

Uncommon Crakes and Rails (Rallidae) from the Irrigated Agricultural Landscape of Anand and Kheda Districts, Central Gujarat, India

Vishal S. Mistry: Darbar Pole, Vaso 387380, District Kheda. vmistry@vncindia.org

Anirudhkumar Vasava: Voluntary Nature Conservancy, 101-Radhadarshan, Behind Union Bank, Vallabh Vidyanagar 388120 & Salim Ali Centre for Ornithology and Natural History, Anaikatti, Coimbatore, Tamil Nadu 641108. aniruddh.vasava@gmail.com [Corresponding author]

Late Dr. B. M. Parasharya: Vishrut Park 1/18, Jitodiya Road, Anand 388001. parasharya@yahoo.com

Aamir Matli: 516/B, Zainabiya Manzil, opposite Nice Point, near Shishuvihar Circle, Bhavnagar 364001. aamirmatli72@gmail.com

Sanjeeth Peter: DDMM Heart Institute, Mission Road, Nadiad 387002. sanjeethpeter@gmail.com

Bhavesh Mengar: Shreej Sadan', Hanuman Faliya, Petlad 388450. mengitoxic@yahoo.com

Introduction

Crakes and rails (Family: Rallidae) represent one of the most poorly understood waterbird groups globally due to their cryptic plumage, secretive behavior, and preference for dense wetland vegetation (Ripley, 1977; Taylor & van Perlo, 1998). In the Indian subcontinent, comprehensive studies on their status and ecology remain scarce despite approximately 25 rallid species occurring in the region (Ali & Ripley, 2001; Rasmussen & Anderton, 2012). Agricultural wetlands, particularly rice fields, have emerged as important habitats for waterbirds across Asia (Elphick, 2000), with Sundar & Subramanya (2010) documenting 351 bird species utilizing rice fields in the Indian subcontinent, including 10 rallid species.

Historical ornithological surveys in Gujarat provide limited rallid information. Ali (1954) documented four resident breeding species: White-breasted Waterhen (*Amaurornis phoenicurus*), Common Moorhen (*Gallinula chloropus*), Purple Swamphen (*Porphyrio porphyrio*), and Common Coot (*Fulica atra*). At Ajwa Reservoir, he observed only Eastern Baillon's Crake (*Porzana pusilla*), mentioning historical records of Slaty-breasted Rail (*Gallirallus striatus*), Spotted Crake (*Porzana porzana*), and Brown Crake (*Porzana akool*). Khacher (1996) claimed the first Gujarat record of Ruddy-breasted Crake (*Porzana fusca*) but omitted several species mentioned by Ali, creating uncertainty about historical status.

The implementation of major canal irrigation projects since 1960, particularly the Mahi Right Bank Canal (MRBC) system and subsequently the Narmada Canal network after 2002, has fundamentally transformed central Gujarat's agricultural landscape, creating extensive networks of perennial and seasonal wetlands (Mukherjee et al., 2000). Despite the potential importance of these irrigated landscapes for rallids, no systematic surveys have been conducted. This study documents the occurrence, distribution, abundance, and habitat use of uncommon rallid species in the canal-irrigated agricultural landscape of Anand and Kheda districts,

comparing current findings with historical records to assess changes in status and evaluate conservation significance.

Materials and Methods

Study Area: The study was conducted in portions of four tehsils spanning Anand and Kheda districts in central Gujarat: Vaso (22.66°N, 72.75°E) and Matar (22.77°N, 72.64°E) tehsils in Kheda District, and Tarapur (22.70°N, 72.90°E) and Khambhat (22.31°N, 72.62°E) tehsils in Anand District (Fig. 1). The region experiences tropical semi-arid climate with annual rainfall of 800–900 mm. The landscape has been intensively irrigated since 1960 through the MRBC system, with dominant land use comprising agricultural fields (approximately 85%), interspersed with villages, tanks, and canal networks. The agricultural cycle follows dual-cropping: paddy (*Oryza sativa*) during monsoon (July–October/November) with fields under 5–15 cm standing water, and wheat (*Triticum aestivum*) during winter (November–March/April) on drained fields. During monsoon, the landscape becomes extensively inundated, creating temporary wetland habitat. After harvest, low-lying patches, canal seepage zones, and village tanks retain water through winter, creating a mosaic of perennial and seasonal wetlands.

Key study sites included Deva Canal (22.74°N, 72.77°E), a 20 km MRBC branch with seepage creating marshy conditions in adjoining fields; Vastana Road (22.75°N, 72.81°E), a 7 km stretch with four marshy patches (0.5–2 ha each); Tarakpur Check Dam (22.68°N, 72.88°E), a shallow wetland approximately 8 km long and 0.5–1.5 km wide; and Pariej Wetland Complex (22.71°N, 72.59°E), a nationally important wetland with large storage tanks including Kanewal and Gobarapura (each >400 ha).

Survey Methods: Systematic surveys were conducted December 2015–March 2019, totalling approximately 150 field visits and 450 hours of observation. Survey intensity varied by season: December–March (3–5 visits per month, 120 visits total), June–October (2–3 visits per month, 25 visits), and

Crakes and Rails....

April–May (monthly visits, 5 visits). Each visit lasted 2–4 hours, conducted primarily during early morning (0600–1000h) and late afternoon (1600–1900h) when rallids are most active. Surveys employed standardized protocols including walks along canal banks and wetland margins with observation stops every 50–100 m, photography for identification confirmation, behavioral observations (minimum 15 minutes when birds detected), and habitat characterization including water depth, vegetation type and cover, substrate, and distance to cover. Species identification followed Grimmett et al. (2011) and Rasmussen & Anderton (2012). For each observation, we recorded date, time, location, species, number, age/sex, behavior, habitat characteristics, and weather conditions.

Results

We documented 12 rallid species including six commonly occurring species (White-breasted Waterhen, Eurasian Moorhen, Eurasian Coot, Grey-headed Swampphen, Brown

Crake, Eastern Baillon's Crake) and six uncommon species (Fig.1). Table 1 provides comprehensive summary of all observations for the six focal species, including abundance, distribution, temporal patterns, and habitat characteristics.

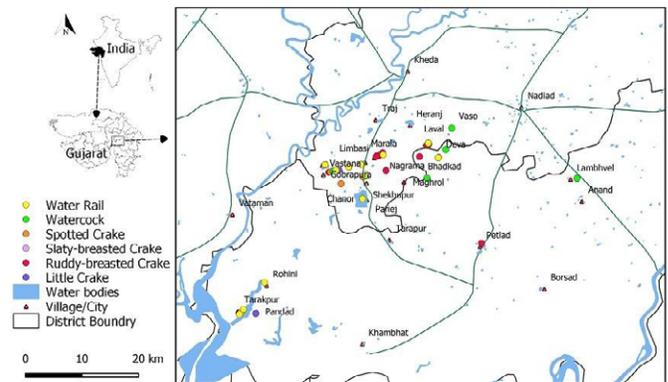


Fig. 1 Distribution records of six species of rallids in the study area.

Table 1: Summary of Uncommon Rallid Species Observations in Anand and Kheda Districts, Gujarat (2015–2019)

Species	Key Locations	Date Range of Sightings	Primary Habitats	Significance/ Key Findings
Little Crake (<i>Zapornia parva</i>)	<ul style="list-style-type: none"> Vastana Road, Matar Tehsil Khambhat Tehsil Gobarapura wetland Tarakpur Tidal Regulator 	October 2018 - March 2019	Shallow wetlands (0.5–1.2 m depth) with sparse <i>Typha</i> (20–40% cover) and floating vegetation	First record for rice-dominated agricultural landscape in Indian subcontinent. Suggests species is overlooked rather than rare in Gujarat. Likely present throughout canal-irrigated areas.
Ruddy-breasted Crake (<i>Porzana fusca</i>)	<ul style="list-style-type: none"> Deva Canal (20 km stretch) Parij wetland (3 locations) Narda tank Chanor Road Limbasi-Vastana Road Tarakpur Check Dam 	December 2015 - May 2016	Canal seepage zones with dense vegetation (60–90% cover), shallow water (5–30 cm)	High density observed - at least 12 pairs along 20 km stretch. More widespread and abundant than previously thought in Gujarat.
Spotted Crake (<i>Porzana porzana</i>)	<ul style="list-style-type: none"> Vastana Road (3 locations) Chanor Road Deva village Multiple sites across Gujarat 	December 2017 - February 2018	Moderate to dense emergent/floating vegetation (40–70% cover), shallow water (10–30 cm)	Confirms widespread winter distribution in Gujarat. Multiple records from Anand, Kheda, Ahmedabad, Rajkot, Bhuj, and Surat districts.
Water Rail (<i>Rallus aquaticus</i>)	<ul style="list-style-type: none"> Tarakpur Check Dam (2 locations) Rohini Parij wetland Vastana Road Deva Canal 	December 2017 - April 2018	Dense reed beds (<i>Typha</i> , <i>Phragmites</i>) (70–95% cover), water depth 20–80 cm	Indicates species may be extending wintering range further south to Indian Peninsula. Suggests uniform distribution in suitable marshy habitats during winter.

Slaty-breasted Rail (<i>Gallirallus striatus</i>)	<ul style="list-style-type: none"> • Tarakpur Wetland • South Gujarat (Bharuch, Valsad, Navsari) 	June - October 2018	Dense emergent vegetation (80–90% cover), shallow water (15–40 cm)	Provides evidence of monsoon breeding in central and south Gujarat. Observation of juvenile at same location as adult suggests local breeding.
Watercock (<i>Gallinula cinerea</i>)	<ul style="list-style-type: none"> • Paddy fields • Deva Canal • Vastana Road • Narda Tank • Lambhvel sewage pond (historical) 	June - August 2018	Flooded paddy fields (breeding), wetland margins with dense grass	Monsoon breeder in Gujarat. 10 of 11 sightings during June-August suggests six-month breeding presence. Previously absent in Ali's 1954 survey but now recorded statewide.

Little Crake (*Zapornia parva*)

The Little Crake, a winter visitor occurring from November through March, represents the first record from rice-dominated agricultural landscapes in the Indian subcontinent. We recorded fifteen individuals at 12 locations across three primary sites during November 2018–March 2019 (Fig. 2). Our first detection comprised two individuals photographed at Vastana Road on November 3, 2018, including an adult male displaying diagnostic features such as light bluish-grey lower neck and breast, red eye, prominent red bill base, and long primary projection extending 15–20 mm beyond scapulars, which distinguishes it from the similar Eastern Baillon's Crake. At Vastana Road, five individuals were observed at two locations one kilometer apart, showing strong site fidelity over four months. By mid-February, habitat desiccation forced birds to relocate to Gobarapura Wetland where five individuals were documented at five locations through March 20, 2019. At Tarakpur Tidal Regulator, we confirmed presence at seven locations with three pairs and four single birds, with three individuals showing site fidelity through March 20, 2019.



Fig. 2 Little Crake at Vastana road, clearly showing long projecting primaries, extending much beyond the length of scapulars.

Pic: Vishal Mistry

Little Crakes consistently selected shallow water habitats ranging from 0.5–1.2 m depth (mean: 0.8 m, n=45 observations) characterized by sparse emergent *Typha angustata* (20–40% cover) with floating *Ipomea aquatica* (20–35% cover) and algal scum, soft mud substrate, and proximity to dense cover (2–8 m distance). Feeding activity concentrated during early morning hours (0600–1100h, representing 62% of observations, n=45) and late afternoon (1700–1900h, 31%), with birds retreating to dense *Typha* stands during midday. Birds foraged by walking deliberately on floating vegetation and algal mats, picking aquatic insects, larvae, and small invertebrates from vegetation surfaces.

Multiple records between 2018-2020 confirm the occurrence of the Little Crake in Gujarat. The first photographic record was from Ranjitsagar Dam near Jamnagar (Trivedi 2018), followed by observations of a pair at Paal Wetland near Surat (Patel 2019) and a photographed male at Nalsarovar Bird Sanctuary on 13 March 2019, which remained until late March (Sama 2019). Three individuals were also reported from the Morkarsagar wetland complex, Porbandar, in December 2019 (Vargiya 2020). Together, these records indicate that the Little Crake is likely widespread in canal-irrigated landscapes across southern and central Gujarat, suggesting it has been previously overlooked rather than being a rare or vagrant species.

Ruddy-breasted Crake (*Porzana fusca*): The Ruddy-breasted Crake, functioning as a resident breeder, proved to be the most abundant uncommon species in our study area. We documented a minimum of 24 pairs (48 individuals) at 15 locations during December 2015–May 2016 (Fig. 3). Intensive surveys along Deva Canal revealed 12 distinct locations along the 20 km stretch near villages including Deva, Laval, Bhadkad, Maalawada, and Naghrama, yielding a density estimate of 0.6 pairs per kilometer. Additional observations occurred at three Pariej wetland locations, Narda tank, Chanor Road, Limbasi–Vastana Road, and Tarakpur Check Dam. VM photographed a breeding-condition pair at Deva village showing bright

Crakes and Rails....

plumage and territorial behavior, confirming local breeding activity (Fig.4). This species inhabited areas with water depth ranging from 5–30 cm (mean: 15 cm, n=32 observations) characterized by dense emergent vegetation including *Typha*, *Phragmites*, *Ipomea*, and *Polygonum* with 60–90% cover, showing particular preference for canal seepage zones where dense vegetation meets agricultural fields. Birds were active primarily during dawn and dusk, occasionally visible during overcast midday conditions, feeding on decaying organic material, earthworms, maggots, and aquatic invertebrates. At Chanor Road, one individual regularly visited an artificial feeding site throughout December 2017–January 2018, feeding alongside a Spotted Crake and providing rare opportunity for comparative behavioral observations. Recent observations from southern and central Gujarat (Parasharya et al., 2016) combined with our findings suggest this species is significantly more abundant and widespread than previously recognized throughout canal-irrigated regions where suitable dense wetland vegetation persists.



Fig. 3 Ruddy-Breasted Crakes were commonly found along the canals in the study region. Pic. Vishal Mistry



Fig. 4 Mounting/mating of a Ruddy-breasted crake pair at Deva Village. Pic: Vishal Mistry

Spotted Crake (*Porzana porzana*): The Spotted Crake occurred as a winter visitor from December through February, with five individuals documented at five locations during December 2017–February 2018 (Fig.5). VM and SP recorded individuals at three separate locations on Vastana Road, each featuring similar habitat conditions. At Chanor Road, VM monitored a single individual feeding at an artificial feeding site for two months, where this bird fed alongside a Ruddy-breasted Crake, showing preference for open muddy areas at vegetation edges and feeding on maggots and small invertebrates primarily during 0700–0900h and 1700–1800h. Another individual was recorded at Deva village on December 22, 2017, in a canal seepage zone with dense *Typha* vegetation.



Fig.5 Spotted crake at Vastana.

This species utilized habitats with water depth of 10–30 cm (mean: 18 cm, n=8 observations) characterized by moderate to dense emergent and floating vegetation (40–70% cover), soft mud substrate, and preference for vegetation edges and semi-open areas. The species proved highly secretive, typically remaining within dense vegetation, though when feeding in open areas it maintained close proximity (2–5 m) to escape cover. Birds fed by walking slowly through shallow water and on floating vegetation, picking invertebrates from vegetation and water surface, with escape response involving quick running into cover rather than flight.

Extensive recent records across Gujarat confirm widespread winter distribution. These include observations by Tejus Naik (2012) in Kheda District in February 2012, from Vadodara (Vyas 2021), multiple records from Surat region (Desai, 2017; Bhatt & Patel, 2017; Patel, 2017), observations at Mokarsagar Wetland Complex in Porbandar (Vargiya et al., 2020), Ashok Mashru reporting near Rajkot for two consecutive years in January and February 2018 (Mashru & Trivedi, Balar, 2018), photographs from Bhuj, Kachchh in February 2018 (Balar, 2018). These numerous recent records contrast sharply with

historical assessments, with Kazmierczak (2000) noting only two winter records in Gujarat. Our compilation confirms the species is a regular winter visitor that has been significantly under-recorded historically.

Water Rail (*Rallus aquaticus*): The Water Rail occurred as a winter visitor from December through April, with ten individuals documented at seven locations within a 40 km radius during December 2017–April 2018, possibly indicating southward range extension (Fig. 6). At Tarakpur Check Dam in December 2017, three individuals were sighted at two distinct locations on a single survey day, both sites featuring dense *Typha* and *Phragmites* stands bordering open water with depths of 40–80 cm. At Rohini in March 2018, VM and BMP observed one individual consistently for one week, with the bird showing strong site fidelity and utilizing the same 50 m stretch of canal margin with dense emergent vegetation. VM recorded two Water Rails at separate locations within Pariej wetland complex during January–February 2018, while at Deva Canal in February 2018, two individuals were consistently observed for 10–15 days and may have represented a pair based on their close association. A single Water Rail was photographed feeding in close proximity to a Little Crake on Vastana Road on November 9, 2018, providing rare documentation of both species utilizing the same microhabitat. A bird observed on March 29, 2018 displayed bright, fresh plumage characteristic of pre-breeding condition, with the last sighting occurring on April 2, 2018, indicating departure by early April for northern breeding grounds.



Fig. 6 The Water Rail was recorded at least from seven sites in the study area during 2017–2018.

Water Rails utilized habitats with water depth ranging from 20–80 cm (mean: 45 cm, n=15 observations) characterized by dense emergent vegetation including *Typha* and *Phragmites*

with 70–95% cover, showing strong preference for margins of deeper water bodies with extensive reed beds while avoiding completely open habitats. Birds proved highly secretive, remaining within or at immediate edges of dense vegetation with only brief feeding forays into semi-open areas during early morning (0630–0800h) and late evening (1730–1900h). Sharp "kip" calls were heard occasionally during evening hours.

Standard references indicate Water Rail distribution is limited primarily to western Himalayas and Kashmir (Ali & Ripley, 2001), but numerous western Indian records have accumulated including observations from Andhra Pradesh (Manakadan & Sivakumar, 2004; Kannan et al., 2009), Madhya Pradesh (Chandra et al., 2010), Maharashtra (Punjabi, 1997), and extensive recent Gujarat records (Shah, 2004; Jadeja & Shah, 2007; Bishop, 2010; Joshi & Karia, 2015; Bhatt & Patel, 2017; Andharia, 2018; Mashru, 2018; Patel, 2018). Seven locations documented in Anand and Kheda districts indicate relatively uniform distribution in suitable marshy habitats during winter, suggesting that canal-irrigated regions with appropriate vegetation structure support substantial winter populations and that the species may be extending its wintering range southward into peninsular India.

Slaty-breasted Rail (*Gallirallus striatus*): The Slaty-breasted Rail occurs as a resident breeder with monsoon breeding confirmed through our observations. We documented two individuals at Tarakpur Wetland: a single adult photographed on June 1, 2018 that remained throughout June, and a juvenile observed on October 2, 2018 at the same location (Fig.7, Fig.8). The adult inhabited dense *Typha* and *Phragmites* stands at the wetland margin adjacent to irrigated agricultural fields, in areas with water depth ranging from 15–40 cm and 80–90% vegetation cover. The juvenile showed characteristic plumage including brownish-grey overall coloration with less distinct barring than adults, and behavior typical of recently fledged birds. The observation of a juvenile at the same location where an adult was present during the breeding season provides strong circumstantial evidence of local breeding, confirming suspicions by Parasharya et al. (2004) regarding monsoon breeding in central Gujarat.

Recent Gujarat records indicate wider distribution than previously recognized (Ganpule et al., 2022) including observations from Barda in Porbandar (Das, 2010), Mokarsagar Reservoir in Amreli (Vagadiya, 2019), multiple records from Vadodara (Ameta et al., 2020; Solomon, 2020), Bharuch District observations in June 2012 and April 2013 (Patel, 2016), records from Baradasagar Dam and Nalsarovar (Ganpule, 2016), and particularly from south Gujarat in Valsad and Navsari

Crakes and Rails....

districts with documented nesting reports (Kapdi et al., 2020). The accumulation of records, particularly breeding season observations and nest records from south Gujarat, confirms that this species functions as a resident breeder in suitable wetland habitats across central and southern Gujarat, with the species' association with monsoon-flooded agricultural landscapes and canal-irrigated wetlands suggesting that irrigation development may have facilitated range expansion or population increase.



Fig. 7 Slaty-breasted Rail was seen throughout the month of June in 2021 at Tarakpur wetland.



Fig. 8 A juvenile Slaty-breasted Rail seen on 02 October 2018 at Tarakpur wetland.

Watercock (*Gallicrex cinerea*): The Watercock occurs as a monsoon breeding visitor from June through November, with seventeen individuals documented across 11 sightings during June–December 2018. Notably, ten sightings comprising 16 individuals (91% of total) occurred during June–August, confirming status as a monsoon breeder. On July 31, 2018, four males and one female were observed in paddy fields during peak breeding season, with males displaying characteristic breeding plumage including black overall coloration with red frontal shield, red legs, and yellow bill (Fig. 9). Males engaged in dramatic courtship displays by holding wings loosely away

from body, standing erect with neck extended, lowering head toward ground, and producing loud, resonant calls audible at considerable distance (estimated 500+ meters). These displays occurred in flooded paddy fields with water depth of 10–15 cm and rice plants approximately 40–50 cm tall providing partial cover. Additional sightings of pairs or single males occurred at Deva Canal, Vastana Road, and Narda Tank. One female recorded in December 2018 represented post-breeding lingering, with this late record suggesting that some individuals may remain longer than the typical breeding period (Fig.10). Birds utilized flooded paddy fields during early to mid-growth stages (rice 30–60 cm tall) with water depth of 5–15 cm for breeding habitat, while post-breeding individuals frequented wetland margins, canal edges, and tall grass areas near water with moderate to dense herbaceous vegetation providing cover while allowing movement. Males proved highly vocal and conspicuous during peak breeding in July–August, with territorial behavior evident as males defended specific paddy field areas.



Fig. 9 Display by a Watercock male. Pic: Vishal Mistry.



Fig.10 Female Watercock sighting during the month of December. Pic: Vishal Mistry.

The Watercock's current status represents a significant change from historical records, as Ali (1954) did not record this species

during his comprehensive Gujarat survey, suggesting either genuine absence or extreme rarity in the 1950s, or that the species was present but overlooked due to its cryptic behavior and monsoon occurrence when most surveys were conducted during winter. Since Ali's survey, the species has been recorded throughout Gujarat during southwestern monsoon (Mashru, 2017; Patel, 2015; Patel et al., 2019). The species' current widespread occurrence suggests either genuine range expansion or population increase, possibly facilitated by extensive paddy cultivation in irrigated areas created through canal development since 1960, or improved detection due to greater observer coverage during monsoon months.

Discussion

Principal Findings: This study reveals unexpectedly high diversity and abundance of rallids within canal-irrigated agricultural landscapes of Anand and Kheda districts, challenging the prevailing view that intensive agriculture offers limited conservation value. Twelve rallid species were recorded, including six previously regarded as uncommon or poorly known in Gujarat. Notably, the study documents the first agricultural landscape records of Little Crake and Spotted Crake from the Indian subcontinent, confirms breeding by Slaty-breasted Rail and Watercock, and reports high local abundance of Ruddy-breasted Crake, with a minimum of 24 pairs along a 40 km canal stretch (0.6 pairs/km). The widespread occurrence of several "rare" species suggests that historical perceptions of rarity may largely reflect detection bias rather than true scarcity.

Ecological Mechanisms Supporting Rallid Diversity: Irrigation development has fundamentally reshaped wetland availability in central Gujarat. The Mahi Right Bank Canal (operational since the 1960s) and the Narmada canal network (post-2002) have created a dense matrix of perennial and semi-perennial wetlands embedded within agricultural land. Canal seepage and water retention in village tanks and storage reservoirs sustain shallow wetlands year-round, characterized by dense emergent vegetation and high invertebrate productivity-conditions highly suitable for rallids. Linear seepage habitats along canals function as high-quality micro-wetlands, as illustrated by the high density of Ruddy-breasted Crake along the Deva Canal. Habitat heterogeneity generated by irrigation infrastructure allows coexistence of rallid species with contrasting ecological requirements. Deep, vegetated water bodies support Water Rail, shallow sparsely vegetated wetlands favor Little Crake, flooded paddy fields provide breeding habitat for Watercock, and dense marshy vegetation along canals and tanks supports Ruddy-breasted Crake and

Slaty-breasted Rail. This fine-scale mosaic of water depth, permanence, and vegetation structure is critical for sustaining multi-species assemblages. Rice cultivation further enhances habitat availability. Flooded paddy fields during the monsoon (July–October) provide extensive breeding and foraging habitat, particularly for Watercock. Post-harvest fields retain moisture and abundant invertebrate biomass, supporting winter-visiting rallids before they shift to perennial wetlands as fields dry. The predictability of these seasonal resources likely facilitates efficient habitat use by migratory species. Beyond rice fields, village tanks, reservoirs, vegetated field bunds, drainage channels, and small groves collectively add structural complexity, increasing food availability and shelter within the agricultural matrix.

Earlier surveys focused largely on winter months and on large wetlands, overlooking monsoon breeders and small, scattered agricultural marshes. Targeted surveys using habitat-specific searches, seasonal coverage, and increased observer expertise revealed substantially higher diversity and abundance. Improved access to identification resources and bioacoustic tools has further enhanced detection. These findings suggest that current distribution maps and abundance estimates for many rallids in India likely underestimate their true occurrence, especially in agricultural landscapes.

Conservation Implications: Intensively irrigated agricultural landscapes should be recognized as integral components of regional wetland conservation networks. While they do not replace natural wetlands, they provide complementary habitats that support significant populations of secretive and uncommon species. In regions where natural wetlands have been extensively lost, agricultural wetlands may represent primary habitats for many rallids. Water and agricultural management practices can substantially influence habitat quality. Maintaining year-round water flow in canals and storage tanks, retaining shallow water zones (5–50 cm), conserving vegetated canal margins, and avoiding excessive clearing of emergent vegetation enhance rallid habitat suitability. Despite current abundance, several threats warrant attention: increasing agricultural intensification and mechanization, canal lining that eliminates seepage wetlands, water scarcity from competing demands, wetland drainage, and land conversion for industrial or residential use. Without deliberate management, these pressures could rapidly erode the habitat mosaic that currently supports rallid diversity.

Comparative Context and Limitations: Species richness recorded in this study equals or exceeds that of several natural wetlands in Gujarat, indicating that agricultural wetlands can

Crakes and Rails....

support comparable rallid assemblages. Evidence of breeding and high local densities confirms that these landscapes function as complete habitats rather than transient foraging areas. However, limitations include non-systematic spatial coverage, greater survey effort in winter than monsoon, short study duration, lack of detection-probability estimates, and limited nest confirmation. Counts should therefore be interpreted as indices of relative abundance. Nonetheless, the extensive survey effort provides the most comprehensive assessment of rallids in intensively cultivated Indian landscapes to date.

Conclusion

This study demonstrates that canal-irrigated agricultural landscapes of central Gujarat support unexpectedly high diversity and abundance of rallids, including species previously considered rare or poorly known. The documentation of breeding by multiple species and high densities of Ruddy-breasted Crake confirms that these working landscapes sustain complete life cycles. Irrigation infrastructure and rice cultivation have created novel wetland habitats that partially compensate for natural wetland loss, highlighting their unrecognized conservation value. The apparent rarity of several rallid species likely reflects historical under-recording rather than true scarcity, underscoring the importance of systematic, habitat-focused surveys. Given the vast spatial extent of agricultural landscapes relative to protected wetlands, integrating agricultural wetlands into mainstream conservation planning is essential. Recognizing and managing these landscapes as multifunctional systems—supporting both food production and biodiversity—will be critical for the long-term conservation of rallids and other wetland-dependent species across South Asia.

Acknowledgements

We thank Pavan Patel, Mehul B. Patel, Savitha Ravi, and Pranjal Saikia for sharing Little Crake photographs; Niyati Patel for map preparation; Sherwin Everett JCT, Ahmedabad, for crake and rail identification guidance; Voluntary Nature Conservancy for logistics and support; Viral Joshi and Batuk Bhil for sharing unpublished observations; and the farmers of Anand and Kheda districts for field access tolerance. This work was conducted without external funding, representing the authors' voluntary contribution to Gujarat ornithology.

[Editor's Note: We would like to thank Dr Anika Tere for reviewing the draft.]

References

- Ali, S. (1954). The birds of Gujarat. Part I. *Journal of the Bombay Natural History Society*, 52(2&3), 374–458.
- Ali, S., & Ripley, S. D. (2001). *Handbook of the birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka* (2nd ed., Vol. 2). Delhi: Oxford University Press.
- Ameta, H., Patel, H., & Padate, G. (2020). Rare Slaty-breasted Rail (*Gallirallus striatus*) in Vadodara (Gujarat, India). *Jalaplavit*, 10, 44–49.
- Andharia, K. (2018). Water Rail in Bhavnagar. *Flamingo*, 16(2), 22.
- Balar, R. B. (2018). Spotted Crake *Porzana porzana*—adult. OBC Image Gallery. Retrieved from http://orientalbirdimages.org/search.php?Bird_Image_ID=155309&Bird_ID=814
- Bhatt, A., & Patel, P. (2017). Sighting of Spotted Crake and Water Rail near Surat. *Flamingo*, 15(3), 15.
- Bishop, D. (2010). The birds recorded on Victor Emanuel Nature Tours—Gujarat and western India, January 1–21, 2008. *Flamingo*, 8(1&2), 18–20.
- Chandra, K., Sharma, R. M., & Ojha, P. (2010). A compendium on the faunal resources of Narmada River Basin in Madhya Pradesh. *Records of the Zoological Survey of India, Occasional Paper No. 310*, 1–152.
- Das, S. (2010). *Slaty-breasted Rail photograph*. Retrieved from <http://www.indianaturewatch.net/displayimage.php?id=160809>
- Desai, N. (2017). Spotted Crake *Porzana porzana*—adult. Retrieved from http://orientalbirdimages.org/search.php?Bird_ID=814&Bird_Image_ID=136422
- Elphick, C. S. (2000). Functional equivalency between rice fields and seminatural wetland habitats. *Conservation Biology*, 14(1), 181–191.
- Ganpule, P. (2016). The birds of Gujarat: Status and distribution. *Flamingo*, 8(3)–12(4), 2–40.
- Ganpule, P., Trivedi, B., Varu, M., & Raina, A. D. (2022). A field guide to the birds of Gujarat. Bird Conservation Society, Gujarat.
- Grimmett, R., Inskipp, C., & Inskipp, T. (2011). *Birds of the Indian Subcontinent* (2nd ed.). London: Oxford University Press & Christopher Helm.
- Jadeja, R. D., & Shah, T. D. (2007). Additions to the birds of Kachchh: *Rallus aquaticus* Linnaeus, *Halcyon pileata* (Boddaert) and *Monticola saxatilis* (Linnaeus). *Flamingo*, 5(3&4), 5.
- Joshi, V., & Karia, P. (2015). Sightings of Water Rail at two places in Saurashtra. *Flamingo*, 13(3), 21.
- Kannan, V., Manakadan, R., Rao, P., Mohapatra, K. K., Sivakumar, S., & Santharam, V. (2009). The waterbirds of Pulicat Lake, Andhra Pradesh–Tamil Nadu, India, including those of the adjoining wetlands and heronries. *Journal of the Bombay Natural History Society*, 105(2), 162–180.
- Kapdi, P., Tandel, N., Desai, J., & Patel, M. (2020). Nest of Slaty-breasted Rail *Lewinia striata* in Navsari, Gujarat. doi: 10.13140/RG.2.2.27845.68321
- Kazmierczak, K. (2000). *A field guide to the birds of India, Sri Lanka,*

- Pakistan, Nepal, Bhutan, Bangladesh and the Maldives (1st ed.). New Delhi: Om Book Service.
- Khacher, L. (1996). The birds of Gujarat—a Salim Ali centenary year overview. *Journal of the Bombay Natural History Society*, 93(3), 331–373.
- Manakadan, R., & Sivakumar, S. (2004). Sighting of Water Rail *Rallus aquaticus* Linnaeus, 1758, in Sriharikota Island, Nellore District, Andhra Pradesh, India. *Newsletter for Ornithologists*, 1(1&2), 15–16.
- Mashru, A. (2017). Records of Watercocks in Gujarat. *Flamingo*, 15(1), 17–19.
- Mashru, A. (2018). Sighting of Ruddy-breasted Crake and Water Rail in Rajkot. *Flamingo*, 16(1), 13–14.
- Mashru, A., & Trivedi, B. (2012). Spotted Crake *Porzana porzana* sightings in Saurashtra, Gujarat. *Indian BIRDS*, 7(6), 162.
- Mukherjee, A., Borad, C. K., & Parasharya, B. M. (2002). A study of the ecological requirements of waterfowl at man-made reservoirs in Kheda District, Gujarat, India, with a view towards conservation, management and planning. *Zoos' Print Journal*, 17(5), 775–785.
- Naik, T. (2012). Spotted Crake (*Porzana porzana*), Kheda, Gujarat. February 2012. Posted May 27, 2012. Retrieved from <https://www.facebook.com/145673722149595>
- Parasharya, B. M., Borad, C. K., & Rank, D. N. (2004). *A checklist of the birds of Gujarat* (1st ed.). Gujarat: Bird Conservation Society.
- Parasharya, B. M., Patel, J., Trivedi, R., Joshi, T., Desai, R. M., & Patel, P. (2016). Status and distribution of Ruddy-breasted Crake in central and south Gujarat. *Flamingo*, 14(2), 8–11.
- Patel, A. (2017). Eurasian Spotted Crake. Surat, Gujarat. Retrieved from http://orientalbirdimages.org/search.php?Bird_ID=814&Bird_Image_ID=137142
- Patel, H. J., Naria, K. H., & Ameta, H. M. (2019). Recent sightings of the Watercock (*Gallixrex cinerea*) from Vadodara, with a note on its distribution in Central Gujarat. *NeBIO*, 10(4), 188–190.
- Patel, J. (2016). Slaty-breasted Rail in Gujarat. *Flamingo*, 14(3), 13–14.
- Patel, J. H. (2015). Notes on Watercock in Dist. Bharuch (South Gujarat). *Flamingo*, 13(3), 4–7.
- Patel, P. (2019). Sighting of Little Crake *Porzana parva* near Surat. *Flamingo*, 17(2–3), 31.
- Patel, R. (2018). Water Rail near Sutrapada, Gir-Somnath District. *Flamingo*, 16(2), 23.
- Punjabi, H. (1997). Sighting of Water Rail *Rallus aquaticus* near Mumbai. *Journal of the Bombay Natural History Society*, 94(1), 156.
- Ripley, S. D. (1977). *Rails of the world: A monograph of the family Rallidae*. Boston: David R. Godine.
- Sama, A. (2019). Little Crake *Porzana parva* near Nal Sarovar Bird Sanctuary. *Flamingo Gujarat*, 17(2), 21.
- Shah, S. (2004). Water Rail (*Rallus aquaticus*) sighted near Vav, Surat. *Flamingo*, 2(1&2), 2.
- Solomon, J. (2020). Slaty-breasted Rail *Gallirallus striatus* near Vadodara. *Flamingo Gujarat*, 3(2&3), 31.
- Sundar, K. S. G., & Subramanya, S. (2010). Bird use of rice fields in the Indian Subcontinent. *Waterbirds*, 33(Special), 44–70.
- Taylor, B., & van Perlo, B. (1998). *Rails: A guide to rails, crakes, gallinules and coots of the world*. New Haven: Yale University Press.
- Trivedi, A. (2018). Sighting of Little Crake near Jamnagar: a first photographic record for India. *Flamingo*, 16(1), 1–2.
- Vagadiya, R. (2019). Slaty-breasted Rail *Gallirallus striatus* near Dhari, Amreli District. *Flamingo Gujarat*, 17(2), 21.
- Vargiya, D., & Bagda, G. (2020). Sightings of Slaty-breasted Rail *Gallirallus striatus*, Little Crake *Porzana parva* and Spotted Crake *Porzana porzana* at Mokarsagar Wetland: Additions to the avifauna of Porbandar, with notes on their behavior. *Flamingo*, 3(2&3), 1–4.
- Vyas, V. (2021). Spotted Crake *Porzana porzana* in Vadodara. *Flamingo Gujarat*, 4(2), 31. □