Marsh Bird Community Index of Biotic Integrity: A Key to Study an Ecological Condition of Wetlands

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ABSTRACT

Aquatic ecosystems have significant impact on migratory bird species. As the Gujarat state, western India falls on an important migratory route of many migrant waterfowls, it is necessary to monitor the wetlands for its ecological condition, anthropogenic pressure and the species composition. The present research is a pilot study of a long term research on such important wetlands through out the entire North Gujarat region. The study was started with two important wetlands of the region. Total 88 species were detected at 12 point count locations distributed in two bird sanctuaries of Gujarat viz. Thol Lake Bird Sanctuary (TLBS) and Nal Sarovar Bird Sanctuary (NSBS) as a pilot research to develop a key methodology to study the major wetland ecosystems in the region. The ecological condition of the wetland were identified by studying the hydrology, geology, vegetation, pressure. Apart from these the Index of Marsh Bird Community Integrity (IMBCI) were worked out for each wetland as well as the bird species were used to determine whether wetland habitat characteristics influence marsh bird community and vice versa. Marsh bird community integrity shows a threshold response to urban development at local scales. IMBCI scores, combined with the identification of a land use threshold, can be easy to interpret and may help communicate complex ecological data to natural resource manager and conservation planners.

Keywords: Bird Community, Biotic integrity, wetland monitoring

INTRODUCTION

Bird communities are often referred as an ideal indicator to monitor the ecological condition of any wetland as they impact on all the trophic levels of an aquatic ecosystem. On the other hand aquatic ecosystems have significant impact on migratory birds. The present study focuses on evaluating the condition of the wetlands using bird as a study system. Index of Marsh Bird Community Integrity (IMBCI) has been used by many researchers to study and monitor the wetland condition and its ecological status (De Luca et al. 2004, Bryce et al. 2002, Hoyer et al. 1994, O’ Connell et al. 1998). Such indices demonstrate a better idea in assessment of the ecological condition of the wetland and prioritization of management prescriptions (O’ Connell et al. 1998). Studying bird community is found to be very useful to know the level of anthropogenic disturbances in and around the wetland. IMBCI has been reported as one of the important indicators to assess the integrity of entire wetland ecosystem in many areas of the world. Very little is known for such indicators of wetland in India and especially in the North Gujarat region where two important bird sanctuaries are located.

With this view, the present study has been carried out as a pilot study of a long term monitoring programme for all the identified wetlands of north Gujarat region, India. The study was initiated with two important bird sanctuaries of Gujarat viz. Nal Sarovar (NS) and Thol Lake Bird Sanctuary (TS). Both the sanctuaries are visited by number of migratory birds and have a diverse species composition (Sejal et al. 2006). Further both are varying in their geographical, physical and hydrological configuration (Singh, 2001). The Thol Lake Bird sanctuary is a man made shallow water reservoir with open water area. While the Nal Sarovar Bird sanctuary is a natural lake known as a typical and a largest natural fresh water reservoir in the Gujarat state.

The basic objective of this study was to identify a technique to evaluate the wetland condition and its ecological status for the monitoring and management purposes. As the study areas are the protected areas the study was initiated with these two sanctuaries and will be continued for all the other identified wetlands in the region.

The study was organized by regular survey followed by the bird counts, identifying the disturbance level and geo hydrological study of both the wetlands. The data were analyzed to workout the IMBCI, species richness and abundance. The bird species composition and their residential status were also recorded. The overall study depicts that the bird community is affected mainly by human disturbance followed by other hydrological and ecological factors.
STUDY AREA

Thol and Nal Sarovar are well known wetlands of Gujarat because of high diversity of migratory birds. Out of the two sanctuaries the Thol Lake Bird Sanctuary is located near the Kadi taluka of Mehsana district of Gujarat (Figure 1a). It is a man made water reservoir constructed for irrigation purpose. Here the water level rise during monsoon results in an increased submerged area. The surrounding area of wetland is cultivated fields and villages. This shallow water reservoir has the catchments area of 153 sq. km where as the main tank is made with a circumference of 6 km being an open water area. It lacks islands, reed beds and prominent shore lands. It has very less habitat diversity and poor submerged vegetation. This wetland was declared as a wildlife sanctuary in 1988 especially for conservation of migratory waterfowls. The hydrophytic flora is not catchy, though the planktons are often abundant. The surrounding vegetation is composed of mainly Acacia nilotica (Desi Baval), Prosopis chilensis (Gando baval), Acacia leucopholia (Harmo), Azadirachta indica (Neem) along with some terrestrial herbs and grasses which may provide the roosting and nesting sites for birds.

Nal Sarovar (NS) is located near Sanand taluka of Ahmedabad district (Figure 1b) covering about 120.82 sq. km of area. NS is having around 360 small and big islands which are very popular for flamingoes (Phoenicopterus sp.), geese (Anser sp), ducks and other migratory waterfowls. This natural lake was declared as a bird sanctuary in April 1969. The basin of a lake is elongated and nearly elliptical with gentle slope. All around the basin, there is sandy to clayey shoreline. In the remote past NS was a creek between the Gulf of Kutchchh and the Gulf of Cambay (Singh, 2001). The lake has a high scientific research, educational and recreational value as highest number of visitors visiting NS compared to the other protected areas of Gujarat. There are about 48 species of algae, 70 species of flowering plants and 76 species of zooplanktons have been recorded in the area (Singh, 2002). Apart from large number of aquatic birds the area also harbours other wild animals like, blue bull (Boselaphus tragocamelus), Jungle cat (Felis chaus), Jackal (Canis aureus), Wolf (Canis vulpus), Hyena (Hyaena hyaena) etc.

METHODOLOGY

The study was organized by regular field survey in both the sanctuaries followed by the data analysis. Four different data collection sites were identified at both the sanctuaries for the study. During the field survey the bird species were identified using standard reference book (Grimmett et al.1999). Number of individuals was counted using point count method (Ralph et al. 1993) to workout the abundance and species richness in both the sanctuaries. Point count location was selected by representive portion of wetlands. Along with the bird count we have also recorded the data regarding the human disturbance and worked out the disturbance index in both Thol and Nal Sarovar Sanctuaries.

The index of Marsh Bird Community Integrity was measured as described by DeLuca et al. 2004, O’ Connell et al. 1998 and Bryce et al. 2002 with some modifications as per the objectives and study area. The score were given on generalist to specialist gradients. Specialist gradient is capable of exploiting specific resources of the habitat or native ecosystem. This indicator species approach allows the IMBCI to be an accurate and sensitive index for bird community. Species attributes were used as basic components for IMBCI development. Species attributes were feeding, nesting; migratory and breeding (Table 1). An IMBCI, score one indicated that only species with generalist attributes was present and for specialist attributes, score three was detected as best indicator of ecological condition. Once all species scores were calculated and score for specific wetlands (WIMBCI) were calculated:

\[ W_{\text{IMBCI}} = \left[ \frac{\sum S_{\text{IMBCI}} - S_{\text{N}}}{W_{\text{O}} \text{N}} \right] + 3 \]

Where \( S_{\text{N}} \) is the total number of species detected at a wetland and \( W_{\text{O}} \text{N} \) is the number of wetland obligate species detected at a wetland (DeLuca et al. 2004). Low IMBCI score indicated that more or all birds with generalist attributes were present. The high score of IMBCI indicated that birds detected have specialist attributes that best indicate a healthy wetland.

The disturbance index was calculated as described by Bryce et al. 2002. The disturbance index for both wetlands was calculated by the aspects of land use or land cover, road density and cover. The score of 1-4, minimal to high disturbance, have been denoted by their human influence. Score of 2 denoted a relatively lake of human influence. Those wetland sites have scored 4 also had attributes mitigating the major impacts of intensive farming, mining, or urban development.
RESULTS AND DISCUSSION

The wetlands studied during the study period were extremely differing in their geo-hydrological and ecological characteristics, as one is a man made shallow water body and the other is a natural shallow wetland. The only similarity is, both are largely visited by the migratory waterfowls and declared as a Bird Sanctuary. The data regarding the surrounding vegetation and fauna have not been collected for analysis but the previous study reveals high vegetational and faunal diversity in NS (Sejal et al. 2006, Singh 2001, Pandey 2004). Total 77 bird species were recorded from TS and 50 from NS bird sanctuary out of which 39 species were found common at both the wetlands. The checklist of the bird species, their family and residential status is given in Appendix 1a and 1b for TS and NS respectively. Out of 37% migratory bird species recorded 57.44% were observed from TS and 42.55% were from NS. Further 63% of the total species were categorized as wetland obligatory in which 62.5% were recorded from TS and 37.5% from NS (Table 2). Table 2 depicts that both TS and NS are the valuable wetlands for migratory bird species. Moreover it can be also said that the Thol lake is more favoured by the wetland obligatory birds than that of the Nal Sarovar. This reflects both man-made and natural wetlands are almost equally preferred by the migratory birds, on the other hand high anthropogenic pressure and tourism activity restricts the number of wetland obligatory birds.

Table 3 shows IMBCI score for all species and wetlands; the table also shows the species richness and disturbance score at both the wetlands. The table reveal lower species and wetland IMBCI score as well as comparatively high disturbance score at Nal Sarovar sanctuary which indicates less healthy wetland for bird integrity than that of the Thol sanctuary. This is also supported by the species richness at both the wetlands. Moreover the species richness and IMBCI also shows positive correlation
(Figure 2 a and b), likewise the wetland with high disturbance index having less species richness and lower IMBCI score. Bryce and others (2002) have also reported such index as an indicator of the condition of the bird assemblage itself. The present study also revealed that if the bird composition and indices of bird community integrity are worked out for a wetland it will be helpful to predict the overall condition of wetland ecosystem. Further the bird assemblage also indicates the eutrophic condition of a wetland because greater availability of food resources in productive lake attracting more birds. Thus the integrity indices have also been found helpful to monitor eutrophication and productive status of a wetland.

Figure 3 describes the species composition by their residential status, which gives a picture of migratory, resident and resident breeding bird species occurring at both the wetlands. It tells that resident and resident breeding birds occur more in the TS than the NS. Where as the migratory and passage migrant species are found more in Naal Sarovar, indicating the larger geographical area of NS may be a focus for large flock of migratory birds; on the other hand the breeding population are preferring the area with less human disturbance and availability of the resources. Out of five IUCN red listed bird species, three are resident breeding in India and hence occurred more in Thol sanctuary. As reported by Chase et al. (2000), presence of individual species may serve as indicator of the overall species composition of birds, but it may say less about the species richness, so the focus should be given to a diverse suite of the range of species representative for conservation purpose.

The overall study reveals that the index of marsh bird community is positively correlated with the species richness and decreases as the disturbance increase. Moreover it is found very useful for the rapid monitoring of a wetland with respect to the bird community and its integrity with ecosystem. As the present study is a part of long term monitoring programme of the wetlands of North Gujarat region, this will be applied for further research and monitoring work. It is anticipated that the results may be more fruitful and amenable when it is applied on a large scale with more number of wetlands.

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REFERENCES


