

Time-activity budget and seasonal behavioural patterns of Ibisbill (*Ibidorhyncha struthersii*) in the Kashmir Himalaya, India

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Abstract The Ibisbill (*Ibidorhyncha struthersii*) is a distinctive wader of high-altitude river systems associated with shingle beds and braided glacial rivers of the Himalayan landscape. Understanding its activity time budget is crucial for elucidating behavioural strategies that facilitate survival in its challenging environment. This study investigates the diurnal activity patterns of Ibisbill across a seasonal gradient, emphasizing foraging, maintenance, vigilance, and locomotion behaviours. Ibisbill was found to spend the majority of time on foraging activity (50%), followed by resting (27%), locomotion (10%), others (7%), and alertness (6%). Annual activity time budget showed no significant difference, however, seasonal data revealed that the bird spent most of its time on foraging during winter season (60.55 ± 1.15) and minimum in spring (41.78 ± 1.42) season. The locomotion time also varied among the seasons with maximum locomotion (14.36 ± 0.17) in summer and minimum in spring season ($6.16 \pm 0.6\%$). Diurnal rhythm of foraging activity showed a maximum peak in the morning hours (08:00 to 10:00) whereas in winter, the maximum peak was observed in the afternoon (12:00 to 15:00) associating with ice melting along river edges. This study enhances understanding of the behavioural ecology of Ibisbill, providing critical insights into habitat use and activity patterns that are essential for developing effective long-term conservation and management strategies in high-altitude riverine ecosystems.

Keywords: behaviour, conservation, diurnal activity budget, Ibisbill, *Ibidorhyncha struthersii*, Himalaya, India

Összefoglalás A kardsőrű töcs (*Ibidorhyncha struthersii*) az alpesi folyórendszerek egyedülálló vízimadara, amely speciális élőhelyéről és sajátos ökológiai igényéről ismert. Aktivitási idejének megismerése döntő fontosságú a kihívásokkal teli környezetben való túlélést elősegítő viselkedési stratégiák felderítése szempontjából. Ez a tanulmány a faj nappali aktivitási mintáit vizsgálja évszakos gradiensben, kiemelve a táplálékkereső, fenntartó, éberségi és mozgási viselkedéseket. A legtöbb időt (50%) táplálkozási tevékenységgel töltötte a faj, ezt követte a pihenés (27%), a mozgás (10%), az egyéb tevékenységek (7%) és az éberség (6%). Az éves tevékenységi időbeosztás nem mutatott jelentős különbséget, azonban a szezonális adatokból kiderült, hogy a kardsőrű töcs táplálkozással a téli időszakban töltötte a legtöbb időt (60.55 ± 1.15), míg a tavaszi időszakban a legkevesebbet (41.78 ± 1.42). A mozgási idő is változott az évszakok között, a nyári időszakban volt a legnagyobb (14.36 ± 0.17), a tavaszi időszakban pedig a legkisebb ($6.16 \pm 0.6\%$). A táplálékkereső tevékenység napszakos ritmusa a reggeli órákban (08:00–10:00) mutatott maximális csúcsot, míg télen a délutáni órákban (12:00–15:00) volt a legnagyobb csúcs, ami korrelált a folyók menti jégolvadással. Az eredmények hozzájárulnak a kardsőrű töcs viselkedésökológiájának megértéséhez, és létfontosságú adatokat szolgáltatnak az élőhelyeire vonatkozó hosszú távú védelmi és kezelési stratégiákhoz.

Kulcsszavak: viselkedés, természetvédelem, nappali aktivitás, kardsőrű töcs, *Ibidorhyncha struthersii*, Himalája, India

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Introduction

Understanding the activity time budget of waterbirds in their respective habitats is essential for gaining insights into their distribution, social structure, habitat use, and niche separation. Such studies contribute significantly to understanding species ecology and provide crucial guidance for the management of avian communities and their habitats (Hepworth & Hamilton 2001, Hamilton *et al.* 2002). The Ibisbill (*Ibidorhyncha struthersii*) is a distinctive species inhabiting high-altitude riverine environments characterized by pebbles, cobbles, and boulders. Despite its ecological importance, there is a paucity of detailed information about the species' ecology and behaviour, both globally and within the Indian Himalayan region.

The Ibisbill is a resident breeder in Jammu and Kashmir, particularly in the Sindh and Lidder rivers (Ul Haq *et al.* 2021). While it is currently listed as “Least Concern”, its global population status and trends remain largely undocumented (Winkler *et al.* 2020, Haq *et al.* 2022). Moreover, its remote and challenging habitat has resulted in limited ecological studies, leaving critical knowledge gaps about its behaviour and habitat use.

This study aims to address these gaps by quantifying the behaviour of the Ibisbill across several sites along the Sindh River in Kashmir. Specifically, the objectives were: (i) to determine the time allocated to various behavioural activities of the species during spring, summer, autumn, and winter; and (ii) to examine seasonal diurnal rhythms, focusing on time allocation for different behaviours throughout the daylight hours. To our knowledge, this is the first study addressing these aspects of Ibisbill ecology in the Indian Himalayan region. Improved understanding from this research will contribute to the informed management and conservation of Ibisbill populations in Jammu and Kashmir.

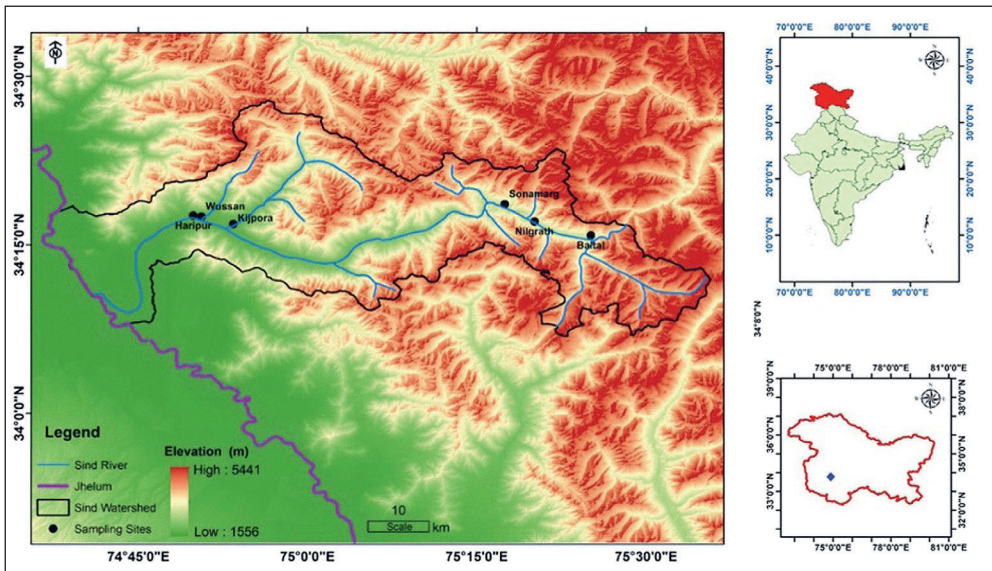


Figure 1. Map of the study area
1. ábra A vizsgált terület térképe

Methods

Data were directly gathered from observations made at visual point on different sites that were initially surveyed and selected along the Sindh River (Ul Haq *et al.* 2021). Bird activities were recorded using binoculars (10×50) and spotting scope, following Altmann (1974) at six sites (*Figure 1*). The study was conducted for a period of two years 2017–18 to 2018–19 during which 227 hours of total observation were made to record the diurnal time budgets in all the four seasons: spring, summer, autumn and winter. Diurnal habitat rhythm of the bird was also studied. Ibisbill performed various behavioural activities that have been broadly categorized into five headings: foraging, resting, locomotion, alert and others which include eliminating waste products, display, mating and antagonistic activities.

Results

Activity time budget

Comparison of the annual activity time budgets revealed a high degree of similarity between the two study periods (*Figure 2*). The proportional contribution of each activity category differed by less than 1% between years, with foraging and resting consistently comprising the largest components of the activity budget. Minor inter-annual variation was evident in alert and locomotory behaviours; however, these differences were small in magnitude and did not exhibit a consistent directional pattern.

Seasonal data indicated that foraging was maximum in winter ($60.55 \pm 1.15\%$) and minimum in spring ($41.78 \pm 1.42\%$) (*Figure 3*). Resting was found to be maximum in autumn ($32.78 \pm 2.16\%$) and minimum in winter ($22.58 \pm 1.59\%$). Time spent on locomotion was maximum ($14.36 \pm 0.17\%$) in summer and minimum in spring season ($6.16 \pm 0.6\%$).

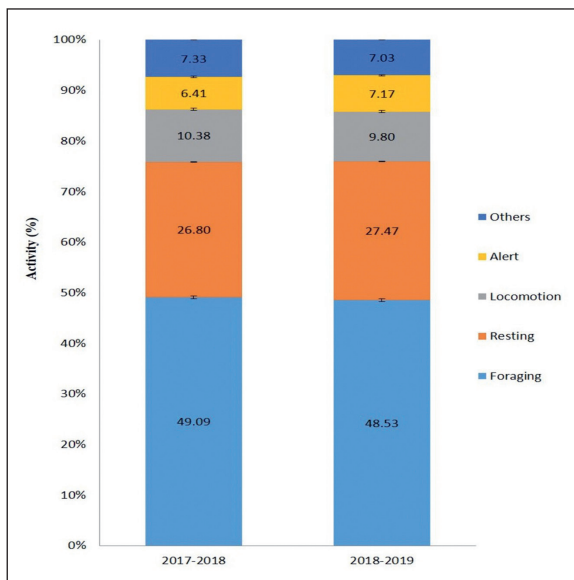


Figure 2. Annual activity time budget of Ibisbill 2017–2018, 2018–2019

2. ábra A kardcsőrű töcs éves tevékenységi aktivitása

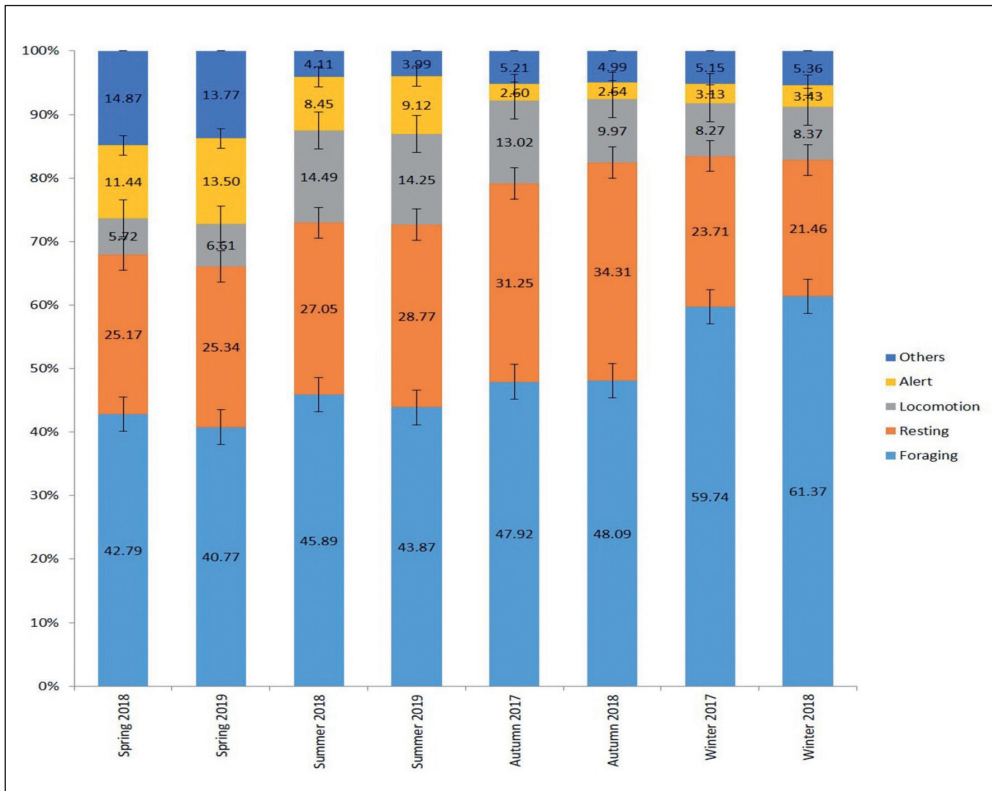


Figure 3. Annual activity time budget of Ibisbill
 3. ábra A kardcsőrű töcs évenkénti szezonális aktivitása

Diurnal rhythms of Ibisbill

Seasonal diurnal rhythms in foraging, resting and other behavioural activities were recorded. The percentage of time spent on each category of the behavioural activities varied throughout the day as well (Figure 4).

In summer foraging showed a maximum peak in the morning hours (08:00 to 10:00), however, in winter the maximum peak was observed in the afternoon (12:00 to 15:00). In autumn the foraging peaked maximum between 11:00 to 13:00, while as in spring foraging showed maximum peak in late morning hours (9:00 to 11:00).

Resting showed a maximum peak between 16:00 to 18:00 in summer and in winter the resting was maximum in the morning hours. In spring the maximum peak in resting was observed in the afternoon between 14:00 to 16:00. Resting in autumn showed a gradual decrease in early morning hours with a sharp increase from 10:00.

The diurnal rhythm of locomotion and alertness showed less variation in all the seasons, however, the alertness behaviour showed an increase in the frequency towards the evening in spring and summer with a reverse trend in autumn and winter.

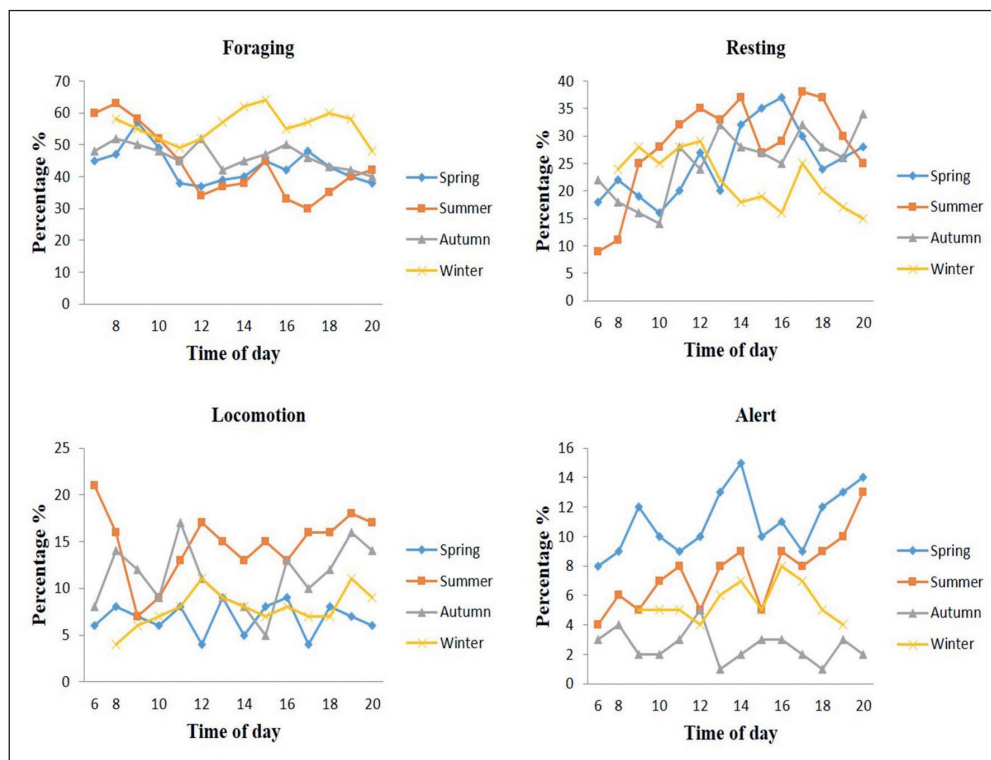


Figure 4. Diurnal rhythms of Ibisbill during different time of day in spring, summer, autumn and winter

4. ábra A kardcsőrű tölcs nappali aktivitása a különböző napszakokban tavasszal, nyáron, ősszel és télen

Discussion

The activity time budget of a species is fundamental for understanding its ecological requirements and involves a comprehensive analysis of behavioural activity patterns, as well as the physical, social and environmental conditions influencing these patterns (Aissaoui *et al.* 2011). For the Ibisbill, behavioural activities included feeding, resting, locomotion, alertness, breeding and maintenance. Among these activities, feeding was the most dominant, accounting for 50% of the total annual activity budget. This aligns with findings by Ye *et al.* (2013) in China, where a similar trend in the foraging rate of Ibisbill was observed.

Significant seasonal variations were evident in the activity time budget of Ibisbill. Foraging peaked during winter. This heightened focus on foraging can be attributed to the challenges posed by ice- and snow-covered feeding grounds, which necessitate increased effort to secure food. Additionally, reduced invertebrate diversity during winter and higher energy requirements likely contribute to this pattern (Ye *et al.* 2013).

Resting was the second most prevalent activity, with a marked increase during autumn. This pattern suggests a possible preparatory phase for harsher winter conditions, similar to patterns observed in Wilson's Plover (*Charadrius wilsonia*), as reported by Morrier and McNeil (1991). Although Wilson's Plover inhabits different ecological conditions, the behavioural parallels highlight the adaptive significance of energy conservation during transitional seasons.

Diurnal activity rhythms of the Ibisbill also exhibited marked seasonal variations in foraging, resting and alert behaviours, while locomotion showed relatively minimal variation. During summer, foraging activity peaked during the morning hours, likely due to optimal prey availability and favourable environmental conditions. Similar pattern was recorded by Norazlimi and Ramli (2015), while investigating relationship between the physical morphology of shorebirds and waterbirds, which include Lesser Adjutant (*Leptoptilos javanicus*), Common Redshank (*Tringa totanus*), Whimbrel (*Numenius phaeopus*) and Striated Heron (*Butorides striata*) and their foraging behaviour in the mudflat areas of Selangor, Peninsular Malaysia. Conversely, in winter, foraging activity showed a maximum peak in the afternoon, coinciding with the melting of ice along river edges, which exposed feeding sites. These observations are consistent with studies conducted in China, where diurnal activity time budgets of Ibisbill were compared between summer and winter (Ye *et al.* 2013). The reduced variation in locomotion across seasons suggests that movement is primarily utilitarian, driven by essential needs such as territory patrol and shifts between activity sites, rather than environmental or seasonal factors.

The acquired knowledge about the behavioural ecology of Ibisbill and its interaction with alpine riparian landscapes offers critical insights for conservation and management. The species' reliance on specific habitats underscores the importance of preserving undisturbed riverine ecosystems in the Indian Himalayan region and other range countries. Conservation efforts should prioritize mitigating human-induced disturbances, maintaining habitat connectivity, and protecting key feeding and resting areas, especially during critical seasons such as winter. By understanding the behavioural adaptations of Ibisbill, conservation strategies can be tailored to enhance the resilience of this iconic species in the face of environmental and anthropogenic challenges.

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