An annotated bird checklist of the Vikramshila Gangetic Dolphin Sanctuary, Bhagalpur, Bihar, India, with an assessment of threats to bird conservation

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The rivers, wetlands and floodplain regions of the eastern Gangetic Plain in Bihar state, India, support a rich resident and migrant aquatic avifauna. These systems are also highly human-dominated, with millions of people dependent on them for their basic needs, livelihoods and commerce. Given this situation, protection of avian diversity becomes a difficult challenge, as even existing freshwater protected areas and bird sanctuaries are under severe pressures from resource extraction and disturbance. Here we report major threats to bird conservation in an important freshwater protected area and Important Bird Area in the eastern Gangetic Plain: the Vikramshila Gangetic Dolphin Sanctuary, Bhagalpur, Bihar. Poaching and illegal hunting, along with changing agricultural practices and erratic flow releases from upstream dams, are the major threats to birdlife within the sanctuary. Based on our biodiversity monitoring between 1999 and 2014, we present a comprehensive annotated checklist, together with observed long-term trends of species occurrence in the sanctuary. We also provide specific notes on the status of threatened bird species such as the Greater Adjutant *Leptoptilos dubius*, White-rumped Vulture *Gyps benghalensis*, Indian Skimmer *Rynchops albicollis*, Black-bellied Tern *Sterna acuticauda* and River Tern *Sterna aurantia*.

INTRODUCTION

River ecosystems and biodiversity worldwide are under serious threat from human activities: widespread habitat degradation, damming and associated flow alterations and severe human population pressures leading to overexploitation of resources (Dudgeon 2000, Collen *et al.* 2010). In the Gangetic floodplain of the Indian subcontinent, millions of people are dependent on rivers for their basic needs, livelihood and commerce. This region also supports a remarkable diversity of freshwater wildlife, including unique charismatic and endangered species such as the Ganges River Dolphin *Platanista gangetica*, Gharial *Gavialis gangeticus*, Marsh Crocodile *Crocodylus palustris*, Smooth-coated Otter *Lutrogale perspicillata* and several species of freshwater turtles, fishes and birds (Dudgeon 2000). The Ganga (Ganges) River floodplain (basin area 861,404 km^2) is the most productive and fertile region of India, aptly described as the nation's 'lifeline', for mankind and biodiversity strongly dependent on riverine ecosystem services (Prasad *et al.* 2002, Islam & Rahmani 2004).

The rivers, wetlands and floodplain regions of the eastern Gangetic Plain in Bihar, India, are perhaps among the relatively neglected areas in terms of protection and conservation efforts of aquatic wildlife (Prasad *et al.* 2002, Sinha 2007). Few protected areas contributing to effective wildlife conservation exist in this region, for a number of reasons (IUCN & UNEP-WCMC 2007): in particular, it is difficult to afford complete protection to active river channels (Saunders *et al.* 2010). First, these floodplain river-wetland systems are very dynamic and subject to major habitat change after the monsoonal flood pulse (Singh *et al.* 2007), making it difficult to define use rights and boundaries of protected areas clearly (Kelkar & Krishnaswamy 2010). Second, due to the open-access, intensive and often unregulated use of these floodplain ecosystems, designation and management of freshwater protected areas is often problematic and conflicts with human economic activity. Therefore, wherever riverine protected areas exist in such regions, they typically occur as multiple-use riverscapes rather than as strictly protected, inviolate river reaches (Kelkar *et al.* 2010, Saunders *et al.* 2010). In these cases it is critical to ensure that regular monitoring of biodiversity is carried out to identify threats and pressures specifically caused by intensive human use of such areas.

The eastern Gangetic Plain also supports a very rich resident and migrant aquatic avifauna, but little is known about the local status of bird species and their conservation requirements (Sinha 2007). The Vikramshila Gangetic Dolphin Sanctuary (hereafter Dolphin Sanctuary) in Bhagalpur, Bihar, is the only specifically riverine protected area (rather than wetland bird sanctuaries) in the eastern Gangetic Plain. The Dolphin Sanctuary was designated especially for the protection of the endangered Ganges River Dolphin (Choudhary *et al.* 2006). It has also been identified as an Important Bird Area (IBA) (Islam & Rahmani 2004, BirdLife International 2013).

Despite having protected status, the Dolphin Sanctuary has been under pressure due to the long-term, near-complete dependence of local communities on farming and fishing (Ara 1954), motorised river traffic, pollution, altered dry-season flows due to upstream dams and historical decline of fisheries due to the construction of the Farakka barrage downstream (Banerjee 1999, Choudhary *et al.* 2006, Kelkar *et al.* 2010). Civil society initiatives such as the Vikramshila Biodiversity Research and Education Centre (VBREC) in Bhagalpur have carried out extensive monitoring, conservation and research work in the Dolphin Sanctuary (Choudhary *et al.* 2006), informing and educating the local communities about conservation issues.

Monitoring effort can enable assessments of the local status of endangered and vulnerable bird species to be made, and help prioritise measures to mitigate significant threats (Hussain 1987, Dudgeon 2000). Given the conservation importance of Gangetic rivers and wetlands, developing baselines of avian diversity for important freshwater protected areas such as the Dolphin Sanctuary is essential (Sinha 2007). The main objectives of this paper are to provide a comprehensive bird checklist for an important freshwater protected area and to update the currently limited knowledge of bird diversity in and threats to the eastern Gangetic Plain, Bihar. Based on monitoring bird diversity in the Dolphin Sanctuary area for the last 14 years, we discuss specific threats to species of conservation significance, and larger, landscape-level challenges in conserving biodiversity in human-dominated riverine floodplains of the Gangetic basin.

METHODS

The Vikramshila Gangetic Dolphin Sanctuary is located in the Bhagalpur district of Bihar, India. It is a 65-km stretch of the Ganga River between the towns of Sultanganj (25.254°N 86.738°E) and Kahalgaon (25.282°N 87.229°E), and part of the Ganga–Kosi interfluve. The geomorphology of the main river channel is characterised by meanders, wide straight channels, alluvial islands,

point and spit bars, rocky mid-channel islands and deep countercurrent pools (Singh *et al.* 2007). The water depth ranges from 0.2 to 40 m, the channel width varies between 150 m and up to 3 km. However, in very wide channels water depths are shallow and there are many islands in the channels. Temperatures vary from a recorded minimum of about 5–8°C in winter (December–January) up to a maximum of 45°C in high summer (May–June).

During water-borne monthly monitoring surveys carried out regularly in the Dolphin Sanctuary between 1999 and 2014, two observers dedicated to spotting birds made direct observations of bird flocks on banks and in the water. Birds were also recorded opportunistically during boat surveys for river dolphins. Boat surveys were operated in three seasons—summer (March–April), pre-monsoon (May–July) and post-monsoon/winter (December–February). Observations were also made from a few fixed locations spread across the Dolphin Sanctuary throughout the year, including the monsoon flood season. All observations were made with binoculars. On sighting distant bird flocks, the boat was steered closer in order to record species composition and numbers. Mid-channel islands and sand spits/point-bars in the river were surveyed on foot to record breeding species. Birds were also opportunistically recorded from the agricultural areas of the river floodplains. Observations were made in daytime, at least five days a month, usually from 07h00 to 17h00 but occasionally at night to look for nocturnal birds. In all, by boat and on foot, we covered more than 8,000 km during repeated replicate surveys in the Dolphin Sanctuary and surrounding areas. Birds were photographed whenever possible, detailed notes were taken, and species identity was confirmed using field guides (Ali & Ripley 1971,1983, Grimmett *et al.* 1998, Kazmierczak & van Perlo 2000).

During the surveys we also regularly recorded information from interviews with local fishermen, farmers and other key informants about local threats to birds by trapping, killing, hunting, poaching or other disturbances. We regularly collected and maintained photographic evidence on bird sightings and threats. Traps or hides found were destroyed whenever possible; trapped birds were confiscated from poachers and rehabilitated back to the wild. Over the last two years, we have formally set up an informer network with the help of local boatmen and traditional fishermen, from which data on any threats to biodiversity continue to be collected, and these have been included in this article (Table 1).

RESULTS

A total of 198 bird species was recorded in the Dolphin Sanctuary and surrounding areas (see Appendix). Sequence follows del Hoyo & Collar (2014) for non-passerines and BirdLife International (2014) for passerines.

Significant records: threatened species

Marbled Teal *Marmaronetta angustirostris*

Vulnerable. A single bird seen only once in December 1999. This bird was seen in a side-channel of the Ganga River near Bhagalpur town, with a small flock of Lesser Whistling-ducks *Dendrocygna javanica*. The channel had some floating vegetation (*Hydrilla* sp.). The species was identified clearly based on the distinct white spots on the buff back and flanks.

Ferruginous Duck *Aythya nyroca*

Near Threatened. Rare winter visitor seen irregularly between 2004 and 2008, but no reports before or after. Reported also by Choudhary & Mishra (2006).

Falcated Duck *Mareca falcata*

Near Threatened. No records in the study period, but one male bird was seen near Bhagalpur in a side-channel in 1996–97 by SD (*in litt.*).

Greater Adjutant *Leptoptilos dubius*

Endangered. The only known breeding population in peninsular India is in the Ganga Kosi interfluve around the Dolphin Sanctuary riverscape. Seen feeding on a human carcass in 2003. About 45 pairs breed on the Kosi River floodplains near villages north of National Highway NH-31. Regularly uses the main river channel in spring and summer (Choudhary & Ghosh 2004, Choudhary *et al.* 2004, Choudhary 2007, Mishra & Mandal 2010, K. K. Sharma verbally, authors' pers. obs.). Population largely stable or even potentially increasing in the area. Last seen in June 2014 on the Jamuna side-channel near Bhagalpur town.

Lesser Adjutant *Leptoptilos javanicus*

Vulnerable. Common, a breeding resident widely distributed in the region. Several breeding pairs have been recorded from both the north and south banks of the Ganga River stretch within the Dolphin Sanctuary, as well as from nearby floodplain wetlands, villages and scrubland (Choudhary 2007).

Painted Stork *Mycteria leucocephala*

Near Threatened. Non-breeding summer visitor in low numbers (about 40–50) but recorded consistently in the Dolphin Sanctuary in May and June each year. Seen on alluvial sandy floodplain islands near water around Lodipur and Bhagalpur. Fourteen birds seen in June 2014.

Asian Woollyneck *Ciconia episcopus*

Vulnerable. Resident in the study area throughout the period (1999–2014). A few pairs (8–10) have been regularly seen

Table 1. Description of threats to bird species' groups in the Vikramshila Gangetic Dolphin Sanctuary riverscape.

Threats	Description	Bird taxa affected	Locations and areas where found
Hunting and illegal killing (poaching)	Shooting of birds, poisoning, poaching, capture in large and small nets, trapping, pesticide use	Indiscriminate, but occasionally preference for waterfowl, egrets, cranes, waders, wagtails, pipits	Floodplain scrub, agricultural fallows on banks
Loss of nesting and breeding habitats	1. Erratic flow releases from upstream dams causing loss of floodplain habitat due to sudden submergence and/or erosion	Many wader species breeding on floodplain banks, such as Indian Skimmer, Little Pratincole, plovers, terns	Mid-channel alluvial deposits, islands, sand banks
	2. Encroachment of cucurbit cultivation on breeding habitats such as alluvial islands and open floodplain scrub		
	3. Loss of nesting or roosting trees due to construction of roads, highways, expansion of settlements	Adjutants and other storks	Diyara region (floodplain settlement areas), especially the north banks of Ganga and Kosi rivers
Loss of foraging habitats	Rapid encroachment and reclamation, burial of existing wetlands, channel-dredging of river silt beds	Diving ducks, some waders	Diyara region
Other factors	High levels of organic pollution, solid wastes and plastic garbage disposal, high boat traffic, cattle movement, human disturbance and transient settlements on banks	Indiscriminate effects	Widespread in the entire region

throughout the year along river banks. Breeding never observed but juveniles seen occasionally in post-monsoon season.

Black-necked Stork *Ephippiorhynchus asiaticus*
Near Threatened. Juveniles seen occasionally in monsoon season (July–September), and two pairs regularly seen throughout the year in the Dolphin Sanctuary. Not abundant in the area. Breeding storks have been recorded in this region (Maheswaran *et al.* 2004, Choudhary *et al.* 2010). Possible breeding of one pair near Jagatpur wetland (Kumar & Choudhary 2011). Breeds also in neighbouring stretches and in the Kosi floodplains (authors' pers. obs.).

Black-headed Ibis *Threskiornis melanocephalus*
Near Threatened. Local migrant and summer visitor. Numbers generally low and have possibly declined.

Dalmatian Pelican *Pelecanus crispus*
Vulnerable. Four birds recorded in January 2008 near Sultanganj.

Spot-billed Pelican *Pelecanus philippensis*
Near Threatened. Sporadic summer visitor. A single, possibly vagrant, bird seen on a river island at Lodipur in June 2012. Also seen and photographed in May 2013.

Oriental Darter *Anhinga melanogaster*
Near Threatened. Rarely seen in the river channel, but fairly common in nearby wetlands.

River Lapwing *Vanellus duvaucelii*
Near Threatened. Common resident recorded every year throughout the period (1999–2014). Breeding in May on sand banks; seen almost every year. Possible decline in abundance in the last 2 years, as fewer birds seen, but difficult to quantify as the species is still common.

Eurasian Curlew *Numenius arquata*
Near Threatened. Regular winter visitor seen every year in flocks of 10–15 birds. No major change in abundance noted over the years.

Black-tailed Godwit *Limosa limosa*
Near Threatened. Common but declining winter visitor; has been seen every year on side-channels and wetlands in moderate-sized flocks (50–100 birds).

Indian Skimmer *Rynchops albicollis*
Vulnerable. Seen frequently in summer until 2008, since when there has been only one sighting of just two birds in May 2011. Breeding was recorded on two occasions in 2004–2005 near Barari, Bhagalpur, but not reported since. This species is critically affected by loss of alluvial island habitats by river flood erosion, erratic releases and changing agricultural practices such as cultivation of cucurbits.

River Tern *Sterna aurantia*
Near Threatened. Frequently sighted every year and common in the dry-season, but possible decline in breeding over the years. Groups of 10–20 birds seen regularly. Uses riverine wetlands and mid-channel islands for breeding in summer (April–May).

Black-bellied Tern *Sterna acuticauda*
Endangered. Summer visitor, seen every year in the spring and summer months, in flocks of 15–20 birds. Also observed during the spring and summer of 2014 in flocks of Little Terns, when approximately 30–40 birds were recorded over a 50 km stretch of river. Breeding of the species has never been observed on this stretch.

White-rumped Vulture *Gyps bengalensis*
Critically Endangered. Over 30 birds seen on a carcass in Khagaria district in 2004, and nesting has been reported from the adjoining Khagaria district that lies to the north (Choudhary *et al.* 2005). However, this remains the only record in the vicinity of the Dolphin Sanctuary and there have been no records since then.

Indian Spotted Eagle *Clanga hastata*
Vulnerable. Generally rare, seldom seen in summer; formerly frequent sightings in winter. No recent records—last recorded in the study area in December 2006. Distinguished from Greater Spotted Eagle by smaller size and considerably lighter colour of and spotting on wings.

Greater Spotted Eagle *Clanga clanga*
Vulnerable. Rare summer visitor. One juvenile seen near Sultanganj in April 2003 and one juvenile seen and photographed in May 2014.

Eastern Imperial Eagle *Aquila heliaca*
Vulnerable. A single subadult seen in April 2008 near Kajjalban, 3 km from Sultanganj.

Pallas's Fish Eagle *Haliaeetus leucoryphus*
Vulnerable. Recorded only once near Kahalgaon in 2001. A pair was sighted in the nearby Udhuwa wetland bird sanctuary, Rajmahal, Jharkhand (Ghosh *et al.* 1993).

Red-headed Falcon *Falco chicquera*
Near Threatened. One pair regularly seen around Bhagalpur town, in addition to a few other sightings elsewhere between 1999 and 2014. No change has been noted in their occurrence; breeding has not been observed but the Bhagalpur pair is resident.

Significant records: rare species and other interesting records

Many records of ducks and waders are interesting because of stray winter migrants. The Gandak and Kosi river fans in north Bihar seem to be a transition zone for such migrants en route to the Tibetan plateau, Central Asia and Siberia, and this seems to reflect in the occasional stopover records of some rare coastal species (Inglis 1946, George 1964, Ali & Ripley 1983, Choudhary & Mishra 2006).

Fulvous Whistling-duck *Dendrocygna bicolor*
Irregular winter visitor. Flock of approximately 200 individuals seen on rocky mid-channel islands near Kahalgaon in November 2000. A flock of about 50 birds seen in May 2014 at Bhagalpur.

Common Shelduck *Tadorna tadorna*
Winter visitor occasionally seen in small groups (10–12) between 1999 and 2008, but no sightings after this period. Regularly recorded in the past (Bucknill 1926, Harman & Munns 1943, Inglis 1946).

Red-crested Pochard *Netts rufina*
Regular winter visitor, some stragglers staying until June. The species has declined steadily over the years and today only a few birds are seen each year.

Mallard *Anas platyrhynchos*
Serious declines in numbers from this region over the past 15 years. Common winter visitor in the 1990s.

Black Stork *Ciconia nigra*
Winter visitor in small numbers. About 6–10 birds recorded sporadically in the low-water season.

White Stork *Ciconia ciconia*
Rare winter migrant. Four birds seen only once in January 2008 near Kajjalban, Sultanganj, with a flock of Asian Openbills *Anastomus oscitans*.

Black-crowned Night Heron *Nycticorax nycticorax*
Long established heronries on rocky islands in the Ganga River at Kahalgaon, about 35–40 nests with Little Cormorants (30–40 nests).

Great White Pelican *Pelecanus onocrotalus*
Few (4–5) birds seen regularly in winter every year near Sultanganj.

Pied Avocet *Recurvirostra avosetta*
Regular wintering migrant in January / February. Seen at Sultanganj and Bhagalpur, in flocks of usually less than 20 birds. One bird seen in the Kosi River in March 2014.

Pacific Golden Plover *Pluvialis fulva*
Uncommon winter visitor, seen on a few occasions between 2001 and 2004 in groups of less than 6–8 birds.

Terek Sandpiper *Xenus cinereus*
Vagrant recorded once near Lodipur island (floodplain region) in January 2001.

Slender-billed Gull *Larus genei*
One bird seen in the Ganga River between Sultanganj and Munger on 2 April 2014.

Sooty Tern *Onychoprion fuscatus*
One bird seen in 2001–2002 and two sightings in summer 2008 (single bird in flock of about 7–8 Indian Skimmers and five River Terns). One record from the Terai region in Bihar is the only previous confirmed sighting from the region (Ali & Ripley 1971).

Hen Harrier *Circus cyaneus*
Recorded once in December 2007. Adult male was seen and distinguished from the Pallid and Montagu's Harriers based on single black trailing edge along wing margin.

Pied Harrier *Circus melanoleucos*
One adult male seen in January 2008.

Montagu's Harrier *Circus pygargus*
Single adult male seen in December–January 2008. Distinguished by barred tail from Pallid Harrier *C. macrourus*. (Note: juvenile and female harriers were often indistinguishable during surveys and we have reported confirmed species only based on adult male sightings. Due to this shortcoming, harriers are probably more common in the area than reported here.)

Northern Goshawk *Accipiter gentilis*
One adult seen in 2002–2003 near Bhagalpur.

Long-legged Buzzard *Buteo rufinus*
One adult seen in April 2008 near Sultanganj.

Upland Buzzard *Buteo hemilasius*
Regular but uncommon winter visitor, staying into spring (March).

Sand Martin *Riparia riparia*, Plain Martin *Riparia paludicola*, Barn Swallow *Hirundo rustica*
These species nested on eroded river banks in large numbers, but recently have been affected by erratic flow releases from upstream dams

DISCUSSION

Forty percent of India's human population inhabits the floodplain riverscapes of the Indo-Gangetic Plain. The consequent high dependence on riverine ecosystem services has caused serious conflicts between conservation efforts for biodiversity and the demand for river resources (Dudgeon 2000). This is evident in the threatened status of the charismatic fauna that inhabit rivers of the Gangetic basin, such as the Gharial, Ganges River Dolphin, Smooth-coated Otter, freshwater turtles, and birds like the Greater Adjutant and Indian Skimmer. The socio-economic conditions of the human population, which depend on agriculture and fisheries in the eastern Gangetic Plain, are extremely poor (Ara 1954, Choudhary *et al.* 2006). In the Dolphin Sanctuary, traditional fishing communities are the key stakeholders in biodiversity conservation, but they live in abject poverty (Choudhary *et al.* 2006). On the one hand, the degraded condition of the Gangetic basin, due to dams, dry-season water abstraction and flow alterations, have marginalised the livelihoods of local people. On the other, the region has had a history of feudal control over land and water, which has led to high socio-political disparity, lawlessness and crime (Kelkar & Krishnaswamy 2010). These factors, albeit indirectly, are serious contributors to the threats to most biodiversity, including birds.

The most important direct threats to birds include rampant poaching, trapping/snaring and hunting, which have adversely affected several resident and migratory species of waterbirds, whose abundances have seen regular declines from year to year, as our monitoring surveys suggest (Choudhary *et al.* 2006). This seems to be particularly true for waterfowl species such as the Mallard and Gadwall *Mareca strepera*, as well as for long-distance visitors such as the Common Crane *Grus grus*. Bird hunting by shooting and trapping has always been common in this region, and has generally been highly indiscriminate (Harman & Munns 1943, Ara 1954). Birds, mainly waterfowl, waders and wagtails (local informants, verbally), are hunted for food. Another serious threat is the killing of birds by the use of poisoned grains laced with pesticides such as thiamate, endosulfan and aldrin. This is practised not for preventing crop damage, but for food. Huge nets, snares and traps are occasionally used by professional bird-hunting tribes, employed by criminal elements that operate in the floodplains, for mass hunting of foraging ducks and geese, waders and even small birds like larks, wagtails and pipits. Until recently, hunters would even sell birds along the national highway, as there was no enforcement of wildlife protection laws even in the Dolphin Sanctuary area. However, sustained awareness campaigns, community meetings and interactions with local people, led by our team, plus regular monitoring seem to have led to a significant drop in poaching incidents and snaring. Large nets are rarely encountered in the sanctuary area (Choudhary *et al.* 2006) and the frequency of hunting reports received from informants has also reduced over the last 5–6 years. Government intervention for strict enforcement of bans on killing of birds is urgently required, to ensure protection of bird populations within the sanctuary area, as well as the surrounding landscape.

Other threats to birds are from high levels of human disturbance in the Dolphin Sanctuary area. Human and cattle movement and changing agricultural practices on the floodplains cause significant disturbance to many bird species (Sundar 2011). Breeding shorebirds in particular, including the endangered Indian Skimmer, have declined, as has the breeding of River Lapwings *Vanellus duvaucelii*, River Terns and Little Pratincole *Glareola lactea*. A significant increase in cultivation of cucurbits on hitherto uncultivated sand-bars and mid-channel islands has caused considerable loss of habitat for breeding birds. Expansion of the road network in Bihar has resulted in damage to long-term nesting

sites of threatened species such as the Greater Adjutant, Long-billed Vulture *Gyps indicus* as well as Black-necked Stork (K. K. Sharma verbally). The Greater Adjutant population on the north side of the Ganga–Kosi interfluve region is the second largest breeding population in India, and the only existing breeding population from peninsular India (Choudhary *et al.* 2004, Choudhary 2007, Mishra & Mandal 2010). Community support for conservation of Greater Adjutants by protection of their nesting trees has been forthcoming, and there is hope to protect these local populations, barring the threat of habitat loss from road construction (Mishra & Mandal 2010). The decline of vultures, apart from the causes well known, is also blamed by local people on the wanton felling of nesting trees such as Palmyra palm *Borassus flabellifer* in the 1990s, as a result of a sudden, state-wide policy change terminating private ownership of these trees (local fishermen, verbally).

Erratic flow releases from upstream dams on the Ganga, Sone and Gandak rivers are leading to sudden submergence and erosion of preferred bird habitats such as mid-channel alluvial islands (Dudgeon 2000). The scale of this unseasonal bank erosion has been increasing, leading to drastic habitat loss for breeding species (Foote *et al.* 1996). Floodplain wetlands are also preferred habitats for many waterfowl species (Hussain 1987). These are rapidly being lost due to reclamation and filling-in for agriculture or settlement, or commercial stocking with exotic alien fish (Foote *et al.* 1996, Prasad *et al.* 2002). Organic pollution, deliberate disturbance of birds and urban area expansion are other important threats in this landscape (BirdLife International 2013).

Complete protection of rivers is very difficult to achieve given the severe pressures imposed by competing human needs and resource extraction. The Dolphin Sanctuary IBA has not received the attention it has long deserved, given the difficult law and order situation, government apathy, and lack of political and administrative will to protect river biodiversity (Choudhary *et al.* 2006). No protective measures have yet been implemented, and there is no proper management plan by the government departments responsible for the sanctuary. Until recently river stakeholders were mostly unaware of the Dolphin Sanctuary's existence (Choudhary *et al.* 2006, Kelkar & Krishnaswamy 2010). The regulatory authorities of the sanctuary (the forest and fisheries departments) have not yet attempted to settle or define human use rights (fisheries, boat usage, agriculture etc.) or 'biodiversity-related' compliance through conservation initiatives. Many fishing and other communities continue to be skeptical about the issue of river biodiversity conservation impinging on their livelihood needs. Unless awareness efforts and community-based management practices are implemented in a regular, sensitive and holistic manner, there is every chance of local stakeholders turning hostile to the Dolphin Sanctuary. Monitoring efforts by civil society initiatives have led to palpable on-the-ground improvement in terms of reducing local disturbance from hunting, poaching and killing wild species (Choudhary *et al.* 2006). To sustain conservation in this contested riverscape further, ensuring government support and community compliance with biodiversity protection are clearly the critical needs today.

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Appendix.

Annotated checklist of birds recorded in the Vikramshila Gangetic Dolphin Sanctuary and IBA

Habitat: Ch = river channel; Wt = floodplain wetland; Sc = alluvial scrub; Ag = agriculture; Fl = alluvial floodplain; Rd = reeds and other bank vegetation. **Occ (Occurrence)**: C = common; U = uncommon; O = occasional; R = rare; V = Vagrant. **Status**: R = resident; W = winter visitor; L = local movement; M = migrant including summer visitor; Bm = breeding migrant; P = passage migrant. **Trend**: DC = decreasing; IC = increasing; NC = no change; NA = unknown. **Notes**: 1 also reported by Choudhary & Mishra (2006); 2.= breeding recorded; 3.= possibly breeding; 4 = species reported in many parts of Bihar (see Harman and Munns 1943, Inglis 1946, Pittie 2004); 5 = also reported by Choudhary *et al.* (2008).

Name	Habitat	Occ	Status	Trend	Notes
Fulvous Whistling-duck *Dendracygna bicolor*	Ch, Wt	U	R, L	NA	
Lesser Whistling-duck *Dendracygna javanica*	Ch, Wt	C	R, L	IC	2
Bar-headed Goose *Anser indicus*	Ch	U	W	DC	
Greylag Goose *Anser anser*	Ch	C	W	DC	
Common Shelduck *Tadarna tadarna*	Ch	U	W	DC	
Ruddy Shelduck *Tadorna ferruginea*	Ch, Wt	C	W	NC	1, 4
African Comb Duck *Sarkidiarnis melanotos*	Ch, Wt	U	R, L	NA	2, 4
Cotton Pygmy-goose *Nettapus caramandelianus*	Wt	U	R	NC	2, 4
Marbled Teal *Marmaranetta angustirastris* (VU)	Ch	R	W	NA	
Red-crested Pochard *Netta rufina*	Ch	U	W	DC	1, 4
Common Pochard *Aythya ferina*	Ch	C	W	DC	
Ferruginous Duck *Aythya nyroca* (NT)	Ch	U	W	DC	1, 4
Tufted Duck *Aythya fuligula*	Ch	O	W	DC	1, 4
Garganey *Spatula querquedula*	Ch, Wt	C	W	DC	
Northern Shoveler *Spatula clypeata*	Ch	C	W	DC	1, 4
Falcated Duck *Mareca falcata* (NT)	Ch	R	W	NA	4
Gadwall *Mareca strepera*	Ch, Wt	O	W	DC	
Eurasian Wigeon *Mareca penelope*	Ch	O	W	DC	
Mallard *Anas platyrhynchos*	Ch	R	W	DC	1, 4
Northern Pintail *Anas acuta*	Ch	C	W	NC	1, 4
Common Teal *Anas crecca*	Ch	O	W	DC	1, 4
Little Grebe *Tachybaptus ruficollis*	Wt, Rd	C	R, L	DC	1, 2
Great Crested Grebe *Padiceps cristatus*	Ch	C	W	NC	1
Rock Dove *Columba livia*	Sc, Ag	C	R	IC	1, 2
Eurasian Collared Dove *Streptapelia decaocto*	Sc, Ag	U	R, L	NC	2
Western Spotted Dove *Spilopelia suratensis*	Sc, Ag	U	R, L	NC	1, 2
Yellow-footed Green Pigeon *Treron phoenicopterus*	Ag	R	R, M	NA	
Asian Palm Swift *Cypsiurus balasiensis*	Ag	O	R	NC	2
Little Swift *Apus affinis*	Ag	C	R, A	DC	2
Greater Coucal *Centropus sinensis*	Sc, Ag	C	R	NC	2
Western Koel *Eudynamys scolopaceus*	Sc, Ag	C	L	NC	2

Name	Habitat	Occ	Status	Trend	Notes
Eastern Water Rail *Rallus indicus*	Rd, Wt	O	W	NA	
White-breasted Waterhen *Amaurornis phoenicurus*	Wt, Rd	C	R, L	NC	2
Watercock *Gallicrex cinerea*	Rd, Wt	O	R, L	NA	1, 2
Common Coot *Fulica atra*	Wt, Ch	O	M	NC	1, 2
Common Crane *Grus grus*	Fl, Wt	C	W	DC	1
Greater Adjutant *Leptoptilos dubius* (EN)	Ch, Wt, Fl, Sc	U	R	NC	1, 2
Lesser Adjutant *Leptoptilos javanicus* (VU)	Wt, CH, Fl, Sc	C	R	NC	1, 2
Painted Stork *Mycteria leucocephala* (NT)	Ch	U	L, M	NC	1
Asian Openbill *Anastomus ascitans*	Ch, Wt	C	R, L	IC	1, 2
Black Stork *Ciconia nigra*	Ch	O	W	NC	1
Asian Woollyneck *Cicania episcapus* (VU)	Ch, Wt	C	R, L	NC	1, 2
White Stork *Cicania cicania*	Ch	R	W	NA	
Eurasian Spoonbill *Platalea leucorodia*	Ch	O	L, W	DC	1
Black-necked Stork *Ephippiarhynchus asiaticus* (NT)	Ch	C	R	NC	2
Black-headed Ibis *Threskiornis melanocephalus* (NT)	Wt, Fl, Sc, Ag	U	R, L	DC	1
Red-naped Ibis *Pseudibis papillasa*	Wt, Ch, Fl, Sc	C	R, L	NC	1, 2
Black Bittern *Ixabrychus flavicallis*	Wt	U	W	NC	
Black-crowned Night Heron *Nycticorax nycticorax*	Ch, Wt	C	R, L	NC	1, 2
Green-backed Heron *Butarides striata*	Ch, Wt, Rd	O	R	NC	2
Indian Pond Heron *Ardeola grayii*	Wt, Rd, Fl	C	R	IC	1, 2
Cattle Egret *Bubulcus ibis*	Wt, Rd, Fl, Sc, Ag	C	R	IC	1, 2
Grey Heron *Ardea cinerea*	Ch	C	R, L	NC	1, 2
Purple Heron *Ardea purpurea*	Wt, Rd	O	R	NA	2
Great Egret *Ardea alba*	Ch, Wt	C	R, L	NC	1, 2
Intermediate Egret *Ardea intermedia*	Ch, Wt	C	R	NC	1, 2
Little Egret *Egretta garzetta*	Ch, Wt	C	R	NC	1, 2
Dalmatian Pelican *Pelecanus crispus* (VU)	Ch	R	W	DC	
Spot-billed Pelican *Pelecanus philippensis* (NT)	Ch	V	L, M	NA	
Great White Pelican *Pelecanus anacratalus*	Ch	U	W	DC	
Little Cormorant *Micracarbo niger*	Ch, Wt	C	R, L	IC	1, 2
Great Cormorant *Phalacrocorax carbo*	Ch	C	W	IC	1, 2

Name	Habitat	Occ	Status	Trend	Notes
Indian Cormorant *Phalacracarax fuscicallis*	Ch, Wt	U	L, W	NA	1
Oriental Darter *Anhinga melanagaster* (NT)	Ch, Wt	O	R, L	DC	
Indian Thick-knee *Burhinus indicus*	Fl, Wt	O	R	NA	2
Pied Avocet *Recurvirastra avasetta*	Ch	U	W	DC	
Black-winged Stilt *Himantapus himantapus*	Fl, Wt	C	L, W	NC	1, 2, S
Eurasian Golden Plover *Pluvialis apricaria*	Ch, Wt	R	W	DC	
Pacific Golden Plover *Pluvialis fulva*	Ch, Wt	O	W	DC	
Little Ringed Plover *Charadrius dubius*	Fl, Wt	C	R	NC	1, 2
Kentish Plover *Charadrius alexandrinus*	Fl, Wt	O	M	NC	3
Lesser Sandplover *Charadrius mangalus*	Fl	V	W	NA	
River Lapwing *Vanellus duvaucelii* (NT)	Ch	C	R	DC	1, 2
Red-wattled Lapwing *Vanellus indicus*	Ch, Wt	C	R	NC	1, 2, 3
Greater Painted-snipe *Rastratula benghalensis*	Wt, Rd, Ag, Sc	U	R, L	NA	2
Pheasant-tailed Jacana *Hydraphasianus chirurgus*	Wt, Rd, Ag	O	R, L	DC	2
Bronze-winged Jacana *Metapidius indicus*	Wt, Rd, Ag	O	R, L	DC	2
Whimbrel *Numenius phaeapus*	Ch	O	W	DC	
Eurasian Curlew *Numenius arquata* (NT)	Ch	C	W	NC	1
Bar-tailed Godwit *Limasa lappanica*	Ch, Wt	O	W	DC	
Black-tailed Godwit *Limasa limasa* (NT)	Ch, Wt	C	W	DC	1
Temminck's Stint *Calidris temminckii*	Fl, Wt	O	W	DC	
Dunlin *Calidris alpina*	Fl, Wt	V	W	DC	
Little Stint *Calidris minuta*	Fl, Wt	C	W	DC	1
Terek Sandpiper *Xeneus cinereus*	Wt, Fl, Sc, Ag	V	W	DC	
Common Sandpiper *Actitis hypaleucas*	Wt, Fl, Sc, Ag	C	R, L	NC	1, 2
Green Sandpiper *Tringa achrapus*	Wt, Ch	U	W	NC	2
Common Greenshank *Tringa nebularia*	Wt	C	W	NC	1
Common Redshank *Tringa tatanus*	Ch, Wt	C	W	NC	
Wood Sandpiper *Tringa glareala*	Wt	O	W	DC	
Little Pratincole *Glareala lactea*	Fl, Wt	C	L, M	DC	1, 2
Indian Skimmer *Rynchaps albicallis* (VU)	Ch, Fl	U	Bm, M	DC	2
Slender-billed Gull *Larus genei*	Ch	V	W	NA	
Brown-headed Gull *Larus brunnicephalus*	Ch	C	W	NC	
Black-headed Gull *Larus ridibundus*	Ch	C	W	NC	
Pallas's Gull *Larus ichthyaetus*	Ch	C	W	DC	
Sooty Tern *Onychaprian fuscatus*	Ch	V	W	NA	
Little Tern *Sternula albifrans*	Ch	C	L, M	NC	1, 2, 5
Common Gull-billed Tern *Gelachelidan nilatica*	Ch	U	L, M	NA	
Caspian Tern *Hydrapragne caspia*	Ch	C	W	NC	
Whiskered Tern *Chlidanias hybrida*	Ch, Wt	O	L, M	NC	1
River Tern *Sterna aurantia* (NT)	Ch	C	R	DC	1, 2
Common Tern *Sterna hirunda*	Ch	V	M	NA	
Black-bellied Tern *Sterna acuticauda* (EN)	Ch, Fl	C	R, M	NC	3
Spotted Owlet *Athene brama*	Ag	C	R	NC	2
Short-eared Owl *Asia flammeus*	Sc	U	R	NA	
Brown Fish Owl *Ketupa zeylanensis*	Fl, Wt, Sc	U	R	NA	
Osprey *Pandian haliaetus*	Ch, Wt	C	RL	NC	1
Black-winged Kite *Elanus caeruleus*	Ag, Sc	C	RL	NC	1, 2
Oriental Honey Buzzard *Pernis ptilarhynchus*	Fl, Sc, Ag	C	R	NC	2
Crested Serpent Eagle *Spilarnis cheela*	Fl, Sc, Ag	O	R	NA	
White-rumped Vulture *Gyps bengalensis* (CR)	Fl	U	R	DC	1
Indian Spotted Eagle *Clanga hastata* (VU)	Fl	U	R, L	NA	1
Greater Spotted Eagle *Clanga clanga* (VU)	Fl	U	R, L	NA	
Tawny Eagle *Aquila rapax*	Fl, Sc	C	L, M, W	NC	
Steppe Eagle *Aquila nipalensis*	Fl, Sc	U	W	NA	
Eastern Imperial Eagle *Aquila heliaca* (VU)	Fl, Sc	V	W	NA	
Western Marsh Harrier *Circus aeruginasus*	Ch, Wt, Fl, Sc, Ag	C	W	DC	1
Hen Harrier *Circus cyaneus*	Fl, Sc, Ag	R	W	DC	
Pied Harrier *Circus melanaleucas*	Fl, Sc	U	W	DC	
Montagu's Harrier *Circus pygargus*	Fl, Sc	R	W	DC	
Shikra *Accipiter badius*	Sc, Ag	C	R	NC	1, 2
Eurasian Sparrowhawk *Accipiter nisus*	Fl, Sc, Ag	U	W	DC	
Northern Goshawk *Accipiter gentilis*	Fl, Sc	V	W	DC	
Pallas's Fish Eagle *Haliaeetus leucaryphus* (VU)	Ch	R	R, L	DC	
Brahminy Kite *Haliastur indus*	Ch, Wt	U	R, L	DC	1, 2
Black Kite *Milvus migrans*	Fl, Sc, Ag, Ch, Wt	C	R, W	IC	1, 2
White-eyed Buzzard *Butastur teesa*	Fl, Sc, Ag	C	R, L	DC	
Long-legged Buzzard *Butea rufinus*	Fl	V	W	DC	
Upland Buzzard *Butea hemilasius*	Fl, Sc	O	W	NC	

Name	Habitat	Occ	Status	Trend	Notes
Hoopoe *Upupa epaps*	Sc, Ag	C	R, L	NC	2
Asian Green Bee-eater *Meraps arientalis*	Sc, Ag	C	R, L	NC	2
Chestnut-headed Bee-eater *Meraps leschenaulti*	Sc, Ag	U	M	NC	3
Blue-tailed Bee-eater *Meraps philippinus*	Fl, Sc, Ag	O	Bm, L	DC	2
Indian Roller *Caracias benghalensis*	Sc, Ag	C	RL	NC	1, 2
Common Kingfisher *Alceda atthis*	Ch, Wt	C	R	DC	1, 2
Pied Kingfisher *Ceryle rudis*	Ch	C	R	NC	1, 2
White-breasted Kingfisher *Halcyan smyrnensis*	Wt, Ch, Sc, Ag	C	R	NC	1, 2
Lesser Kestrel *Falca naumanni*	Sc, Ag	O	W	DC	1
Common Kestrel *Falca tinnunculus*	Sc, Ag	C	L, W	NC	1
Red-headed Falcon *Falca chicquera* (NT)	Ag, Sc, Fl	C	R	NC	2
Peregrine Falcon *Falca peregrinus*	Fl, Sc	O	L, W	NC	1
Rose-ringed Parakeet *Psittacula krameri*	Sc, Ag	C	R	DC	2
Brown Shrike *Lanius cristatus*	Sc, Ag	O	W	DC	
Bay-backed Shrike *Lanius vittatus*	Sc, Ag	C	R, L	NC	2
Eurasian Golden Oriole *Orialus arialus*	Sc	O	R	NC	2
Black-headed Oriole *Orialus xantharnus*	Sc	O	R	NC	2
Black Drongo *Dicrurus macracercus*	Sc, Ag	C	R	NC	1, 2
Rufous Treepie *Dendracitta vagabunda*	Sc, Ag	C	R	NC	2
House Crow *Carvus splendens*	Sc, Fl, Wt, Ag	C	R	NC	1, 2
Large-billed Crow *Carvus macrarhynchos*	Sc, Fl, Wt, Ag	C	R	NC	1, 2
Sand Martin *Riparia riparia*	Fl, Ch	C	R, W	NC	2
Plain Martin *Riparia paludicala*	Fl, Ch	O	W	DC	2
Dusky Crag Martin *Hirunda cancalar*	Fl	C	R, W	DC	
Barn Swallow *Hirunda rustica*	Fl, Ch, Ag, Sc	C	W	DC	1
Wire-tailed Swallow *Hirunda smithii*	Fl, Ch	O	R, L	DC	2
Red-rumped Swallow *Hirunda daurica*	Fl, Ch, Sc	O	R, W	DC	2
Streak-throated Swallow *Hirunda fluvicala*	Fl, Ch	O	R, L	DC	2
Singing Bushlark *Mirafra cantillans*	Sc, Ag	C	R, L	DC	2
Rufous-tailed Lark *Ammamanes phaenicura*	Sc, Ag	C	R	NC	2
Greater Short-toed Lark *Calandrella brachydactyla*	Sc, Ag	C	R, W	DC	3
Indian Short-toed Lark *Calandrella raytal*	Fl, Sc	O	R, W	DC	1, 3
Tawny Lark *Galerida deva*	Sc, Ag	O	R, L	NC	2
Oriental Skylark *Alauda gulgula*	Sc, Ag	O	W	NC	1, 2
Ashy-crowned Sparrow Lark *Eremapterix griseus*	Sc, Ag	C	R	NC	2
Zitting Cisticola *Cisticala juncidis*	Sc, Ag, Rd	U	R, L	NA	2
Plain Prinia *Prinia inarnata*	Sc, Ag, Rd	U	R	NC	2
Red-vented Bulbul *Pycnanatus cafer*	Sc, Ag	C	R	IC	2
Blyth's Reed Warbler *Acracephalus dumetarum*	Sc, Ag, Rd	O	W	NA	2
Greenish Warbler *Phyllascapus trachilaides*	Sc, Ag	O	W	NC	
Common Babbler *Turdaides caudata*	Sc, Ag, Rd	O	R, L	DC	2
Jungle Babbler *Turdaides striata*	Sc, Ag, Rd	C	R	IC	2
Common Myna *Acridatheres tristis*	Ag Wt, Sc, Fl	C	R	IC	1, 2
Bank Myna *Acridatheres gingianus*	Ag, Wt, Ch, Sc	C	R	IC	1, 2
Chestnut-tailed Starling *Sturnus malabaricus*	Ag	U	M	NC	2
Brahminy Starling *Sturnus pagadarum*	Sc, Ag	C	R, L	IC	2
Rosy Starling *Sturnus raseus*	Ag	C	M	DC	
Asian Pied Starling *Sturnus cantra*	Ag, Fl, Sc	C	R	IC	1, 2
Bluethroat *Luscinia svecica*	Fl, Sc, Rd, Ag	O	W	NA	
Oriental Magpie Robin *Capsychus saularis*	Ag, Sc	C	R	NC	2
Black Redstart *Phaenicurus achruras*	Sc, Ag	C	W	NC	
Common Stonechat *Saxicala tarquatus*	Sc, Ag	O	W	NA	
Pied Bushchat *Saxicala caprata*	Sc, Ag	C	R	NC	2
Indian Chat *Cercamela fusca*	Sc, Ag	C	R	IC	2
House Sparrow *Passer domesticus*	Sc, Ag	C	R	DC	2
Black-breasted Weaver *Placeus benghalensis*	Sc, Ag	U	R	NA	2
Baya Weaver *Placeus philippinus*	Sc, Ag	C	R	DC	2
Red Avadavat *Amandava amandava*	Sc, Ag, Rd	C	R	NA	2
Chestnut Munia *Lanchura atricapilla*	Sc, Ag, Rd	C	R	NA	2
White Wagtail *Matacilla alba*	Fl, Ag, Sc	C	W	NC	1
White-browed Wagtail *Matacilla madaraspatensis*	Fl, Ag, Sc	C	R	NC	1, 2
Citrine Wagtail *Matacilla citreala*	Fl, Ag, Sc	O	W	DC	1
Yellow Wagtail *Matacilla flava*	Fl, Ag, Sc	C	W	NC	
Grey Wagtail *Matacilla cinerea*	Fl, Ag, Sc	C	W	NC	
Paddyfield Pipit *Anthus rufulus*	Fl, Ag, Sc	C	R	NC	2
Long-billed Pipit *Anthus similis*	Fl, Ag, Sc	U	W	DC	
Tree Pipit *Anthus trivialis*	Fl, Ag, Sc	U	W	NC	
Olive-backed Pipit *Anthus hadgsani*	Fl, Ag, Sc	U	W	DC	