

Seasonal Diversity and Population Status of Waterbirds in Phewa Lake, Pokhara, Nepal

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Abstract: The study (2007-08) was carried out in Phewa Lake which is one of the largest lake systems in Nepal to evaluate seasonal diversity and population status of waterbirds. A total of 39 waterbird species belonging to 17 families of 5 orders was recorded. The highest number of species (31 species) was found in December and January. Winter was the most diverged season in terms of number of species (35 species) and summer and autumn by 17 species. January had the highest (1584) and September the lowest (345) waterbird population. Out of 39 species, 15 species were winter visitors, 10 resident, and 4 rare winter visitor. The highest diversity (\bar{H} = 2.6228) was found in February and lowest (\bar{H} = 1.2014) in June. The value of evenness (Jacob's coefficient) was higher (0.8485) in February and lowest (0.4555) in June. During June, 69.92% (616 individuals) of the total population (881) constituted only Cattle Egret. The dominance was found highest (C = 0.5058) in June and lowest (C = 0.1020) in February. The bird communities of summer and autumn were more similar (S = 0.7059) than the summer and winter (S = 0.5). The fluctuation in number of individuals of bird species was found unrelated to seasons (months) (F = 1.71, df = 8, 342, P ≤ 0.05). The species richness was found different in different seasons (months) (χ^2 = 29.34, df = 8, P ≤ 0.05). Detail study of bird diversity and population status with periodic monitoring in Phewa Lake is recommended for their conservation and management as a whole.

Key Words: Phewa lake, wetland, waterbirds, diversity, population

1. Introduction

Nepal has many types of wetlands scattered in the Mountain and Terai regions. Its wetlands (approx. 743,500 ha) are particularly important for threatened species (DOAD, 1992). Because of its mountainous physiography, bigger wetlands are rather very few (Manandhar, 2005). However, it possesses unique biodiversity and much more can be expected in wetlands of such areas (Chalise, 2007). Wetlands are one of the most threatened habitats because of their vulnerability and attractiveness for development (Hollis *et al.*, 1988). Wetlands provide homes for a huge diversity of wildlife: birds, mammals, fish, frogs, insects and plants (Buckton, 2007). Among 862 bird species (Baral and Inskipp, 2005) recorded in Nepal, 193 are wetland dependent birds, of which Terai wetlands support 187 species (Thapa, 2006). Nearly half of the country's globally threatened birds (14 species) and 10 near threatened species regularly inhabit wetlands (Baral and Inskipp, 2005). Birds are good bio-indicators and useful models for studying a variety of environmental problems (Urfi *et al.*, 2005). Migratory waterfowls are one of the most remarkable components of global biodiversity (Li Zuo Wei and Mundkur, 2004). Nepal's wetlands are facing tremendous anthropogenic pressure (IUCN, 2004; Bhandari, 1998; Sah, 1997), which can greatly influence the structure of bird community (Francl and Schnell, 2002).

Phewa Lake is home for 18 fish species and many birds, reptiles, frogs and invertebrates like snails and insects harbor around it. The lake is now infested with a floating macrophyte, the Water Hyacinth (*Eichhornia crassipes*) and blue green algae indicating enriched nutrient loading into the lake (NARC-FRCP, 2004/05). Presently, the lake is facing problems as a result of nutrient loading from agriculture, embankment landslides and rapid urbanization from the surrounding area (Lamichhane, 2000). The recent trend is toward rapid eutrophication (Oli, 1997; Rai, 2000) due to tourist flow and recreational activities around the lake.

2. Study Area

Phewa Lake is situated in Pokhara Valley (28° 1' N, 82° 5' E, elevation 742 m from masl) in the western mid hill region of the country that has humid subtropical monsoon climatic condition (Fig. 1). The temperature is moderate, with maximum temperature peaks at 25.5°C in July-August and falls to minimum of 13.2°C in January.

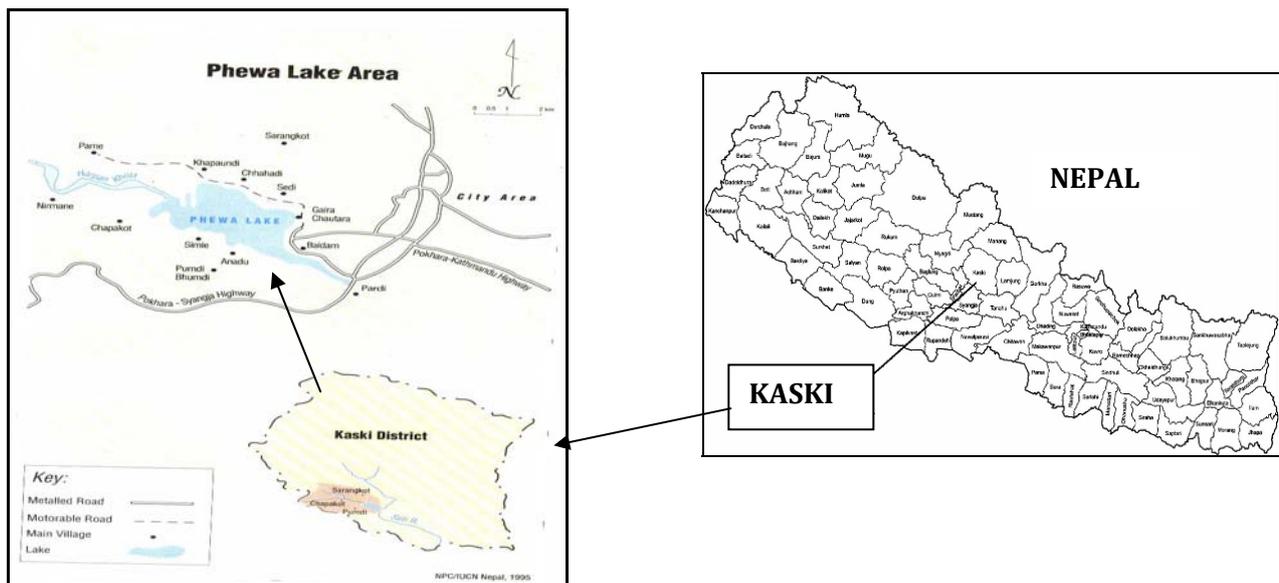


Fig. 1: Map showing Phewa lake

It has a watershed area of approximately 110 km² (Ferro and Swar, 1978). Lamichhane (2000) estimated 443 ha of water surface area with a maximum depth of 23 m. However, a total area of 8.5 sq. km was taken during the present study. The surrounding area of the Phewa Lake is mainly dominated by tree species like Katus (*Castanopsis indica*) and Chilaune (*Schima walichii*).

3. Materials and Methods

Direct count method through ten vantage points was followed to take field data. In each vantage point, 10 to 15 minutes time was spent tending towards as shorter time period as possible to avoid multiple counting of a single individual of the bird species. The study area was visited in the middle of each month from June 2007 to February 2008. The total time spent in the field was 176 hours and the total working period was 155 hours, spending about 17 hours in each visit. Bird counting was done by using binoculars (Shakura, 20×50 magnification). For the identification of the bird species, a comparison was done with a popular field guide, Helm Field Guides "Nepal ka Charaharu" (Grimmett et al., 2003).

Shannon's index of diversity (\overline{H}), Jacob's coefficient (J) and Simpson's index of dominance (C) was used to find the diversity trend of the waterbirds. Similarity index (S) was used to check the similarity of the bird communities of different study periods. One way ANOVA was used to find fluctuation in number of individuals of the bird species according to the seasons (months). Chi-square test (χ^2) was used to test the dependency of species richness in the season (months).

4. Results

During the study, a total of 39 species belonging to 17 families and 5 orders was recorded. Highest number of species (18 species) belonged to order Ciconiiformes. Out of 39 species, 11 species which were winter visitors belonged to the family Anatidae only. The highest number of bird species (31) was found in the months of December and January (Fig. 2). Winter season was the most diverged season in terms of the number of species and summer and autumn by 17 species only. The highest number of birds was found in January (1584) and second largest population was in December (1472 individuals). September had the lowest population of the waterbirds (345 individuals) (Fig. 3). During June, Cattle Egret constitutes 69.92% (616 individuals) of total population (881) counted. December, January and February, had the highest population of Common Coot. The species like Ruddy Shelduck, Common Teal, Common Pochard and Little Grebe also had comparatively higher population.

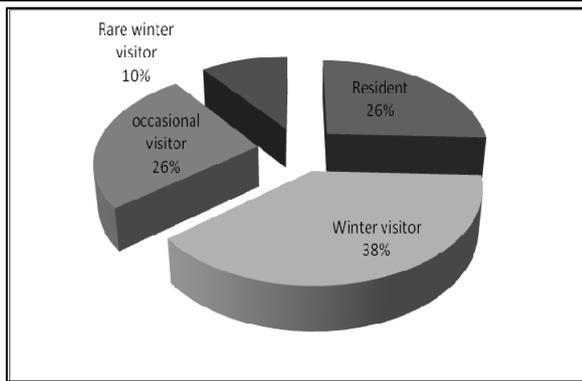


Fig. 2: Species richness in different survey periods

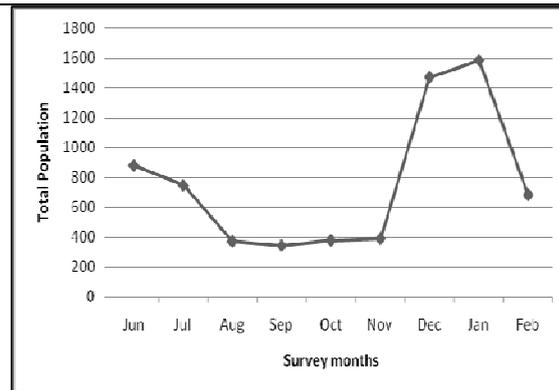


Fig. 3: Population recorded in different survey periods

Out of 39 species recorded, 10 species were resident, 15 species winter visitors, 10 species occasional visitor and 4 species rare winter visitor (Fig. 4). Among them, 13 species were frequent, 6 species common, 17 species uncommon and 3 species abundant (Fig. 5).

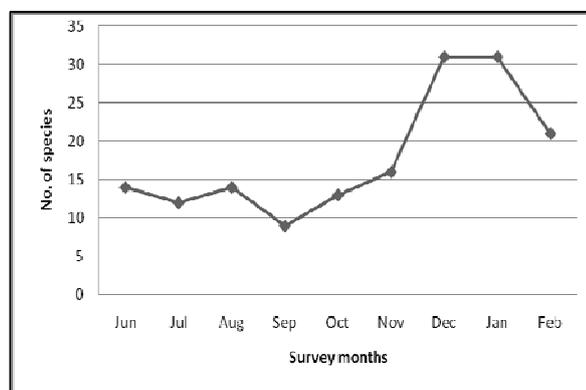


Fig. 4: Status of waterbirds in study area according to time spent in the site

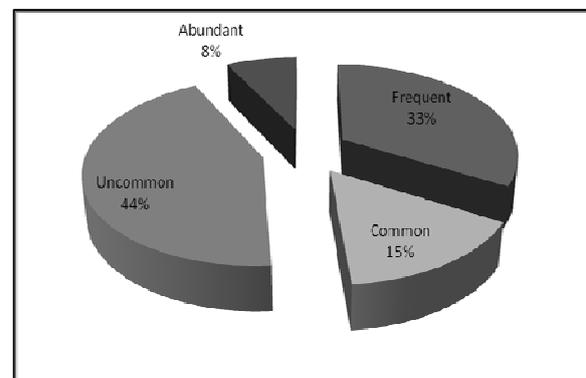


Fig. 5: Status of waterbirds in study area according to the population abundance

The Shannon's index of diversity was found highest ($\bar{H} = 2.6228$) in February and lowest ($\bar{H} = 1.2014$) in June. The value of evenness (Jacob's coefficient) also was found highest (0.8485) in February and lowest (0.4555) in June. The Simpson's index of dominance was highest in June ($C = 0.5058$) and lowest in February ($C = 0.1020$). The Similarity index (S) was higher ($S = 0.7059$) between the summer and autumn than between summer and winter seasons ($S = 0.5000$). The summer bird community ($S = 0.5000$) was found less similar than the autumn season ($S = 0.6154$) with winter season. The value of similarity index of bird communities between the months of a particular season was found higher than the months belonging to different seasons. The calculated value of F (1.71) was less than the table value of F (1.94), at 5% level of significance at df 8,342. So the null hypothesis was accepted i.e. the number of individuals of the bird species were not affected by seasons (months). The calculated value of Chi-square (χ^2) at 5% level of significance and 8 df ($n = 9$) was higher ($\chi^2 = 29.34$) than tabulated value ($\chi^2 = 15.5$). So the null hypothesis was rejected i.e. prevalence of seasonality in the species richness.

5. Discussion

Gautam and Kafle (2007) had presented records of waterbird species combining two survey results conducted by them independently in August 2003 to July 2004 and 1-5 January 2004 respectively. They recorded a total of 43 species of waterbirds belonging to 14 families. During the study only 39 species of the waterbirds were recorded. The species such as Baer's Pochard (*Aythya baeri*), Bar-headed Goose (*Anser indicus*), Comb Duck (*Sarkidiornis melanotos*), Common Golden-eye (*Bucephala clangula*), Darter (*Anhinga melanogaster*), Little Cormorant (*Phalacrocorax niger*), Purple Swamphen (*Porphyrio porphyrio*), etc. were not recorded during the present study. The

species such as Lesser Whistling Duck (*Dendrocygna javanica*), Black-headed Gull (*Larus ridibundus*), Little Heron (*Butorides striatus*), Black-crowned Night Heron (*Nycticorax nycticorax*), Woolly-necked Stork (*Ciconia episcopus*), Plumbeous Water Redstart (*Rhyacornis fuliginosus*), etc. were the additional species recorded during the study. It can thus be concluded that there is possibility of increment of the waterbird species. It will be possible from the improvement of habitat condition.

Gautam and Kafle (2007) had recorded globally threatened species viz: Comb Duck (*Sarkidiornis melanotos*) (Critically Endangered), Baer's Pochard (*Aythya baeri*) (Vulnerable) and Ferruginous Pochard (*Aythya nyroca*) (Near-threatened). But during the study, only Ferruginous Pochard was recorded (in December 5 individuals and in January 7 individuals). The Ferruginous Pochard is listed as Near Threatened on the IUCN Red List of Threatened Animals (Birdlife International, 2002). The Ferruginous Pochard is a little studied, partial migrant, widely distributed in Europe, Asia and Africa (Robinson and Hughes, 2003). The winter months showed less similarity in community composition of waterbirds with other months. This dissimilarity probably was due to higher movement of birds in this area in winter season. The higher diversity and population of birds in the winter was probably because of the addition of birds during this season. Waterbirds tend to be highly mobile in winter, moving to other areas in response to factors such as cold weather and changes in water levels and in food resources (Kershaw and Cranswick, 2003).

Wetlands comprise some of the most valuable and important natural environments for living creatures, including man. And yet, like tropical forests, they are one of the most threatened habitats in the world, under pressure from human activities and development (Sonobe and Usui, 1993). The wetlands are fast disappearing ecosystems of Nepal (Baral, 1998). Wetlands in the Pokhara Valley which are unprotected are even more at risk from drainage, diversion, obstruction, siltation, encroachment, infrastructure development, land use changes, pollution and poison to kill fish (Karki et al., 1997; Karki and Thapa, 1999; Subedi, 2003) resulting in a marked reduction in bird numbers and species diversity since the 1970 (Gautam and Kafle, 2007). The diversity of waterbirds reflects the many ways of life possible for birds in wetlands. Waterbirds exploit a range of different parts of a wetland, or microhabitats. Each of these microhabitats can support a variety of different food types: from fish, crustacean and mud-dwelling invertebrates, to water plants and tiny plankton (Sonobe and Usui, 1993). Rai (2003) recorded 60 wetland species (out of 270 species recorded) in Beeshazari Tal, a wetland listed as Ramsar Site and its suburbs. In comparison to this result, the Phewa Lake also shows the possibility of becoming important area for waterbirds at least of national level.



Fig. 6: Mallard - © Gandhiv Kafle

6. Management Implications

In the case of Phewa Lake, more species can be expected. Like this study, studies related to the diversity and population status of waterbirds should be conducted on regular basis for the assessment of the environmental condition of the Phewa Lake. It can help the implementation of conservation and management programmes in the wetland biodiversity of Lake Phewa. It is recommended to initiate study of bird diversity and population status immediately with periodic monitoring in Phewa lake area for its conservation and management.

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