

**Waterbird
research and
conservation
in India:
An overview**



Abstract

In this brief essay, I highlight some of the more recent research findings on waterbird ecology and conservation. The findings are highlighted against the lacuna of information in each of the aspects discussed. Waterbirds and their habitats in India provide a unique platform on which research and conservation can be practiced in equal measure.

Keywords: *Heronries, agricultural landscapes, landscape-scale research, long-term monitoring*

How much do we know?

One of the more conspicuous waterbirds in India is the Woolly-necked Stork (*Ciconia episcopus*). The description of the habitat needs of this species in the authoritative "Storks, Spoonbills and Ibises of the World" (Hancock *et al.* 1992) was as follows: "*In India, we have generally seen this stork in secluded forest glades and often hidden by tall marshland reeds that surround small muddy pools. Observation proved extremely difficult, if for no other reason than such habitat is the preferred resting place of the tiger, which itself discourages investigation.*" Today, we know that the Woolly-necked Storks are among the most common species of storks in the country with a very wide distribution capable of using a diverse set of habitats including marshes in protected areas (with and without tigers!), flooded grasslands, even occurring in high densities in agricultural crops (BirdLife International 2001; Sundar 2006). The description by Hancock *et al.* (1992) is therefore startling, but symptomatic of two things that are common to most waterbird species in India.

- (1) Much of the work on the waterbird species are descriptive, with most of the focus being on individuals inside protected parks and wetlands in the country.
- (2) Waterbird ecology tends to remain piecemeal with coverage of a miniscule proportion of the country with nearly no large-scale or long-term effort to understand the needs of species.

The recent past has seen a rapid increase in coverage of species and areas for waterbird research, yet there is a real need for expanding focus of studies and adding new geographies in which waterbirds exist. In this article, using a somewhat unorthodox format, I highlight the recent increases made in understanding waterbirds in India, and highlight lacuna that require to be filled if we are to work efficiently towards conserving this magnificent group of birds.

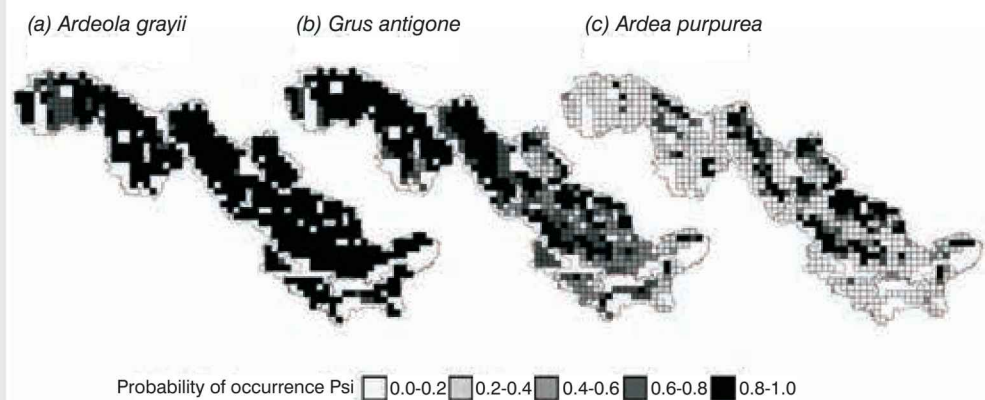
Assessing Distributions and Populations

Despite being a fundamental and basic aspect of ecology of a wild species, there are exceedingly meagre studies that use robust methods to aid in understanding distributions of waterbird species in India. Currently available species-level distribution maps are largely produced as part of field guides where the intent is to provide a crude understanding of where birds occur, rather than to provide results of a robust assessment (e.g. Grimmett *et al.* 1998). Even global conservation agendas for species such as that led by the International Union for the Conservation of Nature and Natural Resources' (IUCN) Red Data Book are forced to draw distributions guided by a combination of historical sightings as part of natural history observations and current sightings by bird-watchers, with a relatively miniscule amount of ecologically-oriented information included (see species accounts in BirdLife International 2001). The accuracy of these maps are very poorly understood as the variety and amount of information used to draw them varies greatly between species. Similarly, there is even less known on population sizes of most waterbird species (Urfi *et al.* 2005). There is an urgent need to reverse this situation, and developments in field and analytical methodologies can enable relatively rapid increases in developing ecologically pertinent distributions of species while also potentially understanding factors that affect distributions and populations of a particular species.

Projects focussing on individual species can be very important particularly for species with restricted ranges and numbers. The surveys for nesting sites of Greater Adjutant Storks (*Leptoptilos dubius*) is one such example that helped highlight the highly clumped nature of nesting sites of this globally-endangered species (Singha *et al.* 2003) leading to several conservation efforts that are ongoing aimed at stemming further decline of the species (e.g. Singha *et al.* 2006). For species with much larger distribution ranges, however, it has been much harder to enable such detailed work. Niche mapping is one potential tool with which to obtain at least crude estimates of distributions of waterbird species in India (Elith & Leathwick 2009). This method uses climatic variables from locations in which species have been sighted in to identify areas with similar conditions, thereby ascertaining areas where a species of interest would most likely occur in. Including additional layers such as habitats and land use will allow a more ecological modelling of potential areas of distribution. Areas with predicted distributions can then be sampled to refine the coarse larger-scale distribution model. The modelling can now be carried out using freely-available software, and the conspicuous absence of efforts to understand waterbird distributions using such tools in India is puzzling. The increasing amount of information from citizen science efforts such as sightings recorded in the globally accessible eBird (Sullivan *et al.* 2009), as well as the long-standing wetland monitoring information from the mid-winter waterfowl census (Li & Mundkur 2007) can provide the much-needed data for such exercises.

The advent of techniques such as patch-occupancy now allows coverage of large areas using sampling techniques with high efficiency to obtain relatively simple information with which to understand factors that affect species distributions. A multi-season exercise across 24 districts of Uttar Pradesh recently helped showcase the very high value of the occupancy method (Sundar & Kittur 2012). The study used relatively coarse habitat metrics such as all wetlands (rather than identifying different kinds of wetlands - lakes, reed beds etc.) to model distributions of 56 species across an agricultural landscape that was dominated by rice (monsoon) and wheat (winter). However, the results showed different distribution (occupancy) patterns of different waterbird species on the landscape suggesting widely varying requirements of each of the species (see Fig. 1). Pond Herons (*Ardeola grayii*) were found to be uniformly distributed with very high occupancy levels across the entire landscape underscoring the ability of this species to live in a very variety of wetland habitats notwithstanding the amount of cultivation and habitation on the landscape (Fig. 1a). Several new high-density Sarus Crane (*Grus antigone*) population were discovered as a result of the occupancy modelling (Fig. 1b), and the decline of numbers of the species towards eastern Uttar Pradesh, where human population densities and intensity of cultivation are much higher, is clearly apparent. Finally, the complex occupancy pattern of the Purple Heron (*Ardea purpurea*) became apparent (Fig. 1c) likely due to the varied preference of this species of different kinds of wetlands for breeding (reed beds) and foraging (shallow marshes with specific vegetation). The study confirmed the belief of all three species being widely distributed in the focal area, but helped provide additional information such as areas with different abundances (measured as occupancy levels), and determined the effect of agricultural intensification on the species (see Sundar & Kittur 2012). Similar exercises in other states and landscapes will be very useful to develop distribution patterns of waterbird species with a strong ecological basis to results. These results can then aid in addressing additional research questions such as the currently prominent question of how and where global climate change will impact species.

Fig. 1 : Modelled winter occupancy of three species of waterbirds across 24 districts of Uttar Pradesh (see Sundar & Kittur 2012) showing the varied patterns of distribution and occupancy levels.



From nests to beyond

Waterbird species, particularly those that nest in heronries, have attracted a disproportionate amount of research and conservation attention worldwide. Heronries are fascinating, relatively easy to locate and study a range of questions varying from behavioural ecology to evolution (Kushlan 2012). In India, heronries have unfortunately not attracted attention beyond studies that list the species in each heronry, and a few questions related to behaviour such as locations of nests of a particular species on a heronry. Despite the majority of heronries occurring outside of protected reserves (Subramanya 1996; 2005), exceedingly little attention seems to have been accorded to urban centres and agricultural landscapes where heronries may occur in (e.g. Hilaluddin *et al.* 2003; 2005). Landscape-scale questions relating to factors driving heronry location, breeding success at heronries, and potential inter-annual variations in these aspects have been largely ignored. These are questions of great academic interest while also being useful to drive conservation action, and are relatively easy to conduct. Studies on the nesting ecology of single-nesting waterbirds such as Black-necked Stork (*Ephippiorhynchus asiaticus*) and Woolly-necked Stork are much rarer (Ishtiaq *et al.* 2004; Sundar 2003), but are badly needed to understand factors that can help sustain these species of global-conservation concern. Nesting studies of waterbird species that do not nest on trees are much rarer, and biased towards large species such as Sarus Cranes (Mukherjee *et al.* 2002; Sundar 2009). A very large number of waterbird species nest in India, but information on even nesting ecology for a large proportion of these is sadly absent. This lacuna needs to be urgently corrected given the rapid changes in land use and decline of waterbird habitat that is currently ongoing in the country. It will help if these studies are designed to include multiple sites wherever possible to enable a broader understanding of factors affecting important demographic parameters such as breeding success.

Long-term studies on waterbird breeding ecology in India are very rare. Dr. A. J. Urfi has led this aspect with his studies on the breeding ecology of Painted Stork (*Mycteria leucocephala*) heronries in the Delhi area (Urfi 2010; 2011). Similar studies on heronries on additional species in other regions of India are absent and are needed. The studies on the Painted Storks have been very useful to understand the importance of climatic variables and urbanization on species that can be located in bustling cities such as Delhi. Tracking aspects such as breeding success is also important in long-lived large waterbirds to understand the effects of changing climate change and land use. Only one study is available that has assessed the relative importance of changing climate change (measured as annual rainfall) and land use change over an eight-year period focussing on Sarus Cranes and Black-necked Storks (Sundar 2011). The study helped to understand that climate change related variables such as changing rainfall patterns are far less important to these long-lived, territorial species relative to land use changes, particularly the permanent ousting of territorial pairs due to urbanisation of agricultural areas. Since many waterbird species in India are likely similarly territorial, it should be relatively easy to set up long-term monitoring exercises across large landscapes and track the impacts of various changes on the waterbird species. These studies are also likely to come up with very specific recommendations for conservation including the identification of important multifunctional landscapes (see Sundar 2011).

Studies of waterbirds beyond the nest and beyond protected reserves in India are relatively rare. However, such studies can be greatly rewarding as the following examples illustrate. Several studies are now being conducted in agricultural landscapes highlighting the importance of waterbirds to understand their behaviour, as well as patterns and processes driving landscape-scale diversity and abundance of species. Though a very large number of bird species use agricultural crops such as rice (Sundar & Subramanya 2010), it is now becoming apparent that retaining wetlands amid crop fields is vital for the increased persistence and improved breeding success of waterbirds (Sundar 2006; 2011). In multi-cropped landscapes, seasonal variation in density, flock-sizes and occupancy is readily apparent underscoring the strong influence of crops at landscape scales on waterbird abundance and behaviour (Sundar 2006; Sundar & Kittur 2012). While large wetlands are the focus for conservation efforts with the implicit assumption of nestedness driving species diversity of wetland birds, in some Indian landscapes, the wide variety of uses by humans at wetlands seems to drive patterns of diversity and abundance, and landscape-scale diversity is clearly driven much more by turnover rather than by nestedness (Sundar & Kittur 2013). Waterbirds are also influenced strongly by the size and density of wetlands showing very strong scale-dependent wetland use. These findings have serious implications for conservation planning; a range of wetland sizes require to be conserved and wetland conservation that focusses on wetland birds require an explicit landscape-scale focus rather than a site-based focus to be of greater use to waterbird conservation. A recent study also helped showcase how changing management regimes of wetlands from multiple-use by the community to privately-owned fish farming can lead to landscape-scale homogenization of wetlands with respect to waterbird abundances (Sundar *et al.* in press). Waterbird communities were found to be similar in wetlands that were closer than those that were further apart, again adding evidence for the need to consider a landscape scale approach to wetland conservation if waterbirds are to be adequately conserved (Chimalakonda 2012). Finally, a new study has underscored the seriousness of illegal hunting on waterbirds in unprotected wetlands; hunting was a primary driver of waterbird community composition and abundance in wetlands overwhelming the influence of variables such as wetland size and vegetation that are well known to be very important for waterbird species and abundances in wetlands (Ramachandran 2014).

Clearly, the Indian landscape and waterbirds therein provide varied and ample opportunities to undertake a very wide variety of studies that can provide insights into the unique conditions that waterbirds experience on the Indian countryside.

Moving from ignorance to information: waterbirds as a platform

There is far too much to be discovered and studied of waterbirds in India. While this can seem to be depressing, the situation should be thought of to be an opportunity by students, researchers and conservationists. In an academic sense, nearly anything that one studies of waterbirds in India is likely publishable. In a practical sense, there is a real need for people to explore new locations and landscapes looking for waterbirds in the interest of time given the very rapid rate of development that is likely to occur in India starting soon. Given the vast subject matter, there is much to keep enthusiasts of waterbirds active and interested for a very long to come. Let us hope that this special issue of ENVIS is a precursor to a flood of information and conservation activities focussing on waterbirds in India in the very near future.

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