



## OPEN ACCESS

### Comparative assessment of avian diversity in cemented and non-cemented ponds

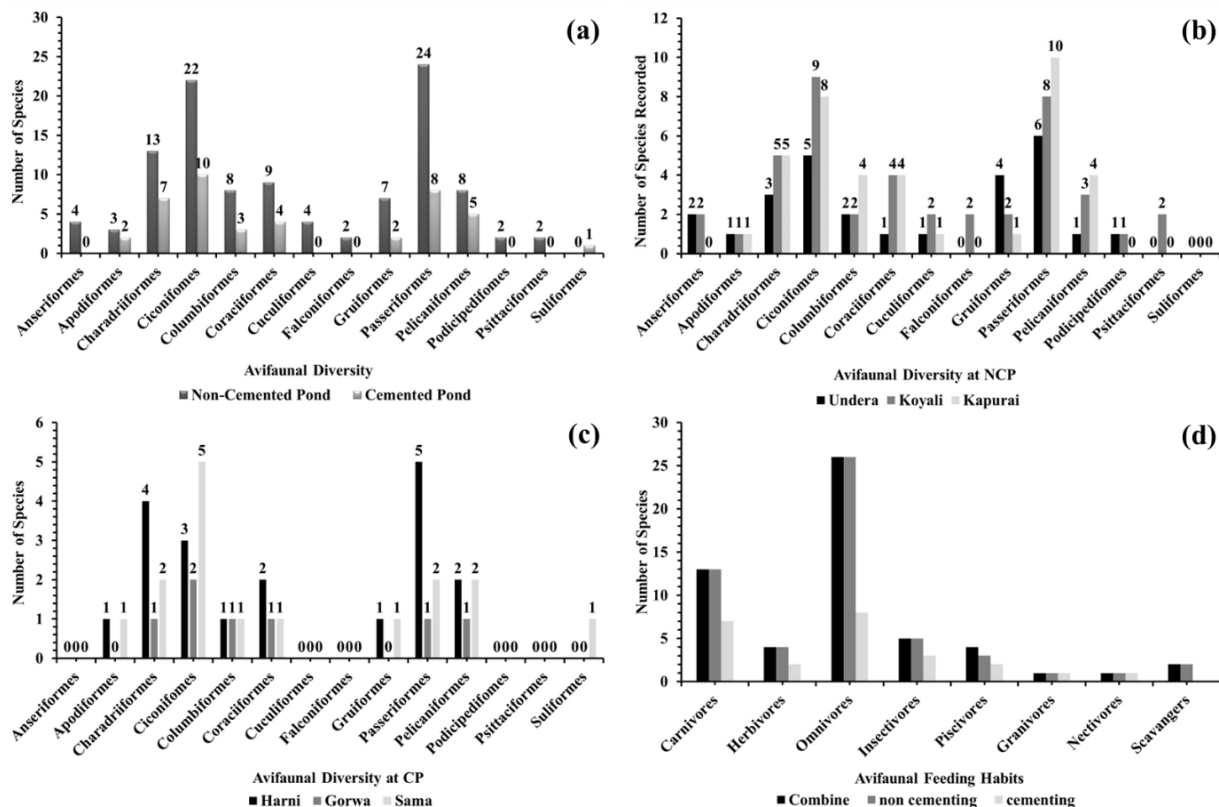
Water bodies are vital for sustaining life. India has about 2.42 million water bodies, with 97.1% in rural and 2.9% in urban areas; ponds make up 59.5% of these. Gujarat has 54,069 water bodies, of which only 8.71% are ponds. In Gujarat, 98.3% lie in rural areas, where ponds account for 7.9%, while in urban areas, ponds make up 56.3% (DWR 2023). Gujarat State of India harbours 615 species of birds (Ganpule 2022). Avifaunal diversity and abundance vary seasonally based on food availability, habitat characteristics, and breeding site preferences (Norris & Marra 2007). Urbanization and population growth lead to habitat fragmentation, altered vegetation, and reduced natural resources, affecting bird diversity, abundance, and distribution (Lee & Rotenberry 2005). Urban expansion causes biodiversity loss, native species decline, and increased extinction rates (Jadczyk & Drzeniecka-Osiadacz 2013, Ciach & Fröhlich 2016). Bird responses vary based on dietary guilds, nesting, and roosting habits, and even minor habitat changes can impact their behaviour (Traut 2003). Previous studies confirmed that urbanization impacts avian species abundance, richness, diversity, and distribution (McGill *et al.* 2015, Koparde & Raote 2016).

This short-term study was conducted to evaluate the preliminary effects of urbanization on avifaunal diversity in Vadodara city, Gujarat. Six ponds were selected—three with non-cemented boundaries: Undera, Koyali, and Kapurai, and three with cemented boundaries: Harni, Gorwa, and Sama. The sites were visited twice a month from December 2023 to April 2024, with a total of 60 visits. Observations were made in the early morning (07:00–09:00 hr) and evening (16:00–18:00 hr). The point count

method was employed, and all birds seen, heard, or hovering were recorded. Olympus 8×42 binoculars and a Nikon D3500 camera with a 70–300mm lens were used. Birds were identified using Grimmett *et al.* (1999), Kazmierczak (2000), and eBird (Fink *et al.* 2024), and later categorized by feeding habits, habitat, and migratory/residential status. Data were analysed using Microsoft Excel 2016.

A total of 56 bird species belonging to 29 families and 14 orders were recorded (Sup. Table 1). Of these, 55 species were found at non-cemented ponds, while only 24 species were seen at cemented ponds (Fig. 1). Among the non-cemented ponds, Koyali recorded the highest diversity (43), followed by Kapurai (36) and Undera (28). Of the cemented ponds, Harni had 19 species, Sama 16, and Gorwa only 8. The higher diversity at non-cemented ponds was likely due to richer food sources (aquatic plants, insects, fish), favourable conditions, and better soil and water quality (Kaur 2017). Urbanization tends to favour a few adaptable species while negatively impacting many others (O'Connell *et al.* 2000). It compels birds to adapt or abandon modified environments (Rathod *et al.* 2017). A similar study in Kolkata indicated the impact of urbanization on bird species composition and distribution (Sengupta *et al.* 2014).

Birds were categorized into eight dietary guilds: carnivores, herbivores, omnivores, insectivores, piscivores, granivores, nectarivores, and scavengers. Omnivores dominated both non-cemented (26 sp.) and cemented (8 sp.) ponds. Granivores were exclusive to non-cemented ponds, while nectarivores appeared only at cemented ones. Higher food resource diversity at non-cemented ponds likely reduced interspecific competition, while limited food and habitat at cemented ponds contributed to lower species richness (Kaur 2017).



**Figure 1.** Avifaunal diversity (a) number of species by order recorded at non-cemented ponds and cemented ponds (b) at NCPs (c) at CPs, and (d) based on their feeding habits at NCPs and CPs of Vadodara City, Gujarat.

In terms of residential status, non-cemented ponds hosted 47 resident and 8 migratory species, compared to 22 residents and 2 migrants at cemented ponds. Migrants and water-dependent birds were mostly seen at non-cemented sites. The oriental darter was observed at Sama Pond, possibly using a central pole-like structure for feeding. Of the 55 species at non-cemented ponds, 30 were terrestrial and 25 were waterbirds; whereas, out of 24 species at cemented ponds, 15 were terrestrial and 9 were waterbirds. Greater terrestrial bird presence at non-cemented ponds was linked to denser vegetation, fruiting trees, and microhabitats supporting insectivores and roosting needs. Water hyacinth (*Eichhornia crassipes*) at Undera pond supported grey-headed swamphen, but their numbers declined after the hyacinth was cleared in March. Subsequently, species like spot-billed duck, lesser whistling duck, little grebe, white-breasted waterhen, and black-winged stilt appeared. Swamphens rely on riparian vegetation for nesting (Kaur *et al.* 2017), explaining their post-clearance decline.

**Acknowledgements.** We thank the Head of the Department of Zoology (The Maharaja Sayajirao University of Baroda, Vadodara, India) for

providing facilities and necessary permissions; Wolfgang Fiedler (Max Planck Institute, Germany), James Eaton (Birdtour Asia Limited, UK), Ronglarp Sukmasuang (Kasetsart University, Thailand), and Ikram Douini (Faculté des Sciences et Techniques, Morocco) for reviewing the manuscript.

### Supplemental data

<https://doi.org/10.47605/tapro.v14i2.386>

### Literature cited

- Ciach, M. & A. Fröhlich (2016). Habitat type, food resources, noise and light pollution explain the species composition, abundance, and stability of a winter bird assemblage in an urban environment. *Urban Ecosystems*, 20(3): 547–559.
- DWR (2023). Department of Water Resources, Ministry of Jal Shakti, Government of India. *Water bodies (Vol. 1). River Development and Ganga Rejuvenation Minor Irrigation (Statistics) Wing*: 200pp.
- Fink, D., T. Auer, A. Johnston *et al.* (2024). *eBird Status and Trends, Data*. Version: 2023; Cornell Lab of Ornithology, Ithaca, New York.
- Ganpule, P. (2022). Fourth update to the Gujarat checklist: December 2022. *Flamingo Gujarat*, 5(4): 8–10.

- Grimmett, R., C. Inskipp & T. Inskipp (1999). *A Guide to the Birds of India, Pakistan, Nepal, Bangladesh, Bhutan, Sri Lanka, and the Maldives*. Princeton University Press, Princeton: 528pp.
- Jadczyk, P. & A. Drzeniecka-Osiadacz (2013). Feeding strategy of wintering rooks *Corvus frugilegus* L. in urban habitats. *Polish Journal of Ecology*, 61(3): 587–596.
- Kaur, R. (2017). Avifaunal diversity of Nangal wetland with special reference to migratory birds. *Unpublished PhD thesis, Punjabi University*.
- Kazmierczak, K. (2000). *Birds of India, Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh and the Maldives*. Om Books International, Noida: 452pp.
- Koparde, P. & N. Raote (2016). Areas of avian richness across an urban-rural setting: A case study of selected water-bodies from Pune, Maharashtra, India. *Indian BIRDS*, 12(2/3): 50–55.
- Lee, P.Y. & J.T. Rotenberry (2005). Relationships between bird species and tree species assemblages in forested habitats of eastern North America. *Journal of Biogeography*, 32(7): 1139–1150.
- McGill, B.J., M. Dornelas, N.J. Gotelli & A.E. Magurran (2015). Fifteen forms of biodiversity trend in the Anthropocene. *Trends in Ecology & Evolution*, 30(2): 104–113.
- Norris, R.D. & P.P. Marra (2007). Seasonal interactions, habitat quality, and population dynamics in migratory birds. *The Condor*, 109(3): 535–547.
- O'Connell, T.J., L.E. Jackson & R.P. Brijis (2000). Bird guilds as indicators of ecological condition in the central Appalachians. *Ecological Applications*, 10(6): 1706–1721.
- Rathod, J., S. Deshkar & G. Padate (2017). Diversity of avifauna in Urban City, Vadodara, Gujarat. *Biolife*, 5(2): 224–231.
- Sengupta, S., M. Mondal & P. Basu (2014). Bird species assemblages across a rural-urban gradient around Kolkata, India. *Urban Ecosystems*, 17(2): 585–596.
- Traut, A.H. (2003). *Urban lakes and waterbirds: Effects of development on distribution and behavior*. Unpublished MSc thesis, University of Florida: 111pp.

Submitted: 28 Jul 2024, Accepted: 22 Jul 2025

Subject Editor: Wolfgang Fiedler

H.A. Khandelwal<sup>1</sup>, V.S. Soni<sup>1</sup>, N.P. Maheta<sup>1\*</sup> & D.M. Bhatt<sup>1</sup>

<sup>1</sup> Department of Zoology, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara 390002, Gujarat, India  
E-mail: niketa.maheta@yahoo.com