When the means of total duck population in the years preceding and succeeding Narmada inundation were compared it was seen that there is a significant difference in the population of total birds. ($P < 0.05$).

The present study suggests that water inundation from the big water reservoirs or the large rivers is beneficial at least in the semi arid zone. The impact of the Narmada water inundation has proved to be positive for the water birds in this area. The site supports more than 20,000 water birds (AWB reports). This makes the site highly potential to be declared as Important Bird Area too. Also if the irrigation department and the forest department work together, the water level can be managed properly and the wetland can prove to be an oasis for the migratory birds visiting the semi arid zone.

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REFERENCES:

- Adamus, P.R., Stockwell, L.T., Clairain, E.J., Jr., Morrow M.E., Rozas, L.P., and Smith R.D. 1991. Wetland Evaluation Technique (WET). Volume 1 : Literature Review and Evaluation Rationale. U.S. Army Corps of Engineers, Wetland Research Program Technical Report WRT-DE-2.
- Ali, S. and Ripley, S. 1983. A Pictorial guide to the birds of Indian subcontinent. Bombay Natural History Society Centenary publication. Oxford University Press, Mumbai, India.
- Andren, H. 1994. Effects of habitat fragmentation on birds and mammals in landscape with different proportions of suitable habitat: a review. *Oikos*, **71**: 355-366.
- Belanger, L. and Couture Richard 1988. Use of Man-Made ponds by Dabbling Ducks Broods. *J. Wild. Manag.*, **52**(4): 718-723.
- Brown, M. and Dinsmore, J.J. 1986. Implication of marsh size and isolation for marsh bird management. *J. Wild. Manag.*, **50**: 392-397.
- Dimalexis, A. and Pyrovetsi, M. 1997. Effect of water level fluctuations on Wading Bird Foraging Habitat Use at an Irrigation Reservoir, Lake Kerkini, Greece. *Colonial Waterbirds* **20**(2): 244-252.
- Doherty, S., Cohen, M., Lane, C. Line, Laura and Jim Surdock. 2000 Biological criteria for Inland Freshwater Wetlands in Florida: A Review of Technical and Scientific Literature (1990-1999). A Report to United States Environmental Protection Agency Biological Assessment of Wetlands Work group.
- Douglas, A., Meeker, J. E., Hudson, P.L., Armitage B. J., Black, M. and Uzarski, D. G. 2002. Hydrologic variability and the application of index of biotic integrity metrics to wetlands: A great Lakes Evaluation. *Wetlands*, **22** (3) : 588-615
- Green A. J. 1998. Comparative feeding behaviour and niche organization in a Mediterranean duck community. *Can. J. Zool.*, **76**: 500-507.
- Gosselink, J., Duever, M. Gunderson, L. and Mazzotti, F. 1994. Report of technical panel on Interim criteria to limit the Drawdown of Aquifers for wetland protection. South Florida Water Management District, West Pal, Beach, FL.
- Hart, R. and Newman, J.R. 1995. The importance of isolated wetlands to fish and wildlife in Florida. Project report for non game wild life program project NG88-102, Florida Game and Fresh Water Fish Commission, Tallahassee, FL.
- Grimit, R., Inskip, T and Inskip, I. 2001. The Birds of Indian Subcontinent, Oxford Press of Mumbai. http://www.ramsar.org/key_criteria.html.
- Mckinney, R. A. 2006. Waterfowl-habitat associations during winter in an urban North Atlantic estuary. *Biological Conservation*, **132** :239-249.

- Milder, M. E. and Moyle, P. 1992. Wetland and Aquatic Habitats: *Agriculture, Ecosystems and Environment*, **42**: 165-176
- Moser, M., Prentice, R. C and Van Vessum J, editors, 1993. Waterfowl and wetland conservation in the 1990s-a global perspective. Proceedings of a symposium, St.Petersburg Beach, Florida. Special publication 26. International Waterfowl and Wetlands Research Bureau, Slimbridg, England.
- Nagarajan, R. & Thiyagesan, K. 1996. Shore birds and substrate quality of the Pichavaram wetlands, south India. *IBI. S*, **138**: 710-721.
- Nilson, S.G. & Nilsson, I.N. 1978. Breeding bird community densities and species richness in lakes. *Oikos*, **23**:83-91.
- Opdam, P. 1991. Metapopulation theory and habitat fragmentation: a review of holartic breeding bird studies. *Landscape Ecology*, **5**: 93-106.
- Owen, M. and Black, J. M. 1990. *Water fowl Ecology*. Blackie and Son Ltd., Glasgow, London. Parasharya, B. M.; Borad, C.K and Rank, D. 2004. A checklist of the Birds of Gujarat. Bird Conservation Society, Gujarat, 26.
- Parcuellos, M. & Telleria, J. 2004. Factors affecting the distribution of a waterbird community: The role of habitat configuration and bird abundance. *Waterbirds*, **27(4)**: 446-453
- Parcuellos, M. 2006. How can habitat selection affect the use of a wetland complex by water birds? *Biodiversity and Conservation*, **15**:4569-4582.
- Ramchandran, T., Kiran, A., Ahylaya, N., Deepa, R. S., 2002: Status of Wetlands of Bangalore Technical Report 86. available at <http://wgbis.ces.iisc.ernet.in/energy/TR86/welcome.html>
- Sampath, K. and Krishnamoorthy, K. 1990. Bird fauna and limnology of the Koliveli tank, Tamil Nadu, India. In Vijayan. V.S. (ed) Proc. Seminar on Wetland Ecology and Management:47-48 Bombay : Bombay Natural history Society.
- Sillen, B. and Solbreck, B. 1977. Effects of area and habitat diversity on bird species richness in lakes. *Ornis Scandinavica*, **8**: 185-192.
- Sonobe, K. and Usi, S. 1993. A Field Guide to the Waterbirds of Asia. Wild Bird Society of Japan, Tokyo.
- Turner, I. M.1996. Species loss in fragments of tropical rain forest: a review of the evidence. *J. App. Ecol.*, **33**: 200-209.
- Weller, M.M. 1978. Management of Freshwater marshes for wildlife. In freshwater wetlands: Ecological process and management potential. In Good, R.E., Whingham, D.F & Simpson, R.L. (eds). Academic Press Newyork.