International Journal of Environmental and Ecology Research
www.environmentaljournal.in
Online ISSN: 2664-7117, Print ISSN: 2664-7109
Received: 17-06-2021, Accepted: 04-07-2021, Published: 22-07-2021
Volume 3, Issue 3, 2021, Page No. 10-14

Activity pattern and time budget of little grebe *(Tachybaptus ruficollis*) at Kumbakonam region of Tamil Nadu

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Abstract
The Little Grebe (*Tachybaptus ruficollis*) or Dabchick (Order Podicipediformes; Family Podicipedidae) is one of the smallest grebes with body length of 25–29 cm and having a buoyant rounded body. Study on Little Grebe in the pond environment for their activity patterns and assess the time of various activities. The present study was conducted in a pond which is situated in the Government Arts College campus of Kumbakonam. During the study period, regular observations of diurnal activities were conducted following the focal and scan sampling methods. The Little Grebe spent most of the annual time-activity budget (87.79%) in only three activities, namely feeding by dives (43.10%), swimming (35.62%) and preening (9.07%). During the wintering (December 2020 to January 2021) and the breeding season (February 2021 to March 2021), swimming and feeding by dives were two dominant activities. Swimming (Mann–Whitney U-test, $Z = -3.361$, $p < 0.001$) and feeding by dives (Mann–Whitney U-test, $Z = -3.361$, $p < 0.001$) differed significantly between breeding and wintering seasons. The monitoring of the hourly time budget of the Little Grebe showed that feeding activity is dominated in all the hours, except between 11:00 am and 3:00 pm. To our knowledge, this is the first study that determines and analyses the dynamics of the time-activity budget of Podicipedidae in the study area. Further research could address the diet, habitat use, nest site selection and some breeding life history traits of the species in the study area and analyse to what extent of this species have overlapping niche requirements.

Keywords: little grebe, dabchick, activity, time budget, scan and focal sampling, Kumbakonam, Tamil Nadu

Introduction

Presence of waterbirds and wetlands are inseparable elements in an ecosystem (Grimmett and Inskipp, 2005) [9]. The birds present in wetlands for feeding, breeding, nesting or roosting activities are defined as water birds (Kumar *et al.*, 2005) [19]. These water birds are considered as a good bioindicators of the wetlands to study various environmental problems (Jayanta and Saradha, 2015; Veeramani and Hemalatha. 2021) [17, 32]. Due to availability of high nutritional value and productivity, the wetlands attract huge number of migratory and resident bird species (Manikannan *et al.*, 2012) [20]. In recent years these wetlands face tremendous anthropogenic pressure mainly due to discharging of domestic sewage, discharging of industrial effluent, dumping of solid waste, over exploitation of their natural resources and conversion of wetlands in to barren lands. This resulted in biodiversity loss and disturbance of the wetland services (Ramachandra, 2006) [25].
The Little Grebe (*Tachybaptus ruficollis*) or Dabchick (Order Podicipediformes; Family Podicipedidae) is one of the smallest grebes with body length of 25–29 cm and having a buoyant rounded body. The global conservation status of Little Grebe is of Least Concern (IUCN, 2009) [16]. Little grebe is widely distributed all over the world. It occurs in Europe, central and southern Asia and sub-Saharan Africa, Pacific islands and southern Africa except in Kalahari (Hockey *et al*., 2005) [15]. In India, Little Grebe is widespread in distribution. It is resident to large lakes, but very rarely seen in the flowing rivers and occasionally visits the estuaries and salt water bodies along the seacoast. Time budgets quantify the percentage of time of animals allocate to different activities (Rave and Baldassarre 1989) [26]. Patterns of daily activity and behaviour can vary widely between species, and activity budgets help us in understanding the life history and ecological adaptations of birds (Evers 1994; Hamilton *et al.*, 2002; Jónsson and Afton 2006) [11, 18]. Resulting data can increase understanding of habitat use and niche separation among species because natural selection should favour individuals that best apportion their time among each activity, habitat and climatic condition (Titman 1981; Rave and Baldassarre 1989) [30, 26].
Except for the work dealing with the breeding ecology of the Great Crested Grebe (Rouibi *et al*. 2013) [27], Podicipedidae have not benefited from any detailed studies: no published time budget studies for any species of this family exist. Little Grebes are found breeding on various wetlands in India. Hence this study is indented to study on Little Grebe in the pond environment to study activity patterns of the species, assess time of various activities and recommend strategies for the conservation of the species.

Materials and Methods

The present study was conducted in a pond which is situated in the Government Arts College campus of Kumbakonam. During the study period, regular observations of diurnal activities were conducted following the focal and scan sampling methods (instantaneous scan sampling) adopted for this type of observations (vast, clear and low-disturbed) (Altmann 1974;

Baldassare *et al*. 1988) [1, 2]. This method involves the observation of a group and recording instantaneous activities of each individual. Then, applying mathematical transformations, the temporal percentage of each of the activities is estimated (Altmann 1974) [1]. Seven instantaneous activities were monitored continuously from 0600 hrs to 1800 hrs. *Viz.* resting (inactive with eyes open, or sleeping), feeding (by diving, by picking from the water surface and by immersing the head), preening or cleaning (including scratching and splash-bathing), swimming, flying, parading and agonistic behavior.

Time budgets were calculated by dividing the number of instantaneous samples for each activity by the total number of samples. Principle component analysis (PCA) were made for possible correlations among diurnal activities. For each PCA, a varimax normalized rotation was applied to a set of principal components with eigenvalues >1.0 to obtain simpler and more interpretable gradients. All statistical analyses were performed with SPSS Software V 19. Results were considered significant at $p < 0.05$.

Results

Identification: 25-29 cm. In summer with dark grey plumage, with chestnut cheeks and fore neck; bill with pale yellow gape. In winter juveniles are paler, with brown upper parts and pale grey underparts, without yellow gape on bill.

Sexing: Both sexes with similar plumage although, in breeding plumage, females are usually duller than males. In adults, size can be useful for extreme birds: male with wing longer than 102 mm; female with wing shorter than 95 mm.

Ageing: 4 age groups can be recognized: Juvenile with remnants of nestling pattern (dark brown or white striping) on sides of head and neck; buff cheeks; iris dark; orange bill. 1st year winter similar to adult in winter, but easily recognizable if keeps juvenile downy feathers on back or remnants of pale striping on face and neck sides; iris dull reddish; tips of the outermost primaries narrow. 2nd year spring similar to adult, but with tips of the outermost juvenile primaries narrow. Adult with reddish iris; tips of the outermost primaries wide and rounded; in summer with black bill.

Moult: Complete post breeding moult, usually finished in November. Partial post juvenile moult, confined to head and body feathers, finished between August and November. Both age groups have a partial pre breeding moult changing body feathers to acquire the breeding plumage.

Diurnal behaviour

The Little Grebe spent most of the annual time-activity budget (87.79%) in only three activities, namely feeding by dives (43.10%), swimming (35.62%) and preening (9.07%). The remainder of the time was spent in resting (3.63%), feeding by immersing the head (2.68%), feeding by piking (2.18%), pattering flights (2.07%) and agonistic behaviour (1.65%). These two last activities were rarely observed (Figure 1).

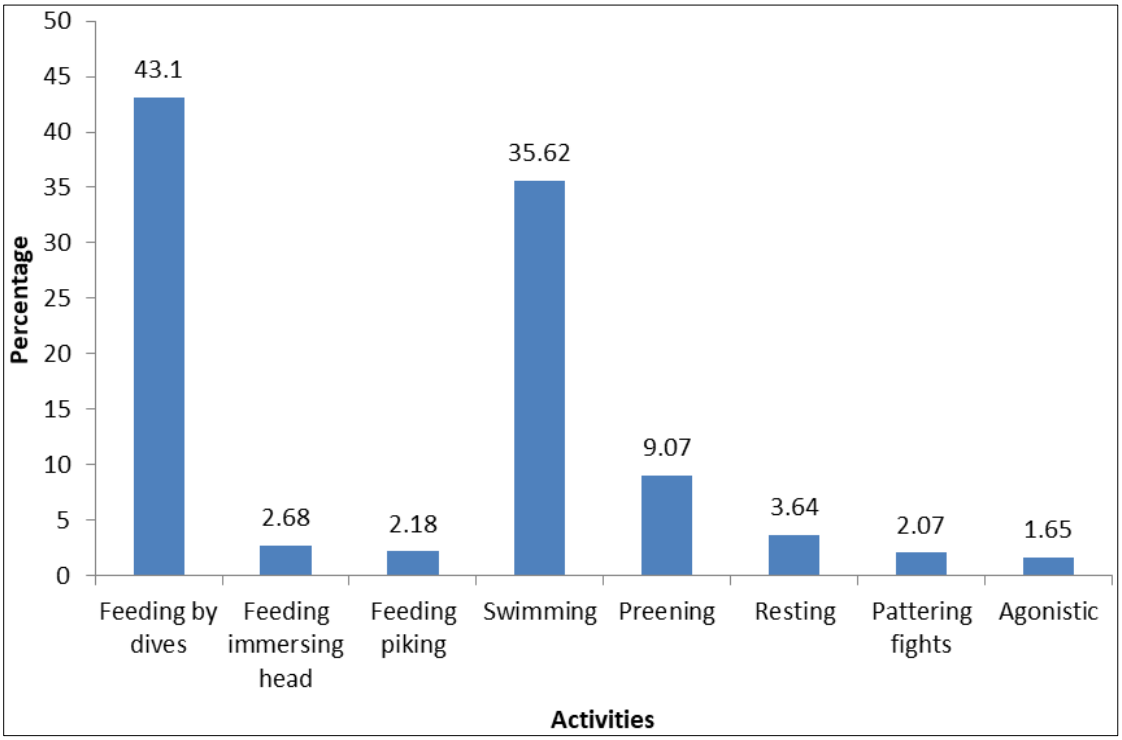

Fig 1: Percentage of time spent for different activities by Little Grebe

During the wintering (December 2020 to January 2021) and the breeding season (February 2021 to March 2021), swimming and feeding by dives were two dominant activities. Swimming (Mann–Whitney U-test, $Z = -3.361$, $p < 0.001$) and feeding by dives (Mann–Whitney U-test, $Z = -3.361$, $p < 0.001$) differed significantly between breeding and wintering seasons. Besides, swimming (Kruskal Wallis test, $H = 45.22$, $p < 0.0005$) was significantly the dominant diurnal activity in the wintering season whereas feeding by dives (Kruskal Wallis test, $H = 41.38$, $p < 0.0005$) was the dominant activity in the breeding season. Little Grebes allocated most of their time to swimming, which achieved its highest level (21.4%) in March and feeding, especially in December (53.55%) (Figure 2)

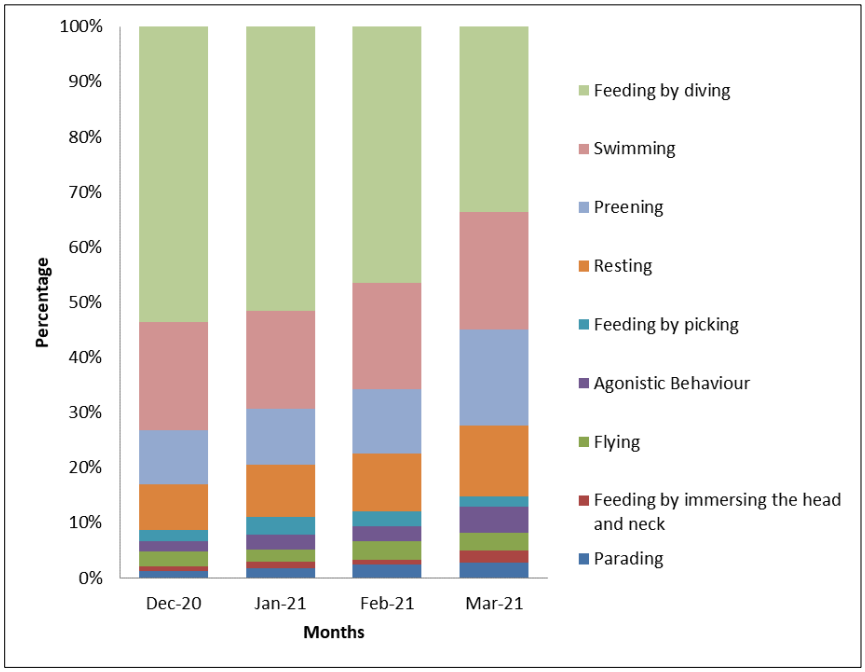

Fig 2: Percentage of different activities of Little Grebe in various time period

The monitoring of the hourly time budget of the Little Grebe showed that feeding activity is dominated in all the hours, except between 11:00 am and 3:00 pm. Swimming was similarly important and occupied a more or less stable percentage of the time budget throughout the day. Feeding by dives was the preferred method of food supply occupying major parts of the time budget during the first daylight hours (40.08%). Maximum rates of preening were watched after 10:00 am and 3:00 pm. From 11:00 am to 2:00 pm, the percentage of this activity varied between 9.88 and 11.74%. The time allocated to resting culminated after 2:00 pm. Throughout the day, it exhibited an inverse pattern in comparison to swimming and feeding (Figure 3). The multivariate statistical analysis by PCA summarized the field variables studied by two independent axe accounting for 65% of the variance of the data-set (49.9% PC1, eigenvalue = 4.003; 15.1% PC2, eigenvalue = 1.201).

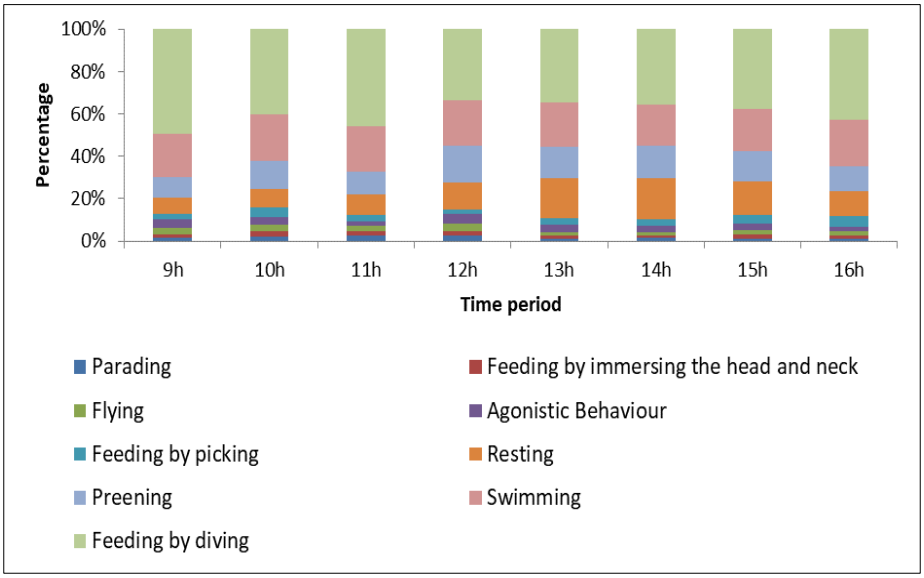

Fig: 3 Percentage of time spent for different activities by Little Grebe.

Discussion

Little Grebe is one of the resident breeders in the study area which is also mentioned by (Metallaoui and Houhamdi 2008) [21]. Agonistic behaviour at the beginning of the breeding season was not uncommon in the Little Grebe (Hartley 1933) [14]. It is suggest that parading was not observed because of the shy behaviour of the Little Grebe (Cramp and Simmons 1977; Vinicombe 1982; Moss and Moss 1993) [4, 33, 22]. With respect to feeding, most grebes feed mainly by dives, in spite of a higher energy cost in comparison to feeding from the water surface which is also delivered by (deLeeuw 1996; Quintana, Wilson, and Yorio 2007; Varo *et al*. 2011) [5, 24, 31]. The time spent in feeding by dives may be influenced by the availability and accessibility of food to diving birds (Fjeldså 1973) [7]. Moreover, there is an upper limit to the time that grebes can spend foraging each day, because they must spend a certain amount of time for preening and resting (Caudell and Conover 2006) [3]. Most of the feeding occurs during daylight hours which is witnessed by (Cooper, Winkler,

and Lenz 1984; Fox 1994) [8] because they locate food by sight (Caudell and Conover 2006) [3]. Flight exercises marked the end of the wintering period when the assemblage of moulting individuals trained the wings to leave the study site. Fox (1994) [8] reported that roosting activity during the daylight period decreased in mid-winter, with most daytime roosting occurring in spring and autumn; by contrast, preening was reasonably constant throughout winter. Here the grebes are Roosted in the banks of the pond with the dense bushes seen around the pond. The diurnal time spent for swimming by the Little Grebes varied throughout the study period. This behaviour was frequently used for changing the resting or feeding places, and sometimes for parading. In the present study, the average percentage of daytime spent for feeding did not exceed 20% during all the year. All foraging took place around dawn and around dusk (Piersma, Lindeboom, and van Eerden 1988) [23]. Gwiazda (1997) [10] declared that Great Crested Grebes began to forage about 1 h before sunrise and ceased about 1 h after sunset; they foraged for about 15 h in spring and during autumn migration and 18 h during the breeding season. Earlier studies have reported that Great Crested Grebes often, but not always, feed in the twilight periods (Harrisson and Hollom 1932; Hanzák 1952; Simmons 1977) [4, 11, 13]; this may be the reason of a low feeding rate recorded in the present study, which did not cover the dawn and the dusk period, as we started our surveys from 9:00 am until 4:00 pm. The constant level of preening may be explained by feathers care (Storer and Jehl 1985) [29]. Flight occurred mainly after disturbance caused by the predators and occasionally by humans.

Conclusion

The population size of the Little Grebe showed seasonal variation, and the diurnal behavioural activities. To our knowledge, this is the first study that determines and analyses the dynamics of the time-activity budget of Podicipedidae in the study area. Monthly and hourly diurnal behaviour exhibited significant variations. Overall, the Little Grebe devoted most of its time to feeding followed by swimming, preening and resting activities. Parading, agonistic behaviour and flying were observed rarely with this species. Further research could address the diet, habitat use, nest site selection and some breeding life history traits of the species in the study area and analyse to what extent of this species have overlapping niche requirements. The study of other factors such as food abundance, vegetation, physico-chemical water characteristics, water depth, precipitation and average daily temperature could provide important arguments for the fluctuation of the population sizes.

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