

Save UP Wetlands to Save Flagship Species Sarus and in turn Wetland Biodiversity under the Umbrella

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Introduction

Uttar Pradesh (UP) has 5.1% of its geographical area in the form of wetlands like, lake/tank/pond, oxbow lakes/cut off meanders, riverine wetland, waterlogged area, river/stream and reservoir/barrage. The wetlands of UP are rich in biodiversity of resource producing as well as resource consuming flora and fauna. Loss and degradation of wetlands, due to agriculture expansion, industrial development, river basin development, heavy use of pesticide and other factors, is the most important threats to these species, especially in India.

A flagship species is defined as the species that serve as a symbol and rallying point to stimulate conservation awareness and action but is often used synonymously as *de facto* umbrella species to delineate the reserve boundary. Therefore, the protection of this species (flagship or umbrella) protects other sympatric species under the umbrella of its large habitat requirement (Simberloff, 1999).

Sarus Crane is a well recognized wetland species which needs conservation due to its vulnerable status on account of loss and degradation of its habitat. Therefore, management of UP wetlands could be taken up on certain lines like, maintenance of marshy conditions in the wetland, stoppage of land use change of wetland, inclusion of Sarus conservation initiative in eco-sensitive zone, mass awareness about Sarus conservation needs, promotion of research activities etc. to protect itself and dependent flagship species and other

wetland biodiversity of that habitat.

The text is sequenced under subheadings like General introduction to Sarus, Sarus a Wetland species, Sarus crane given due attention, Sarus a flagship species, Sarus in UP, Sarus wetlands in UP, Wetland management in UP, Wetland management requirements, and Management recommendations which gives insight about wetland management in UP in order to conserve Sarus and sympatric species.

General Introduction to Sarus

One of the subspecies of Sarus cranes, is Indian Sarus Crane (*Grus antigone*) which has the largest population in India and mostly confined to Uttar Pradesh which is known as the stronghold of this crane. On the evolutionary tree Sarus crane (*Grus antigone*) is placed at the top (Figure 1) just below the Brolga (*Grus rubicunda*) and parallel to the Whooping crane (*Grus americana*). The Brolga is an Australian crane found along with one of the subspecies of Sarus Crane, *Grus antigone gilli*. One of the striking features of these two cranes is the typical crimson coloured head which extends down the neck in the case of Indian Sarus. As the Figure 2 suggests, although, the historical distribution range of this species in India was getting extirpated through the upcoming assessments, 1890 through 1996, Uttar Pradesh (UP) had always been the main constituent of it. This bird is a flagship species of wetlands which needs conservation due to its vulnerable status on account of loss and degradation of its habitat.



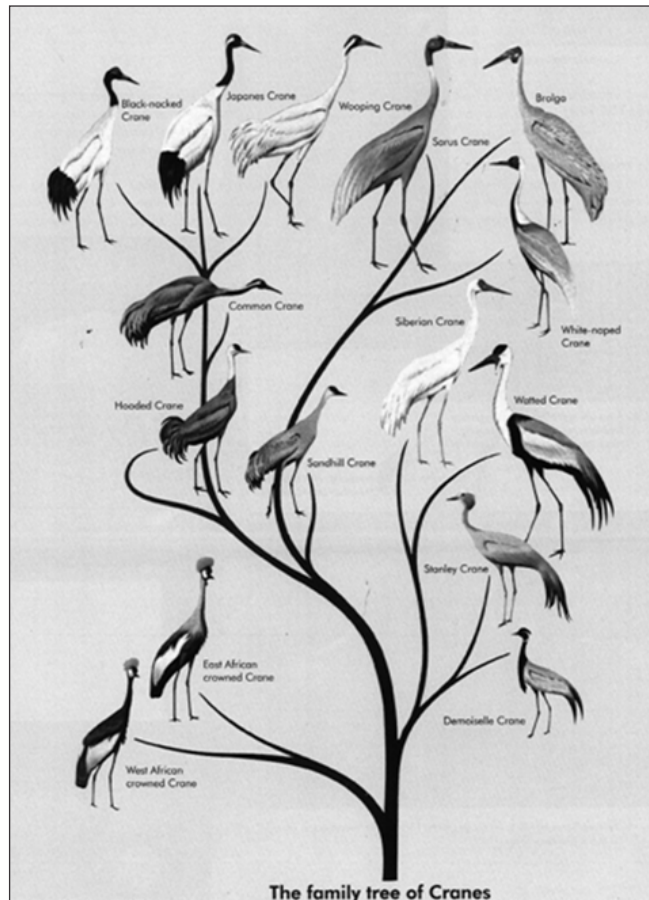


Figure 1 shows Sarus Crane at the top of the tree along with the nearest relatives like the Brolga (on left) and the Whooping Crane (on right).

In the following text unless otherwise mentioned Sarus means the Indian Sarus Crane and the data related to demography and ecology of species pertain to 2010 collection in UP.

Sarus a Wetland species

Based on the study conducted in Sarus populated states like, Gujarat, Haryana, Rajasthan and Uttar Pradesh, it was concluded that on the all India level Sarus habitation dominated in natural wetlands (Gole, 1989) but in an exclusive study in Gujarat after one decade of this study it was found that crop fields were the major habitat use by this bird (Mukherjee, 1999). However, (Sundar & Choudhary, 2008) reviewed that in areas with large wetland tracts, the Sarus used more wetlands, and in areas where agriculture dominated they used more

crop fields. It was also reviewed by them that Sarus prefer natural wetlands as nesting habitats, though they are known to use flooded paddy fields extensively for nesting. This could possibly be due to forced nesting in paddy fields on account of reduction in wetland habitats for Sarus in recent years. Paddy has the similar features to wetland except that it is seasonal and hence temporary. Recent survey conducted in the summer of 2010 in all the districts of UP revealed that Sarus crane used approximately 70% of natural wetlands, 20% crop fields and 10% other habitats.

Sarus crane given due attention

The Sarus crane has been given high attention by the statutory bodies in India as well as on global forums so that its alarmed status could be reversed. IUCN (International Union for Conservation of Nature) has placed the Sarus crane in the VU (vulnerable) Category. A taxon is vulnerable when it is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future. Vulnerability of this species is mainly caused due to habitat degradation or its loss.

In the CITES (Convention on International Trade in Endangered Species of Flora and Fauna) it is placed in Appendix II which indicates that the species that are not necessarily now threatened with extinction but may become so if trade is not strictly controlled. The signatory countries have a binding on each other to stop illegal trade of the listed species.

The CMS (Convention on Migratory Species) has also placed this species in Appendix- II of migratory species that needs or would significantly benefit from international co-operation.

The Wildlife (Protection) Act, 1972 of India has given legal protection to this species by listing it in schedule IV along with different groups of animals. Therefore, the species cannot be hunted or its habitat cannot be destroyed without legal implications and punishment.

Sarus a flagship species

In the last century, conservation has revolved around the pivotal concept of protected areas (PAs). While PAs represent a necessary response in times of

rampant habitat loss, they do not address the fundamental economic and social causes of the threats to biodiversity (Gössling 1999 in (Verissimo, 2007)). The use of the flagships approach can, if scientifically managed, undoubtedly become a valid response to these and other new challenges that lie ahead (Verissimo, 2007). In the case of UP this concept could be utilized on Protected Wetlands (Wildlife and Bird Sanctuaries), Important Bird Areas, Potential Ramsar Sites and their satellite wetlands.

The wetlands of Uttar Pradesh are rich in biodiversity of resource producing as well as resource consuming flora and fauna. Different varieties of fishes and birds are the special attraction from economics as well as tourist point of view (Jha & Chaudhary, 2011). Managed wetlands, even some unprotected but important bird areas, are considered the paradise of the birders. In fact they are the havens of diving, dabbling, wading and shorebirds be it migratory or resident category. Winter is the period of highest species richness and abundance when one can see beautiful ducks, geese, swans, teals, storks, ibises, herons, pelicans, egrets, hens, jacanas, wagtails etc. Even the arboreal and countryside birds like, kingfishers, parakeets, raptors etc. can be seen in the vicinity of woody thickets of certain wetlands.

The Sarus, one of the 500 bird species recorded around the countryside and woody wetlands in UP (UPFD, 2005), is basically a wetland species. This species was found inhabiting wetlands of all sizes in Uttar Pradesh, smaller ponds of less than half a hectare and larger lakes of even 2000 ha. The Wildlife Organization of UP Forest Department is the major stakeholder, practically monopolistic, as far as the conservation of any wildlife, including the Sarus, is concerned. Outside the protected and wooded areas the Sarus is the designate flagship as well as the umbrella species of Uttar Pradesh. The selection criteria matched with the Regional Organization aptitude where it tended to choose species that is symbolic of the region and appeal to the attachment to place of local population (Home *et al.* 2009). This was done because it is cost effective to conserve a flagship species instead of several important species of a whole community. Also because it is indeed possible to manage a whole community or ecosystem by

focusing on the need of one or few species, then the seemingly intractable problem of considering the needs of all species is resolved (Lambeck, 1997).

The Sarus is a worthy flagship species for the reasons that it is a charismatic, endemic, and symbolic species inhabiting large wetland area scattered in the agriculture landscape of Uttar Pradesh. The habitat is shared by several economically, environmentally and aesthetically important bio-diversity.

The Sarus has privileged position in wetland ecosystem as it is almost at the top of trophic level just below the raptors, a floating component in the wetland food web system (Figure 3, modified from (Jha & Chaudhary, 2011). This gives an idea of several species having umbrella protection of Sarus if this species could be conserved by protecting the habitat.

Sarus in Uttar Pradesh

The first authenticated account of Sarus population was based on qualitative assessments until 1989 when P. Gole reported 8000-10000 Sarus cranes in India (Meine & Archibald, 1996). Another all India survey done by Wildlife Institute of India in 1999 suggested that the population was less than 2000 (Sundar *et al.* 2000) which indicated drastic decrease in number. In UP there were attempts to estimate the population by different organization mostly on a localized basis (Chauhan & Kumar, 2000) but in 2010 a total count was done by the Forest Department (FD) with the help of NGOs and volunteers and, of course, its own infrastructure.

As anticipated by (Sundar, 2010) Sarus crane was distribution in the whole state, FD census showed deviation from this concept as Sarus cranes were seen in only 55 districts of UP. Fourteen districts (Allahabad, Ambedkarnagar, Bagpat, Bhadohi, Chandauli, Ghazipur, Jaunpur, Jyotibaphulenagar, Mau, Mirzapur, Muzaffarnagar, Saharanpur, Sonbhadra and Varanasi) were devoid of them. Density class wise grouping showed different clusters of districts as very high (>500 individuals in Auraiya, Etah, Etawah, Kanpur Dehat, and Mainpuri), high (101-500 individuals in Aligarh, Barabanki, Bareilly, Basti, Bulandshahar, Farrukhabad,

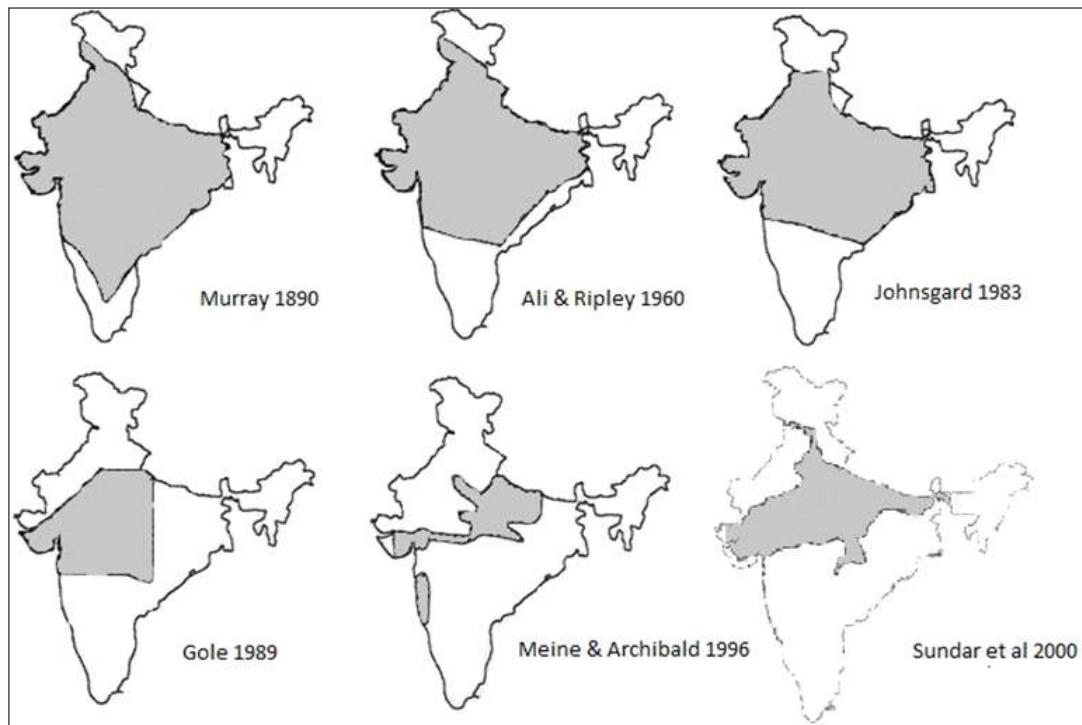


Figure 2 depicts the historical distribution of the Sarus Crane in India, modified from Sundar *et al* (2000)

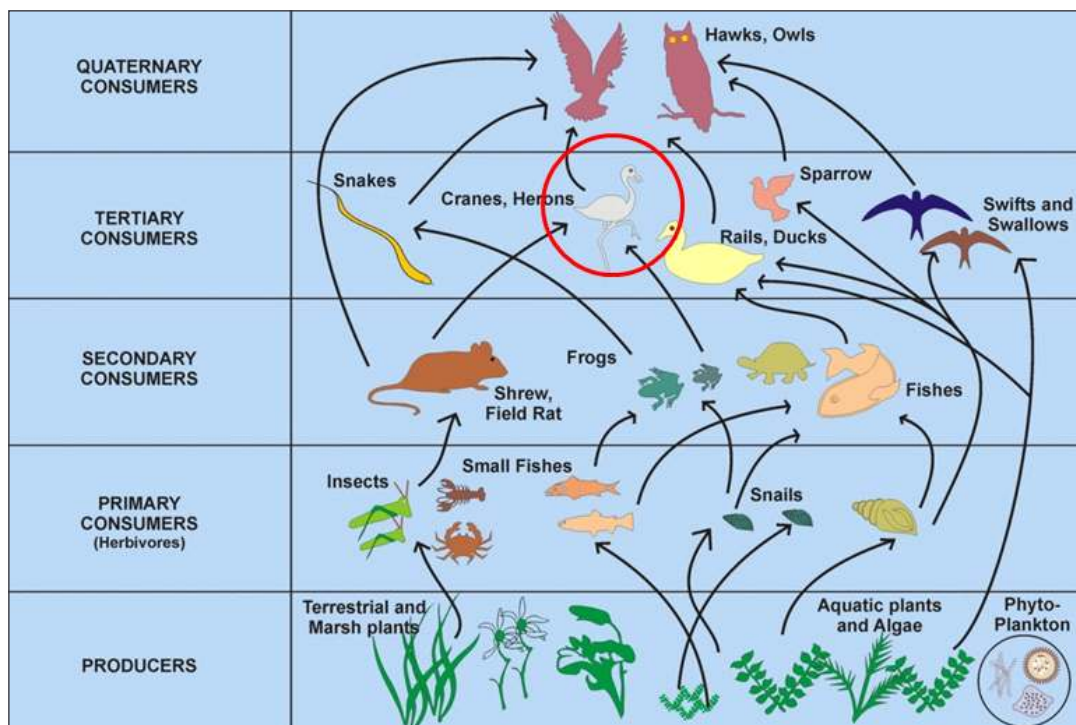


Figure 3 The Sarus Crane almost at the top of production and consumption system of wetland, borrowed from Jha and Chaudhary (2011).

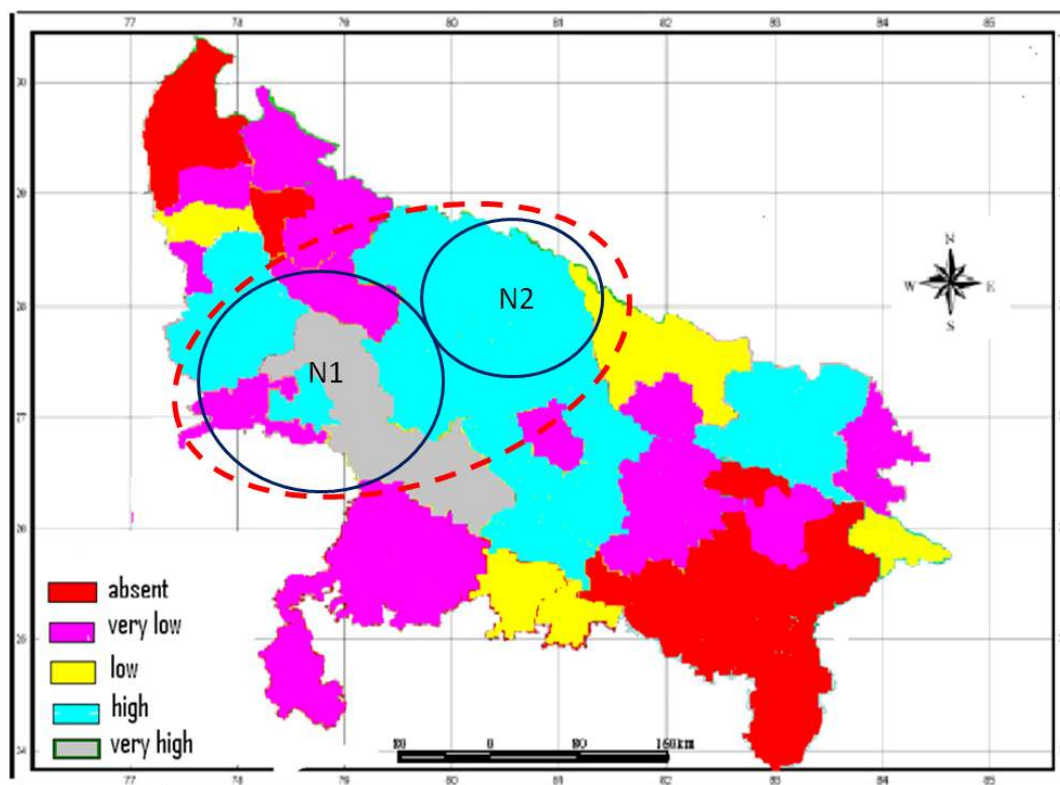


Figure 4 Distribution of Sarus by artificial density Classes. Red oval is the priority conservation potential zone and blue circles are the Sarus concentration nuclei (N1 and N2)

Fatehpur, Firozabad, Gorakhpur, Hardoi, Kannauj, Kashiramnagar, Lakhimpurkhiri, Mahamayanagar, Maharajganj, Mathura, Pilibhit, Raibareilly, Santkabir-nagar, Sidharthnagar, Shahjahanpur, Sitapur and Unnao), low (51-100 individuals in Bahraich, Ballia, Balrampur, Banda, Ghaziabad and Kanpur) and very low (1-50 individuals in Agra, Azamgarh, Badaun, Bijnor, Chitrakut, Deoria, Faizabad, Gautambudhnagar, Gonda, Hamirpur, Jalaun, Jhansi, Kushinagar, Lucknow, Mahoba, Meerut, Muradabad, Lalitpur, Pratapgarh, Rampur and Sultanpur). Some unlisted districts here are included in their parent districts. This distribution of the Sarus has been depicted in Figure 4 (modified from (Jha & Singh, 2010)). It was evident from the data that ISC population had concentration at two places centering around Mainpuri and Shahjhanpur, termed in this paper as Nucleus 1 and Nucleus 2. These two nuclei had major contribution from western part of Central zone and Western Semi-arid zone. Former had very high density as compared to latter.

Uttar Pradesh is considered as Shangri-La of the Sarus crane since it supports the highest population of this species in the country. This state has recorded 11905 individuals out of which 10394 were the adults and the rest 1511 were the juvenile cranes. This indicated that adult juvenile ratio was 13% which means that the state supports a promising population (File record of UP Forest Department), considering the report of Archibald *et al* (1981) that 10-15% adult: juvenile ratio is healthy one. However, when it was considered Agro-climatic zone wise some of the zones have this ratio within the range (Central Western Plain, North Eastern Plain, South West Semi-arid Plain, Tarai and Western Plain) while others were of serious concern (Bundelkhand, Central Plain, and Eastern Plain) where this ratio was much below 10%. The zone of immediate attention was Central zone where it was 4% and the population was highest of all the zones in the state.

Although Sarus crane is a wetland species it is seen foraging predominantly in agricultural fields. Therefore, looking at its distribution Agro-climatic zone

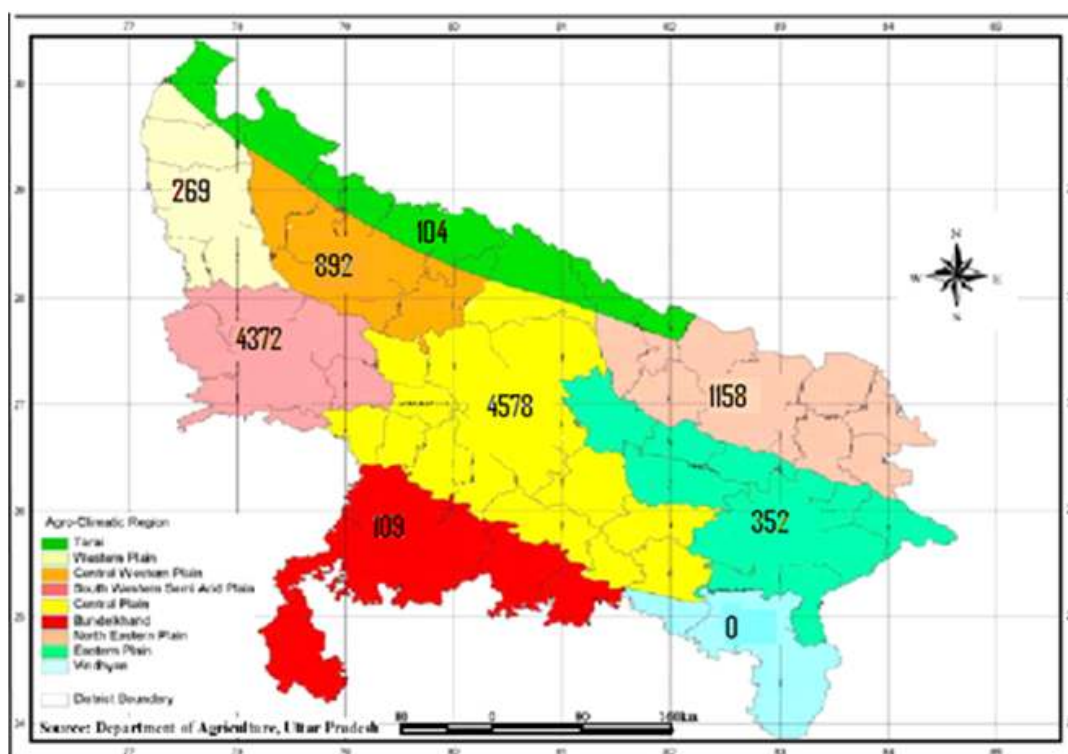


Figure 5 Distribution of Sarus in different Agro-climatic zones of Uttar Pradesh

wise could be very significant. Out of nine Agro-climatic zones Vindhya did not record even single Sarus. Other zones like, Central Plain, South western Semi-arid Plain, North eastern Plain, Central western Plain, Eastern Plain, Western Plain, Bundelkhand and Terai Plain had 4578, 4372, 1158, 892, 352, 269, 190 and 104, respectively. It can be speculated that the Agro-climatic zones showing a decreasing population has decreasing suitability of habitat for the Sarus. Pictorial distribution of the Sarus is given in Figure 5 (borrowed from (Jha & Singh, 2010))

Reproduction biology

Life cycle of the Sarus is very simple as depicted in Figure 6. Adult Sarus pair, invariably, produces two eggs that hatch into chicks in roughly 45 days. These chicks grow up and start flying in around 90 days. Well grown up juveniles leave their parents in the same year before monsoon or mating period. Since data on biology of Sarus crane regarding lifespan, breeding maturity age, breeding termination age, number of chicks etc. were not available, qualitative data through questionnaire

survey were collected on these aspects by UP Forest Department in 2010. This survey suggested that average lifespan, maturity age, breeding termination age, number of breedings in the life span, and number of chicks produced at a time were 21 years, 3 years, 12 years, 8 times, 2 individuals, respectively. Although these data had wide range of variability they can be used as indicative ones.

Population viability

Though population viability depends on many factors, the most important is annual increment which finally depends on annual recruitment and annual mortality of the species. Difference of annual recruitment rate (which is maximum annual population increase) and annual post-juvenile mortality (which is an estimate of life expectancy in the population) provides actual annual rate of population increase (Johnsgard, 1982). Considering recruitment rate of Sarus Crane in UP as 11% and taking average annual mortality rate of whooping crane (average 9.7% in (Johnsgard, 1982)) for Sarus crane (since this data is not available for

Sarus crane and whooping crane is one of the closer species to the former), annual increment rate comes out to be a positive number 1.3 %. This indicates that if everything is maintained at present level the Sarus population should not decrease; in fact there is possibility of it getting increased, or at least being getting stabilized. With this rate of increase the population will double in around five decades from now. Although it is from the localized observation, (Sundar K. G., 2009) and (Mukherjee *et al.* 2000) have also reported that the Sarus crane population has stabilized in the area of highest population in Uttar Pradesh and Gujarat, respectively. With lot of conservation efforts going on to save Sarus in the country and increasing higher awareness level it can be assumed that there will not be further increase in present threat condition and therefore, one can speculate that decline of Sarus at least in UP, even India, does not seem to be plausible in near future.

Sarus wetlands in UP

Wetlands of Uttar Pradesh have varied topography, vegetation and other variables which interact to produce a resource complex and in turn affect the population of the Sarus directly or indirectly. The Sarus which is one of the stakeholders of the wetland also uses plants or animals as food or nesting materials depending on their availability in the production system. Major interacting components are water depth, topography, vegetation, food material and salinity of water. A schematic representation of interaction among habitat variables affecting wetland habitat use of the Sarus crane is given in Figure 7 (modified from (Ma *et al.* 2010)). The direction of the arrow in the figure indicates influence of one variable onto other. For example, water depth of the wetland regulates distribution of animal and plant food, availability of food material, salinity of water and vegetation growth. Vegetation in a wetland is regulated by topography and salinity. Food and food availability in the resource pool is governed by water volume, animal food and vegetation. The Sarus population is affected in the wetland by food availability, water depth and vegetation material directly while other variables have indirect control on it. However, all the wetlands are not inhabited by the Sarus probably due to unsuitability of

wetlands as habitat or absence of Sarus crane in particular area due to harsh climatic and other conditions.

Uttar Pradesh has 5.1% of its geographical area in the form of wetlands like, lake/tank/pond, oxbow lakes/cut off meanders, riverine wetland, waterlogged area, river/stream and reservoir/barrage. Larger wetlands (>2.25 ha) are 23890 while smaller ones count 97352 in number totaling 121242 (NWA, 2011). More than 99% of these wetlands are not inhabited by Sarus. Going through the past records potential sites of Sarus habitation was surveyed before last the Sarus census in UP. Out of 1547 residency sites only 1074 wetlands were found to be used during 2010 summer. These wetland sites were distributed among ponds and lakes (62%), river beds (16%), and canal sides (22%). Deep reservoirs and wetlands in forested area were devoid of Sarus cranes. (File record of UPFD). There could be several possibilities of not utilizing such a huge number of wetlands in the state, for example most of the smaller wetlands would have dried up, and many would not have been suitable habitat or locality. Some workers have reported about optimal habitat which includes a combination of marshes, ponds, fallow lands, and cultivated lands. Adult pairs use cultivated fields, fallow lands, and other drier habitats, as well as flooded fields, rice paddies, and degraded lands. Families with pre-fledged chicks, however, use wetlands almost exclusively. Breeding pairs use larger wetlands where ever they are available, but are typically scattered across the landscape, nesting in fields, along canals and irrigation ditches, beside village ponds, and in shallow marshes, rice paddies, jheels, and reed beds (Gole 1989b, 1991b, 1993a, Suwal 1995 in (Meine & Archibald, 1996)).

Wetland management in UP

From the ownership viewpoint wetlands of UP could be categorized as government owned, community owned and privately owned. Government owned wetlands are used as direct service or goods provider for example, Irrigation department managed wetlands are meant for water supply to crop fields, the fisheries department generates revenue by doing aquaculture etc. Only forest department owned wetlands are intended to provide ecological services by protection to wetlands

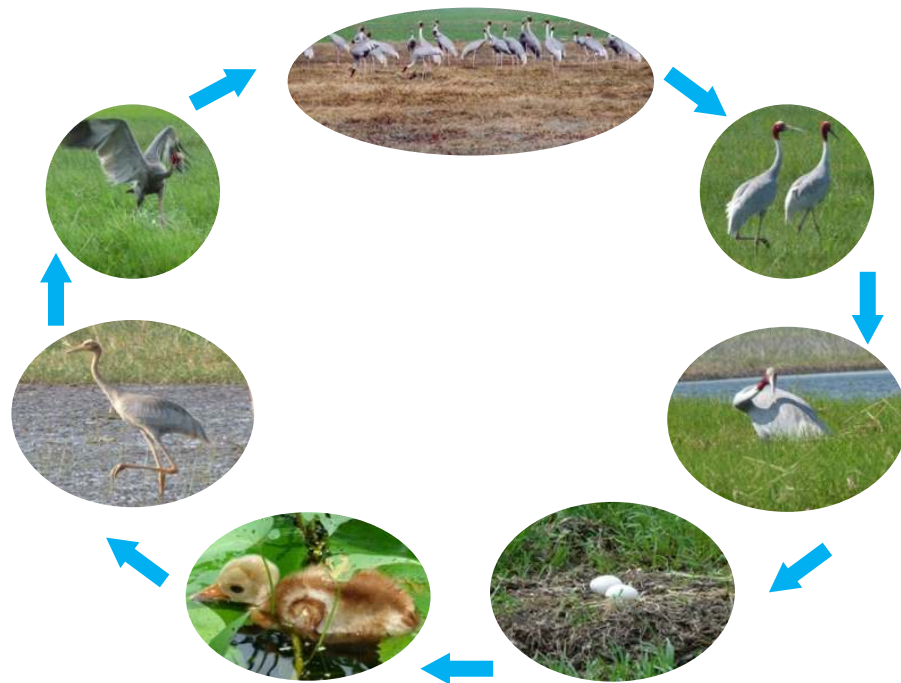


Figure 6 Different stages in the life of Sarus: Large flock called Congregation yields breeding pairs which make nests and then lays eggs. The chicks come out and fledge and finally grown up sub-adults join the congregation for making pairs in due course of time. Adult stage life risks are hunting and trapping, pesticides and heavy metals consumption, habitat loss, disturbance, and droughts and predult stage life risks are egg stealing, mongoose and dog attacks.

and their flora and fauna. This department has 15 wetland based bird sanctuaries meant for conservation of primarily resident and migratory birds along with other animals. There are no Sarus conservation reserves or sanctuaries in the state. Nevertheless, Forest Department lays thrust on conserving the Sarus crane outside the protected area under its control as more than 90% Sarus population inhabit outside the Protected Area Network of Forest Department.

Community owned wetlands in UP are providing goods and services to the people but their fate is just like “Tragedy of Commons” of Garret Hardin where in dilemma arise from the situation in which multiple individuals, acting independently and rationally consulting their own self-interest, ultimately deplete a shared and finite resource even after it is amply clear that it is not in anyone’s long-term interest for this to happen (Hardin, 1968). Therefore, this type of wetland is the most affected from anthropogenic pressures. Most of the small and medium sized wetlands are community owned

in the state. Privately owned wetlands are smaller and fewer in number catering to the interest of individuals. Recently conducted Sarus habitat survey in UP revealed that out of 1547 Sarus crane habitation sites 25% were privately owned and rest were either government or community owned (File record UPFD).

Wetland management requirements

Loss and degradation of wetlands, due to agriculture expansion, industrial development, river basin development, pollution warfare, heavy use of pesticide and other factors, are the most important threats to the species, especially in India and Southeast Asia (Meine & Archibald, 1996). Increasing human demands on India's wetlands may be contributing to the decline of the Sarus crane by reducing the recruitment rate within the population (Meine & Archibald, 1996). Keeping this in view threats to the wetlands (potential sites of Sarus crane habitation) were recently surveyed by the UP Forest Department and it was found that these

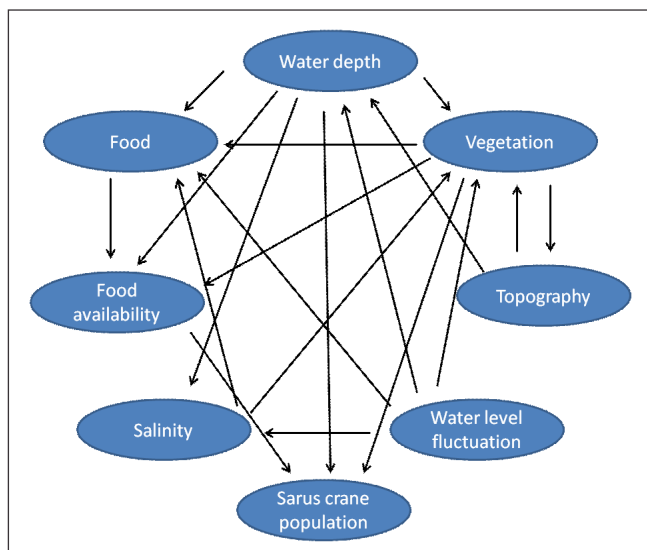


Figure 7 Interaction between habitat variables affecting habitat use of Sarus at wetlands.

sites suffered from one or more threats like, pollution, agricultural extension, removal of soil for various purposes, removal of vegetation (extraction of consumable products), expansion of vegetation (spread of weeds), land encroachment, fishing, siltation and others (category not known to the data collectors but during interview they indicated that habitat condition was not normal. In certain cases water quality was very bad and in some others visitors' pressure was high). Pollution in the habitats was further categorized in to five different types namely, disposal of household waste, drainage of industrial discharge, solid waste disposal and the use of excess fertilizers and pesticide that drained into the habitats. Therefore, following aspects of Sarus habitats or wetlands, mainly the stagnant water bodies need to be taken care of:

1. Hydrology

Sarus cranes prefer to wade in 30 - 45 cm deep water for food (Johnsgard, 1983), therefore, maintenance of minimum water depth is required, for want of which the Sarus could be forced to move to wetland like habitat and the normal life cycle of the bird may be affected negatively. Since, wetland habitat is being used by this species throughout the year seasonal availability of water may also affect the behavior of the bird. Since many of the state wetlands are seasonal and dry up

during summer and some dry up early due to excess draw down of water by bore-wells for irrigation, water sufficiency in these wetlands needs to be taken care of.

Contamination free water is important for proper maintenance of the ecosystem. Recent survey on potential Sarus sites has revealed that most of the pollutants come from house hold waste. Another source of contamination was from industry and solid waste disposal. Excess use of fertilizer in agricultural catchment also added to the water quality deterioration which ultimately leads to imbalanced growth of aquatic diversity. Most of the UP wetlands are the temporary reservoir of pesticide as it comes from agricultural catchment where it was being used copiously. Industrial discharges, heavy metals, also drain in some of these wetlands. Therefore, these two pollutants affect the life of biotic components adversely. Pesticide use has been reported as one of the Sarus mortality reasons (Muralidharan, 1993). Figure 8 (modified from Saxena & Gopal, 1995) depicts transfer of pesticides in to Sarus crane through food chain. Toxic pollutants like pesticides and heavy metals entering the wetland in the first place affect the organism directly. They move through the chain to higher trophic level in higher concentration which may become lethal to different organisms(Saxena & Gopal, 1995).

2. Topography

The primary reason behind the threatened status of the Sarus crane in the state is the increased rate of conversion or modification of wetlands for diverse human uses and the biggest threat is conversion of conglomerates of small wetlands. It reduces breeding habitat, breeding success and ultimately breeding population(Sundar G. K., 2010).

Deepening and desilting of community or government owned ponds and lakes under the newly implemented scheme of Government of India-MNREGS mainly for fish culture and water chestnut cultivation needs a relook if wetland conservation is to be given a priority. Not only does deepening change the topography of the water body it eliminates the emergent vegetation which is one of the most important components of the balanced wetland profile. Desilting alters the nutrient balance of the wetland ecosystem

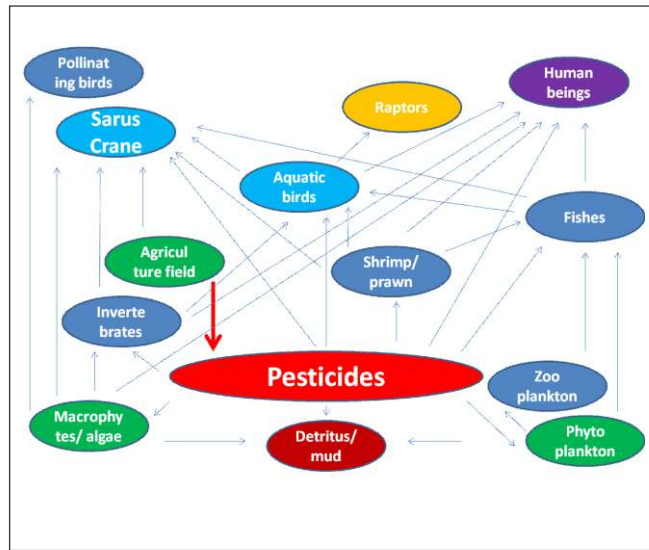


Figure 8 Flow of Pesticides in different component of wetland system including Sarus crane.

resulting in a changed vegetation configuration in turn affecting the food availability in the system. Prior to this scheme too the topography of wetland used to be changed by various developmental activities. Figure 9 (modified from (Jha & Chaudhary, 2011)) reflects the change in topography related features from a ruggedly sloping marsh to a deep pond with a sharp vertical fall on the edges due to deepening and silt removal. There is the likely possibility that the emergent vegetation will disappear immediately causing hardship to the wading birds, reed sheltering lower animals, even the Sarus. Open water area of the wetland will increase and hence there is possibility of fauna and flora replacement, for example, by diving ducks and submergent vegetation, respectively. This means the aquatic biodiversity, both plant and animals, (letters indicate plants and the numbers animals in the figure, example (a) free floating hydrophyte, (b) suspended hydrophyte, (c) submerged anchored hydrophyte, (d) floating leaved anchored hydrophyte, (e) floating shoot anchored hydrophyte, (f) emergent amphibious hydrophyte, and (g) wetland hydrophyte; and 1. raptor (eagle), 2. carnivorous wader (heron), 3. omnivorous wader (sarus crane), 4. hovering and plunge diver (tern), 5. subsurface eater (gull), 6. surface eater (pintail), 7. diver (pochard), 8. hovering raptor (harrier), 9. vegetarian diver (coot), 10. pickers (passeriformes), 11. piscivorous diver (grebe), and 12.

surface traveler (moorhen)) will be altered as into non hemi-marsh condition.

3. Vegetation use

The Sarus crane being omnivorous animal uses vegetation for food (roots of aquatic plant, shoots of grasses, tuber of sedges, rhizomes of *Eleocharis plantaginea*, *E. ochrostachys* and occasionally *E. dulcis* and *E. palustris*, *Nymphaea*, *Scirpus tuberosus*, *Typha* sp., *Oryza rufipogon*, *Cyperus* sp. and many more non-aquatic plants like *Arachys hypogea*, *Cicer arietinum* etc.) and lower animals. Some vegetation is the shelter for lower animals (*Typha angustata*, *Phragmites karka*, *Ipomoea carnea* etc.) used for food by Sarus. Vegetation material is also used for the nest building (locally available grass like material, more frequently *Paspalum distichum* and *Sporobolus helvolus* grass pulled by roots, raft of rushes are also reported to be made in deep water to keep the nest afloat, in paddy field it is paddy straw. In Sandi Bird Sanctuary *Jussiaea repens*, *Eleocharis palustris*, *Arundo donax*, *Ipomoea aquatica*, *Paspalum* sp. and occasionally *Typha angustata* and *Eichhornia cracipes* were seen in nest component analysis (Pers. obser.). A detailed study on nest materials used by the Sarus crane in Gujarat reported more than 25 species being picked by them for making their nests (Mukherjee *et al.* 2000) (Mukherjee, Soni, Borad, & Parasharya, 2000). This indicates that the Sarus crane can use almost any vegetation available in its surroundings. Thus, clearing of such useful materials for Sarus from the wetland during deepening and desilting of wetlands could go against the conservation effort for this bird.

4. Regulated tourism

Many wetlands, especially the bird sanctuaries with good population of Sarus cranes, are very popular in the state for bird watching based tourism. Usually tourism creates more or less negative impacts on flora and fauna (Parekh & Gadhvi, 2011). Although Sarus crane is known to live in human presence regular persecution in agriculture field next to the wetland disturbs the rhythm of biological behavior. In captivity it was observed that disturbance during copulatory attempts affected the behavior negatively (Hren & Greenwell, 1983). The nesting of Sarus crane is most frequently seen in the sanctuary area. In 2011 monsoon three nests each in

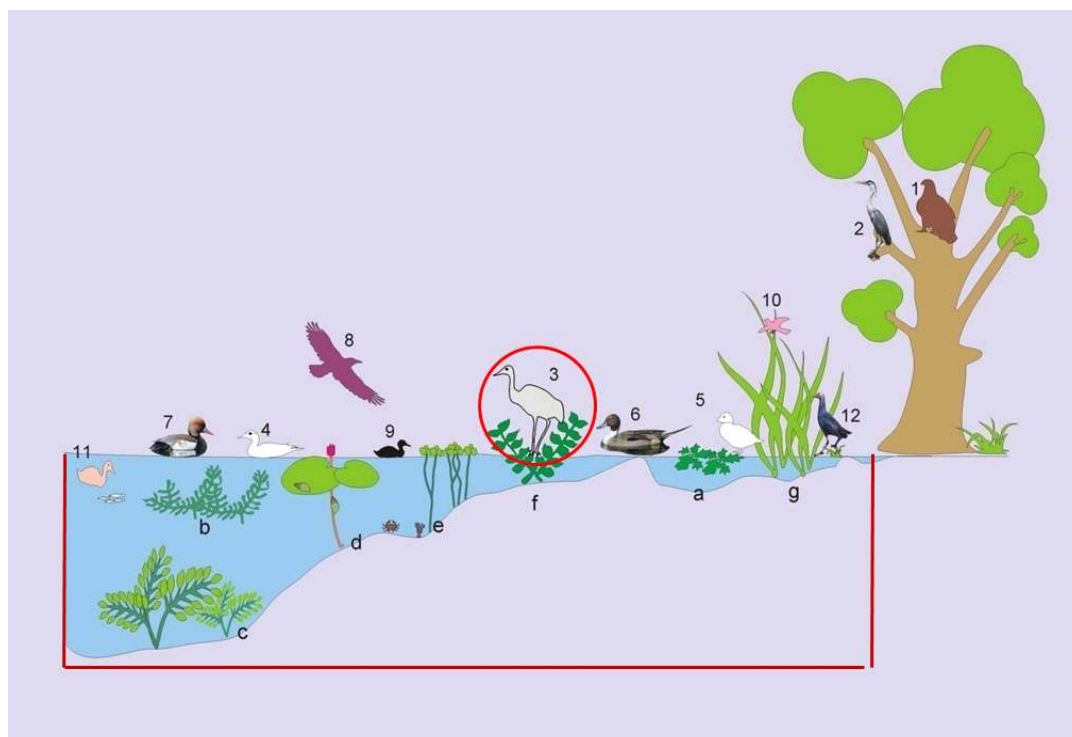


Figure 9 showing marsh with forms, including Sarus crane and superimposed tank topography.

Saman and Sandi bird sanctuary were seen in the close vicinity of a walking trail of the tourists (Pers. Obser.) Forest department is trying its best to provide nature based tourism with proper care of conservation still due to tremendous pressure on the sanctuaries this is creating enormous amount of disturbance to the birds. This needs to be regulated further to minimize the impact. Figure 10 presents the tourism generated artificial structures which attract tourists in enormous number resulting into disturbance to Sarus cranes along with other birds.

Management recommendations

1. Maintenance of marshy conditions in the wetland

As the major population of the Sarus crane is thriving on smaller and medium size wetlands, and marshy conditions are most suited for habitation of this species, it is of utmost importance that these wetlands should be prevented from drying in order to maintain marshy condition. Water storage in the pond or lake with

shallow topography is needed to ensure this. The emergent vegetation and open water ratio should be maintained at 1:1 and simultaneously be dispersed through the wetland.

2. Stoppage of land use change of wetland

It has been established that natural wetland of different sizes is being converted for various economic and non-economic activities and thus is posing a threat to the residency of the Sarus by making them unsuitable. Initiative has to be taken at different level to intervene and stop land use change of at least Sarus inhabiting wetland in the state without wasting much time as the population viability of the Sarus in the state is at the lower end of success range.

3. Inclusion of Sarus conservation initiative in eco-sensitive zone

As per a government of India directions all the states and union territories are supposed to develop an eco-sensitive zone around their protected areas. An Eco-sensitive zone, with reference to Wetland based



Sanctuary, could be the ecologically sensitive area around it playing the role of shock absorber of the incoming pressure radiating from the fringe area of the sanctuary. This zone will mean a positive attempt to protect the sanctuary and its precious resources for the benefit of public but in no case will it hamper the day to day activities of the inhabitants. Since wetland sanctuaries of UP have a very small population (> 8%) of Sarus crane and lot of these cranes, either from sanctuaries or from other areas, feed in the surroundings of the sanctuary the role of eco-sensitive zone becomes crucial in their conservation. Some of the suggested activities in this zone which will help conserve the Sarus, are a minimized use of pesticides, the promotion of organic farming, the safe disposal of domestic and solid wastes, the promotion of cultural values and emotional attachment of people towards the Sarus, discourage land use change of satellite wetlands, dissuading people from growing sugarcane, pigeon pea and other crops which are detrimental to Sarus residency, creating social fencing around the nests from incubation to fledging period, initiation of wetland maintenance policy for high Sarus density wetlands (During 2010 census 18 lakes or ponds other than sanctuary supported around 50 or more Sarus. These wetlands could be selected for the said purpose etc. Therefore, while creating the eco-sensitive zone around the Bird Sanctuaries the authority should make such provisions in order to achieve success in Sarus conservation.

4. Mass awareness about Sarus conservation needs

Although due to local traditions and religious belief about the Sarus crane among the rural people this bird species has got social protection but they are probably not aware of the fact that the habitat of the Sarus, mainly the wetland, is deteriorating as well as shrinking very fast. As a result, Sarus cranes have become vulnerable and if appropriate steps are not taken very soon they might face a threat to their existence. Therefore,

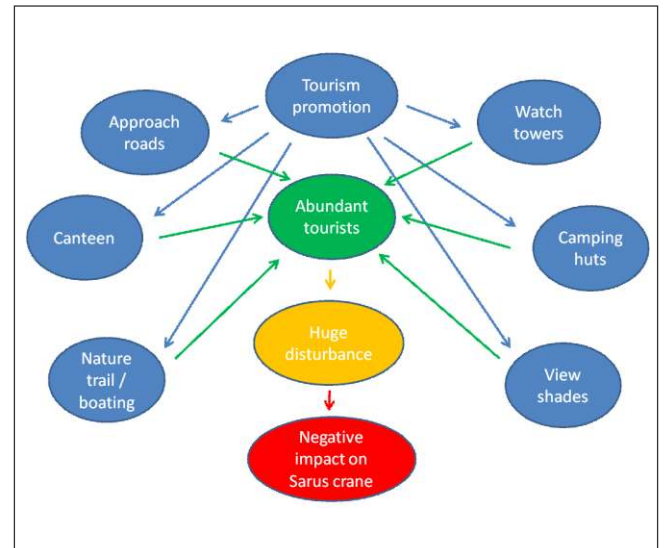


Figure 10 Generation of facilities bringing in enormous tourists which may cause disturbance to Sarus crane beyond repair.

people should be educated about arresting further deterioration of small to medium sized wetlands and quick restoration of already deteriorated wetlands.

5. Promotion of research activities

It is worth mentioning at this point that information and knowledge, specifically scientific, is the most important tool for the management planning of any activity. Although researches are being carried out by various institutions on this species in piecemeal manner, effort is needed to be concentrated on the biology and ecology of the Sarus. This might include an impact of threat on Sarus wetland and the Sarus crane itself. Qualitative as well as quantitative information should be generated on the use of pesticides, fertilizer, domestic and solid waste disposal in the Sarus landscape causing damage to the Sarus habitat and in turn the Sarus crane. Among other things, monitoring of Sarus crane population over the years is very important so that the population growth trend could be ascertained and further Sarus conservation strategy could be drawn up.

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