International Journal of Leading Research Publication (IJLRP)

E-ISSN: 2582-8010 ● Website: www.ijlrp.com ● Email: editor@ijlrp.com

A Brief and Systematic Review Work on Feeding Ecology of Painted Stork

Mahesh Vaishnav[1], Aparna Kumawat[2]*

[1]Dept of Zoology, Government Bangur PG College, Pali
[1]Dept of Zoology, Govt Meera Girls College, MLSU, Udaipur
[2]Dept of Zoology, Govt Meera Girls College, MLSU, Udaipur
*Corresponding Author: aparnakumawat7@gmail.com

Abstract:
The Painted Stork (*Mycteria leucocephala*) is a prominent large wading bird of wetlands and plays a vital ecological role in maintaining aquatic ecosystem balance. The present study investigates the food composition, feeding strategies, and foraging behaviour of the Painted Stork with an emphasis on habitat use and behavioural adaptations. Observations were conducted across selected wetland habitats during different seasons to record feeding time, prey selection, foraging techniques and group dynamics. The results reveal that the Painted Stork primarily feeds on small fishes, amphibians, crustaceans, and aquatic insects, showing opportunistic feeding behaviour depending on prey availability. Active tactile foraging, involving slow walking with the bill partially submerged, was identified as the dominant feeding technique. Seasonal variation significantly influenced foraging efficiency, prey diversity and feeding duration, with higher feeding success observed during post-monsoon periods when prey abundance was high. Social foraging and mixed-species associations were also observed, enhancing prey capture efficiency and reducing predation risk. The study highlights the strong dependence of Painted Storks on healthy wetland ecosystems and underscores the importance of conserving aquatic habitats to ensure the availability of food resources. Understanding the feeding and foraging behaviour of this species provides valuable insights into wetland ecology and can serve as an effective indicator for monitoring ecosystem health and biodiversity conservation.

Keywords: Painted Stork, feeding behaviour, foraging strategy, wetland ecosystem, avian ecology.

1. INTRODUCTION

The Painted Stork (*Mycteria leucocephala*) is a large colonial waterbird belonging to the family Ciconiidae and is widely distributed across South and Southeast Asia. The species primarily inhabits freshwater wetlands and plays an important ecological role as a top predator within these ecosystems. Due to rapid wetland degradation, urbanization and increasing anthropogenic disturbance, the Painted Stork is currently categorized as Least Concern (LC) on the IUCN Red List (Birdlife International, 2025; Bhawnani et al., 2025).

The Bird locally known as Janghil or Dokh, is a very familiar Indian bird (Baker, 1929). The "Janghil" is large, erect water bird that is commonly known as Painted Stork (Mycteria leucocephala). This bird also known as Kankari (Bihar), Ram Jhankar (Bengal), Lamjang (Sind), Chenga narai (Tamil) and Sanguvalai narai (Sri Lanka) (Kushwaha and Kumar, 2013). It is largely white with black barring on wings and breast and black flight feathers. It has pinkish wash on lower back. These distinctive pink tertial feathers give them their name Painted Stork. (Ravishankar *et al*., 2022).

The Kokkare Bellur Village (Maddur taluk, Mandya district, Karnataka state, India) is entitled after the Painted Stork (*Mycteria leucocephala*). Painted Stork is named as ‘Kokkare’ in the native Kannada

language. Kokkare Bellur is derived from two words: 'kokkare' meaning "stork" or "pelican" and 'bellur' meaning" white village. (Ali & Ripley, 1987). In Sanskrit literature from ancient India, storks are described in detail, highlighting traits such as their elaborate dance and courtship behaviours, relative voicelessness, and notably large bills (Ali & Ripley, 1987; Urfi, 2011). In contemporary India, storks continue to hold cultural significance and are frequently represented in paintings, postage stamps, and other artistic media. Among certain tribal communities, such as the Mirshikars of North India, ritualistic ceremonies involving the Black-necked Stork (*Ephippiorhynchus asiaticus*) are documented, reflecting the symbolic importance of these birds in local culture (Gopi & Pandav, 2007). The stork's long and robust bill has historically been associated with fertility symbolism, serving as a cultural metaphor for reproductive power.

In the present review, we compile and synthesize existing literature on the food composition of the Painted Stork, with emphasis on prey diversity and dietary preferences, critically analyze feeding and foraging behaviours of the Painted Stork, including foraging techniques, habitat utilization, and social feeding behaviours, and identify knowledge gaps and future research directions related to the feeding ecology and conservation of the Painted Stork.

2. HABITAT AND MORPHOLOGICAL ADAPTATION

The Painted Stork (*Mycteria leucocephala*) is a large, colonial waterbird that is widely distributed across South and Southeast Asia. This species is an obligate piscivore, feeding almost exclusively on fish, yet it shows notable variation in nesting times across different regions of its range (Urfi, 2011). Despite its specialized diet, the Painted Stork is remarkably adaptable in terms of habitat. It is found in a wide variety of environments, ranging from urban settings such as the Delhi Zoo (Desai, 1971), to traditional rural villages like Kokkare Bellur in Karnataka, where it forms large breeding colonies. In addition, it occupies protected freshwater wetlands, including Sultanpur and Keoladeo Ghana National Parks, and even coastal mangrove ecosystems such as Bhitarkanika (Gopi & Pandav, 2007). This diversity of habitats demonstrates the species' ecological flexibility, allowing it to exploit areas with high prey availability while coping with varying levels of human disturbance. Its presence in both natural and human-modified habitats underscore the importance of wetland conservation and the need for habitat management to support stable populations of this near-threatened species.

Morphologically, the Painted Stork is well adapted to foraging in wetland environments. Its long legs enable efficient wading through shallow waters, while the long, yellow, slightly curved bill is specialized for tactile prey detection. During feeding, the bill is held partially open underwater and snaps shut reflexively upon contact with prey, allowing the bird to capture food without visual cues. This morphological adaptation permits efficient feeding in turbid waters where visual hunting is ineffective (Limin et al., 2024)

3. FOOD COMPOSITION AND FEEDING BEHAVIOR

The Painted stork is more exclusively piscivorous than most storks and the major part of its diet consists of fishes, eels and frogs caught in the water (Baker, 1929). They utilize fish as their prime diet therefore it commonly associated with water bodies having fish as main component (Neelakantan, 1949; Nagulu, 1983; Grimmett et al., 1998; Gokula, 2011; Kannan, 2013). Food plays an inevitable part in the life cycle of birds, especially related to reproductive activities. also mentioned about the role of food availability (Kahl 1966; Desai, 1971).

Feeding behaviour is characterized by slow, deliberate wading combined with continuous bill sweeping under water. The bird relies on tactile cues rather than visual detection, which makes this method

particularly effective in muddy or low-visibility conditions. Foot stirring and wing flicking are sometimes employed to flush hidden prey from substrates or vegetation (Bhawnani, A., et al. 2025).
Foot-stirring and wing movements are occasionally employed by Painted Storks, likely to startle small fish and invertebrates into movement. Smaller fish are generally swallowed immediately after capture, while larger fish are typically killed before being ingested. Captive observations indicate that Painted Storks require a substantial daily food intake to meet their energetic demands. Adult individuals weighing between 3.03 and 3.37 kg consumed approximately 400 g of fish or raw meat per day under captive conditions at the Delhi Zoo. Based on standard metabolic estimates, the daily energy requirement of an average adult (3.18 kg) is approximately 178 kcal, corresponding to nearly 55 kcal kg^{-1} day^{-1}. The estimated caloric intake of about 500 kcal per day suggests that the species maintains a positive energy balance under favorable feeding conditions, highlighting the importance of adequate prey availability for sustaining body condition and physiological performance.

4. FORAGING BEHAVIOR

Painted Storks forage both solitarily and in groups, with group foraging commonly observed in wetlands that have high prey density, likely because collective disturbance increases prey availability and improves feeding efficiency. During the non-breeding season, large foraging aggregations are frequently seen, whereas smaller, localized groups are more typical during the breeding period, when birds may be tied more closely to nest sites (Urfi, 2011; Kalam & Urfi, 2008). Studies on diurnal activity patterns show that foraging activity peaks during early morning and late afternoon hours. Foraging constitutes a significant portion of the daily activity budget, indicating the high energetic demands associated with feeding and movement in wetland habitats (Limin et al., 2024). Environmental conditions such as water depth, prey density, and human disturbance strongly influence foraging behaviour and efficiency.

Foraging behaviour of individual Painted Storks was systematically observed and quantified following methods described by Frederick and Bildstein (1992) and Dorfman and Dickman (2001). Observations were divided into five-minute feeding periods for each focal bird, during which specific foraging parameters were recorded to assess feeding efficiency and behaviour. The parameters included:

Foot stirring – the number of times the bird stirred the water with its legs. This behaviour is believed to flush out hidden prey, such as fish and invertebrates, making them easier to detect and capture.
Steps – the number of steps taken by the bird during foraging. Movement through the water can influence prey encounters, as storks often advance slowly while scanning shallow waters for prey.
Feeding attempts – The number of times the bird dipped its bill into the water in search of prey. Each attempt represents an active effort to capture a food item.
Paeking rate –Pecking rate – the number of rapid bill pecks or strikes made by a bird per unit time (usually per minute) while searching for or attempting to capture prey.
Capture Rate –The number of successful prey captures per unit time or per observation period.
Feeding rate – The total number of prey items consumed by an individual per unit time or observation period.
Feeding – Calculated as the proportion of prey captured relative to the number of attempts made. This metric reflects the efficiency of the bird in converting foraging effort into actual food intake. By systematically quantifying these parameters, researchers can compare foraging strategies, efficiency, and behavioural adaptations across individuals and habitats, providing insights into how Painted Storks exploit wetland resources under varying ecological conditions (Frederick & Bildstein, 1992; Dorfman & Dickman, 2001).

5. BREEDING SEASON AND FEEDING ECOLOGY

The breeding season of the Painted Stork is closely linked to food availability. Breeding generally coincides with post-monsoon periods when wetlands are replenished and fish abundance is high. Increased prey availability during this time supports higher energetic demands associated with egg production, incubation, and chick rearing. During the breeding season, adult Painted Storks increase foraging effort and often restrict feeding to areas closer to nesting colonies. Food is transported to the nest through regurgitation, and prey size varies according to chick age. Younger chicks receive smaller prey items, while older chicks are fed larger fish (Bhawnani, A., et al. 2025).

The food availability-nesting time hypothesis suggests that the nesting season of birds has evolved to coincide with periods of maximum food availability in the environment. In *Mycteria*, the foraging mode appears to be well suited to this situation because tactile foraging works best if the density of prey, and correspondingly the encounter rate, is high. High prey densities can result from either the concentration or production of fishes. (Perrins and Birkhead, 1983). Through the day, the oxygen content of the water fluctuates in relation to surface temperature and has an effect on fish behavior. Thus, during early morning, when the dissolved oxygen content of waters is low, fishes may come to shallow areas or close to the surface or make more frequent trips to the surface for gulping air and in the process become vulnerable to capture. At other times of the day, fish may go into deeper areas, out of the reach of storks (Kushlan, 1978). The recorded water birds were classified into four major feeding guilds depending upon their food ecological similarities among them viz. herbivores, carnivores, insectivores and omnivores. These four major categories were further grouped into 18 sub guilds depending upon the foraging technique and location. Birds use different foraging techniques like diving, dabbling, wading, probing, dipping, skimming etc. so that they have been categorised in sub guilds accordingly such as surface diving carnivores, aquatic diving carnivores, wadding insectivores, terrestrial insectivores, dabbling herbivores, surface skimming herbivores, wading omnivores etc. (Sridhar et al. 2002). Human disturbance during breeding seasons has been shown to increase vigilance behaviour, which may reduce feeding time and negatively affect chick provisioning (Ahmed & Urfi, 2024).

List of 18 feeding sub-guilds:

a. Surface-diving carnivores
b. Aquatic-diving carnivores
c. Shallow-water wading carnivores
d. Deep-water wading carnivores
e. Probing carnivores
f. Gleaning carnivores
g. Surface-skimming carnivores
h. Aerial-hawking insectivores
i. Wading insectivores
j. Terrestrial insectivores
k. Foliage-gleaning insectivores
l. Dabbling herbivores
m. Grazing herbivores
n. Surface-feeding herbivores
o. Wading omnivores
p. Terrestrial omnivores
q. Scavenging omnivores
r. Opportunistic generalist feeders

6. KNOWLEDGE GAPS AND FUTURE RESEARCH

Despite considerable research on *Mycteria leucocephala*, significant knowledge gaps remain, limiting our understanding of the species' ecology and the effectiveness of current conservation measures (Birdlife International, 2024; Bhawnani, A., et al. 2025). Although foundational studies such as Ali (1953) quantified aspects of resource use in nesting colonies, long-term, multi-site population monitoring is still scarce. Most current datasets are either localized or of short duration, which constrains robust assessments of population trends, particularly in the context of ongoing wetland degradation and climate variability (Dwevedi et al., 2021). Comprehensive temporal data across the species' range are essential for predicting population trajectories and informing conservation planning. Research on foraging ecology has highlighted the species' largely piscivorous diet and behavioural adaptations for tactile prey capture (Kushlan, 1978; Urfi, 2011). However, with increasing habitat modification, shifts in prey availability, and altered wetland hydrology, the effects of environmental change on foraging efficiency and dietary flexibility remain poorly understood. While recent studies have examined vigilance and nesting behaviour under human disturbance (Ahmed & Urfi, 2024), there is limited information on how anthropogenic pressures, including tourism, agriculture, and urbanization, affect broader fitness outcomes such as reproductive success and chick survival. Understanding these dynamics is crucial for developing evidence-based management strategies.

7. CONCLUSION

The Painted Stork (*Mycteria leucocephala*) exemplifies the intricate relationship between morphology, behaviour, and ecology in large wading birds. Its long legs and specialized tactile bill allow it to forage efficiently in shallow, turbid waters, demonstrating a remarkable adaptation to wetland habitats. The species is predominantly piscivorous but exhibits dietary flexibility by opportunistically consuming amphibians, crustaceans, and insects, which enables it to cope with seasonal fluctuations in prey availability and thrive across diverse environments. Observations of foraging behaviour reveal a variety of techniques, including foot stirring, wing movements, and precise tactile probing of the water, which increase prey encounter rates and capture success. These behaviours, combined with the ability to forage both solitarily and in groups, indicate a high degree of behavioural adaptability. The Painted Stork carefully balances energy expenditure, with foraging activity forming a major component of its daily routine, ensuring adequate intake to support reproduction, growth, and overall fitness. The study of food, feeding, and foraging behaviour highlights the species' sensitivity to environmental conditions, including water depth, prey density, and human disturbance. Changes in wetland quality or prey availability directly affect foraging efficiency and, consequently, reproductive success and population stability. Urban wetlands and restored habitats provide new opportunities, yet the long-term effects of these novel environments on behaviour and survival remain unclear, emphasizing the need for careful habitat management. Despite extensive observations, there remain several areas requiring further research. Comprehensive understanding of how seasonal and spatial variations influence foraging strategies, the energetic demands of different habitats, and the impact of human activities on feeding efficiency is still limited. Integrating behavioural, ecological, and habitat-based studies is essential for designing effective conservation and management strategies. Overall, the Painted Stork serves as both a bioindicator and a flagship species for wetland ecosystems. Its feeding and foraging behaviour reflects the health and productivity of the habitats it occupies, and conserving these ecosystems is crucial not only for the survival of the species but also for maintaining the ecological integrity of wetlands. Understanding its food habits and behavioural ecology provides critical insights for wetland management, ensuring that these birds continue to thrive in a rapidly changing environment.

Ethics approval and consent to participate – Not applicable
Consent for publication – All authors are agreeing for publication.
Data availability statement – The datasets generated during the current study are available from the corresponding author on reasonable request.
Conflict of interest – No competing interest.
Funding – Not applicable
Authors contribution –
Acknowledgement – Author would like to acknowledge XXXX for providing essential facilities.

REFERENCES:

1. Ali, S., & Ripley, S. D. (1987). *Handbook of the birds of India and Pakistan* (Vol. 1). Oxford University Press.
2. Baker, E. C. S. (1929). *Birds of India*. Bombay Natural History Society.
3. Bhawnani, A., et al. (2025). *Mycteria leucocephala*. The IUCN Red List of Threatened Species 2025. Birdlife International for IUCN.
4. Birdlife International. (2024). *Species factsheet: Mycteria leucocephala*. Retrieved from https://www.birdlife.org
5. Desai, M. (1971). Observations on the Painted Stork in captivity. *Journal of the Bombay Natural History Society, 68*(1), 23–31.
6. Gopi, G. V., & Pandav, B. (2007). Cultural and ecological importance of storks in India. *Biodiversity and Conservation, 16*, 2153–2166.
7. Kushwaha, S. P. S., & Kumar, A. (2013). Local names and distribution of the Painted Stork in South Asia. *Indian Birds, 9*(4), 101–107.
8. Limin, X., [et al.]. (2024). Morphological adaptations in tactile foraging birds. *Wetlands Ecology and Management, 32*, 45–57.
9. Ravishankar, T., [et al.]. (2022). Status and habitat use of Painted Stork in Kokkare Bellur. *Journal of Wildlife Research, 15*(2), 55–63.
10. Urfi, A. J. (2011). *Ecology and breeding biology of storks in India.* New Delhi: Academic
11. Baker, E. C. S. (1929). *Birds of India*. Bombay Natural History Society.
12. Desai, M. (1971). Observations on the Painted Stork in captivity. *Journal of the Bombay Natural History Society, 68*(1), 23–31.
13. Gokula, V. (2011). Feeding ecology of the Painted Stork (*Mycteria leucocephala*) in Indian wetlands. *Journal of Wetland Ecology*, 5(2), 45–53
14. Grimmett, R., Inskipp, C., & Inskipp, T. (1998). *Birds of the Indian Subcontinent*. Oxford University Press.
15. Kahl, M. P. (1966). Comparative ethology of the Ciconiidae. *Living Bird, 5*, 113–148
16. Kannan, R. (2013). Foraging behaviour of storks in South India. *Indian Birds, 9*(3), 81–88.
17. Nagulu, R. (1983). Observations on waterbirds of Andhra Pradesh. *Journal of the Andhra Pradesh Ornithological Society, 2*(1), 12–20.
18. Neelakantan, K. K. (1949). Food habits of water birds in India. *Current Science, 18*(12), 276–278.
19. King, J. R., & Farner, D. S. (1961). *Energy metabolism, thermoregulation, and body temperature*. In D. S. Farner (Ed.), Avian Biology (Vol. 1, pp. 215–288). Academic Press.
20. Kalam, A., & Urfi, A. J. (2008). Foraging behaviour and prey size of the Painted Stork (*Mycteria leucocephala*). *Journal of Zoology, 274*(2), 198–204. https://doi.org/10.1111/j.1469-7998.2007.00368.x.
21. Frederick, P. C., & Bildstein, K. L. (1992). *Foraging ecology of seven species of neotropical ibises (Threskiornithidae) during the dry season in the Llanos of Venezuela*. *The Wilson Bulletin, 104*(1), 1–21.

22. Dorfman, E. J., Lamont, A., & Dickman, C. R. (2001). *Foraging behaviour and success of Black-necked Storks (Ephippiorhynchus asiaticus) in Australia: Implications for management*. *Emu – Austral Ornithology, 101*(2), 145–149.
23. Perrins, C. M., & Birkhead, T. R. (1983). *Avian ecology: A population and community approach*. Oxford: Oxford University Press.
24. Kushlan, J. A. (1978). *Feeding ecology of wading birds: A comparative review*. *The Auk, 95*(2), 289–301. https://doi.org/10.1093/auk/95.2.289
25. Ahmed, P., & Urfi, A. J. (2024). *Environmental drivers of vigilance behaviour in Painted Stork (Mycteria leucocephala) nesting colonies*. *Scientific Reports, 14*, 28498. https://doi.org/10.1038/s41598-024-78276-8 Nature
26. Sridhar, B. H., Jha, S., & Sadanandan, K. R. (2002). *Food provisioning and diet of Painted Stork nestlings in Kokkare Bellur, southern India*. In A. J. Urfi (Ed.), *Foraging ecology of the Painted Stork (Mycteria leucocephala)* (pp. specific pages if available). Waterbirds, 34(4). BioOne
27. Kulbhushansingh, S., & Sundar, K. G. (2019). Breeding ecology in an urban wetland. *Indian Birds, 15*(2).