Black Kite Project Report

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Submitted by:

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Summary

The research team working in the National Capital territory, since December 2012, and through major funding support from the raptor Research and Conservation Foundation (RRCF), envisioned a long collaborative term study around the urban adaptations of a large raptor, the Black Kite *Milvus migrans*. Supervised since its inception by Profs. Y. V. Jhala and Q. Qureshi from the Wildlife Institute of India, and Dr. F. Sergio of CSIC, Spain, this project is a unique attempt in the Sub-Continent to holistically unravel the adaptations around Black Kite's densest urban settlement in the world. Phase-I of the project (December 2012 – June 2014) focussed on basic natural history observations, followed by the Phase-II (July 2014 – July 2016) which further extended the efforts to cover more sampling units, focusing on the aspects of habitat selection. We plan to structure the ongoing project, currently in its third phase (August 2016 – July 2018), as a comprehensive assessment of the response by Black kites to an urban gradient within the megacity of Delhi. We already have introduced the general theme of animal adaptation and responses to urbanization in Kumar *et al.* (2014) where we quantitatively described the study population. We have examined habitat selection along the urbanization gradient, as tested through the analysis of breeding habitat attributes for 154 kite territories (sampled from 2013 to 2016) vs 154 random locations. In addition, we also examined the effect of the same urban variables on breeding success and on the rate of territory occupancy, used as an estimate of territory quality. The same is currently under submission to international SCI journal and more analysis is in progress, with three manuscripts planned for submission within the next autumn. In this sense, the project is now entering its intensive-publication stage, as enough data have now accumulated to enable high-level publications on international scientific outlets. Finally, the project has incorporated through these initial years: (1) a remarkable amount of environmental education of Delhi citizens; (2) the completion of the Master thesis of N. Kumar; (3) the initiation of a PhD by N. Kumar at an institute of repute (Oxford University, Department of Zoology, Edward Grey Institute of Ornithology); and (4) the initiation of a Master program by U. Gupta at the Department of Geography of Oxford University. All in all, the overall research team is extremely satisfied of all the progress and research formation attained and eager to move on to expand and intensify the project even more.

1. Background

Urbanization is one of the most radical environmental changes caused by human beings worldwide (Grimm *et al.* 2008 and Pauchard *et al.* 2006) and attention to its impacts on biota has been growing steadily over the recent decades (Seto *et al.* 2012 and Sodhi *et al.* 2004). It is known to cause deleterious impacts on most species but in certain adaptable species it can have positive impacts. In urban areas, species sufficiently plastic in their response to changing environment can become commensal with humans, exploiting and benefitting from garbage, incurring profits from favorable microclimate and protection (Chace and Walsh 2006 and Marzluff *et al.* 2001). In most developing countries, poor focus over the repercussions of this rapid urban sprawl on the native flora and fauna has altered urban biological communities (Seto *et al.* 2012). There have been few intensive studies in urban environments, especially for mega-cities, for urban areas of tropical latitudes and for species at higher trophic levels (Chace and Walsh 2006). Top trophic species, like Black kites, are usually considered more specialized than lower trophic level species (Ferguson-Lees and Christie 2001 and Newton 1979).

The Black Kite is a medium-sized raptor, currently considered as one of the most numerous and successful birds of prey of the world (Ferguson-Lees and Christie 2001). It is an opportunistic feeder, capable of reaching extremely high densities where food concentrations allow it (e.g. review in Sergio *et al.* 2005 and Malhotra 2007). It may occupy habitats which range from fully natural to completely urban (Ortlieb 1998, Ferguson-Lees and Christie 2001). Such adaptability allows it to exploit human-modified habitats, affording it a generally favourable conservation status (e.g. Sergio *et al.* 2003). In India, the species is strongly associated with human settlements and acts as the main avian predator of the urban ecosystem (Kumar *et al.* 2014). Previous research from the city of Delhi (Desai and Malhotra 1979, Galushin 1971, Kumar *et al.* 2014) showed that that these birds were stable in their overall breeding density since the 1960s. Kites, like most raptors, often exhibit exigent ecological requirements (Newton 1979). Though mainly recognized as city scavengers, presence of live and wild prey in their diet has been frequently reported (Ferguson-Lees and Christie 2001, Kumar *et al.* 2014 and Naoroji 2011). Within Delhi, kites nest in trees (i.e. they will need green space), or, less frequently, on anthropogenic structures, which amount to less than 5% of the overall nests. The nest substrate in the form of trees is readily available in the city. As the major predator in a city which affords them plenty of garbage-based food, these birds further enjoy a favourable attitude by local people to wildlife, which allows them to breed undisturbed in the immediate proximity of large human concentrations (Galushin 1971). Breeding in their dense colonies in the city of Delhi, these human commensal birds exhibit a moderate breeding success, where approximately 50% of the pairs successfully raise chicks to fledging (review in Kumar *et al.* 2014).

The resulting high density, often reached by this species in its southern Asian breeding quarters, offers a unique opportunity to replicate, extend and compare the reported individual-level and population-level patterns and processes reported for European populations (e.g. Bustamante and Hiraldo 1988, Hiraldo *et al.* 1990, Sergio 2003 and Sergio *et al.* 2004, 2011, 2014, Veiga and Hiraldo 1990 and Viñuela 1996, 1997a, b, 1999 and

2000). In particular, some of these studies, published in the 1990s, have been ground-breaking, with very detailed analyses of laying asynchrony, hatching asynchrony, sibling rivalry and brood reduction. They have become model studies for this sort of analysis, especially for raptor biologists (Hiraldo *et al.* 1990, Veiga and Hiraldo 1990, Viñuela and Bustamante 1992, Viñuela 1996, 1997a, b, 1999 and 2000). One of the main findings of the above studies was that food availability acts as a proximate factor that modulates brood reduction through sibling fights. This would fine-tune brood size on food availability when the latter is unpredictable, especially at the time of laying.

In the Delhi population, hatching asynchrony and brood reduction is common and Black Kites nest across steep gradients of urbanisation that impose substantial variation in food supply (Kumar 2013, M.Sc. thesis). To study such links between brood reduction, food availability and urban landscape structure, use camera-trapping devices (n= 35 from 2015 – 2017) positioned in nests, sampling all the urbanization gradients, and to integrate such data with regular visits at the same nests, so as to gather estimates of hatching asynchrony, brood reduction, chicks' growth rates, and the behaviour around nest defence and decoration. This will allow us to test: (1) how the components of urbanization (e.g. human waste-management, meat-tossing practices, human density, etc) translate into parental provisioning performance and diet composition, with repercussions on nestlings' growth, condition, stress levels and survival; and (2) how intra-siblings fights and killings may mediate such relations.

Summary of the research efforts (2014- 2016)

At the moment of writing, currently available sample size for camera trapping, growth curves, and eco-physiology is:

n = 48 nests and ~ 90 nestlings for which growth curves have been adequately recorded.

N = 140 nestlings (from 90 nests) for which feathers have been collected for corticosterone analysis.

n = 30 nests equipped with camera-trapping devices.

These sample sizes will be augmented during the ongoing field-season (many nest are still at the incubation stage) and, if deemed important, during the next fieldwork season 2017-2018, after consultation with the supervisors. All the data on growth from previous field seasons are already available in Excel datasheet format and the data entry for this year, plus screening of camera-trapping images will be conducted during April-September 2017. About 10% of the camera trapping data (~ 20,000 pictures) has already been screened for the information over the breeding ecology. We plan to have the entire camera trapping data extracted and available as through Excel spreadsheets by December 2016, well in time for the planned analysis related to this chapter (see work plan at the end of the report).

Currently available sample size for nest defense is:

n = 50 nesting pairs i.e. 100 breeding individuals for over three seasons and about 70 non-breeding individuals tested for FID.

N = 210 nests tested for nest defense during each nest visit.

n = ~ 200 nests for nest decoration, recorded during each nest visit (the regularity of inspection may vary).

All the data from previous field seasons are already available in Excel datasheet format.

Currently available sample size for the population based response is:

n = 50 surveyed plots.

These sample sizes will be augmented during the next fieldwork season 2017-2018, if deemed important after consultation with the supervisors. All the data from previous field seasons are already available in Excel datasheet format. The data entry for this year's data will be conducted during July-September 2017.

Abstract of the manuscript under publication consideration

Title: Habitat selection by an avian top predator in the tropical megacity of Delhi: human activities and socio-religious practices as prey-facilitating tools

Research in urban ecology is growing rapidly in response to the exponential growth of the urban environment, driven by the increasing concentration of humans in cities (in 2009 the global urban population exceeded 50% for the first time). However, few studies have focused on tropical megacities, and on the interplay between top predators, habitat selection, and human socio-economic aspects, which may mediate their resilience and coexistence with man in extreme anthropogenic environments. To fill these gaps of knowledge, we examined mechanisms of breeding habitat selection by a synanthropic avian top predator, the Black Kite *Milvus migrans*, in tropical Delhi. Here, kites mainly subsist on two types of human subsidies: (1) refuse and its associated prey-fauna, such as rodents or pigeons, and (2) ritual feeding of kites particularly practiced by members of the Muslim communities in Delhi. These aspects require the incorporation of estimates of human activities into habitat models. We used mixed effects models to test the effect of urban habitat configuration and human practices on habitat selection, site occupancy and breeding success. Kite habitat decisions, territory occupancy and breeding success were tightly enmeshed with human activities. Kites preferred sites with high human density, with a road configuration that facilitated better access to resources provided by humans, in particular to Muslim colonies that provided ritual subsidies, and to areas with poorer waste management. Furthermore, kites bred at 'clean' sites with less human refuse only when close to Muslim colonies, suggesting that the proximity to ritual-feeding sites modulated the suitability of other habitats. Rather than a nuisance to avoid, as portrayed by many urban studies, humans were a keenly-targeted foraging resource, whose food 'subsidies' tied a predator's distribution to that of human activities, and by implication then also with religion, politics, history, socio-economics and urban planning at multiple spatio-temporal scales. Many synurbic species may exploit humans in more subtle and direct ways than previously thought, but uncovering them will require higher integration of human socio-cultural estimates in urban ecological research.

Achievements: 2014 - 2016

We have successfully trained >80 university students on basic field research, out of which 18 have joined institutions of national and international repute for their higher studies (Oxford, Ireland, India: WII, JNCASR, TERI, DU, FRI etc). Alongside, with the team of volunteers, we have also imparted conservation education to ~ 30,000 Delhi citizens, as a mobile conservation education unit through the years of field research. Additionally, we have voluntarily lectured in 5 schools and 3 colleges, and ran a workshop led by Ms. Urvi Gupta (currently doing her MSc Biodiversity, Conservation & Management at Somerville, Oxford), for **Department of Science & Technology, Govt. Of India's** initiative INSPIRE. The latter was organised at Miranda House College, Delhi University to motivate top 200 high school students in the state towards science.

Peer reviewed publications: (Published and in review)

Kumar N, Gupta U, Jhala Y V, Qureshi Q, and Sergio F, Habitat selection by an avian top predator in the tropical megacity of Delhi: human activities and socio-religious practices as prey-facilitating tools (**under review**)

Kumar N, Dhananjai Mohan, Yadvendradev V. Jhala, Qamar Qureshi & Fabrizio Sergio (2014): Density, laying date, breeding success and diet of Black Kites *Milvus migrans govinda* in the city of Delhi (India), *Bird Study*, 61 (1), page 1-8

Conference Proceedings:

Kumar N, 2016. **Passive' Nature in anthropologically-architectured environments,** India Policy Day, University of Oxford, UK.

Gupta U, **Kumar N**, Jhala, Y.V., Qureshi, Q and Sergio, F. 2016. **Being a large raptor in a rapidly changing megacity of Delhi** *Student Conference on Conservation Science. Bangalore*

Kumar N, Gupta U, Jhala, Y.V., Qureshi, Q., Gosler A G and Sergio, F. 2016. **Interplay of Opportunities and Challenges for urban Black Kites *Milvus migrans*.** *British Ornithological Union Annual Congress.* University of Leicester. *2016.*

Prajapati R, Gupta U, and **Kumar N**, 2016. **Kites in the Capital.** *Young Ecologists Talk and Interact Conference, Amity University Delhi-. 2016*

Gupta U, Malhotra H, **Kumar N**, Jhala, Y.V., Qureshi, Q. and Sergio, F. 2015. **Black Kites of Delhi** *Uttarakhand Bird Festival Seminar. Corbett National Park 2015*

Grants (National and International):

Title: Migration of Black-eared kites *Milvus migrans lineatus* through the Asian migration flyway to Delhi: Implications for the conservation of Central Asian migrant birds and local environmental education
Main Investigator: Nishant Kumar
Funding Agency: Microwave Telemetry Inc.; USA: **Christian Howey Raising Scholar Award**
Duration: November 2015; **Grant Value:** £ 16,000 (for 5 free GSM PTTs, no cover for data download)

http://www.microwavetelemetry.com/uploads/newsletters/2016_Winter/MTINewsletter_2016_Winter_page8.pdf

Travel grants for the field work: From Somerville College, Oxford + Dept. Of Zoology Oxford
Awarded to: Nishant Kumar
Grant Value: £ 2000

2. New Initiative with the Microwave tags received as free grant

Science is the engine to prosperity and scientific temperament is the definitive human attribute.

Indian Sub-continent houses the largest population of youngsters (age <25 years); a fact which pumps immense promise of future development and solidarity. Sadly, it is also a region where basic science education has possibly received the poorest focus and innovation. Plain speaking, a global citizen can't imagine the optimisation of this youth power with >75% of municipal and government schools not maintaining adequate lab facilities for science. The situation becomes grimmer when this ill informed young population abreast the 'information age' (internet facility for a month costs < £0.5). This research is an outcrop project aspect I intend to start in April 2017. We have recently been awarded multiple grants to deploy 20 – 25 transmitters on the migratory sub-species of Black Kites *M. m lineatus* on the landfills of Delhi (these kites migrate back to Russia and other Central Asian Centres to breed). The team wishes to formalise conservation awareness drive for school going students, using tagged birds as drivers of interest.

We believe that the ability to employ PTTs would immensely benefit the educational component of the study (see supporting information), because the only possibility to show the journeys to China, Mongolia, or Russia that we expect the birds to do, would likely leave many students and children deeply fascinated. It would also give their teachers much to explain about the importance of conservation even in a highly urban setting. This is especially important in a historical era of skyrocketing urban sprawl, where 77 % of the world population is expected to be concentrated in cities by 2030 (according to UN global projections), and especially so in developing and tropical countries. For large crowds, their urban coexistence with study species like ours will be their only possibility of a connection with nature.

Overall, the idea to show on a map and in real time, how kites' journeys connect Delhi to such faraway places as the Mongolian steppes, through kites crossing barriers such as the Himalayas and the Chinese desert north of it, would be an ideal accomplishment both for research, for scientific dissemination and public education. I aim to make several schools of Delhi adopt each of the twenty five tags. I wish to nurture appreciation for nature in the new generation, fulfilling **Aichi Biodiversity Targets, CDB (https://www.cbd.int/sp/targets/).**

Expected Outcomes

1. Migratory connectivity of rubbish dumps in India during the non-breeding months is likely to affect the potential for disease and pathogens accumulation, spreading and transmission by kites. Knowledge of the provenance, migration routes, staging areas and winter-movements of kites will be of paramount importance to tackle potential case of disease outbreaks (see http://www.timesnow.tv/india/video/avian-flu-scare-in-delhi-govt-issues-dos-don%E2%80%99ts/51032).

2. Teachings to local people regarding the importance of these birds and how are communities connected through faraway places in China, Kazakhstan, Mongolia and Russia; to inculcate responsibility in them about the local and international relevance of local conservation actions (see supporting information).

Supporting Information

a.

b.

Fig. 1 a & b. The enthusiasm of school kids for the birds in their backyard and for the Black Kite project took us by surprise. Photo clicked at a Municipality School, Idgah (Old Delhi), just after one of our lessons on urban kites. With an aim to sensitise them for nature's awareness and conservation at a young stage, I plan to expand this teaching and environmental education program, as a public impact of science, to many more schools in the coming years. Data from PTTs and a program where school classes adopt specific individuals equipped with PTTs and can follow their fate through their migratory journeys (at no cost to the class) would add immense value and impact to the public dissemination component of our study.

Fig. 2. Black Kite Project Research team explaining scientific objectives and informing citizens of Delhi on the ecological importance of predatory kites (as well as other birds) while ringing kite chicks. This sort of citizen-groups assembles constantly in a mega-city of about 20 million inhabitants like Delhi, as I move from nest to nest during our routine fieldwork activities, offering a unique opportunity to reach thousands of people in disseminating science and sensibilizing the population on urban environmental issues of conservation importance. Since 2012, we have reached more than 30,000 Delhi citizens through this mobile conservation education initiative, which we see as a mobile laboratory. For many of these peoples, this may be one of their few opportunities to empathize and get in contact with nature. In addition, more than 70 undergraduates from various Universities in Delhi, Mumbai, Assam etc. have been trained in the basic field research through volunteering opportunities. **About 18 trained volunteers have joined International and National institutes of repute for their MSc degrees**: one at the **University of Oxford**; one at **University of Dublin, Ireland**, three at the **Wildlife Institute of India, Dehradun**; two at the **Forest Research Institute**, Dehradun; two at **The Energy and Resources Institute TERI**, Delhi; two at the **Jawaharlal Nehru Centre for Advanced Scientific Research**, Bangalore; five in various MSc courses at the **University of Delhi**, etc.

Fig. 3. Our fieldwork allows us to do daily live demonstrations of a conservation-based project before the citizens, which improves their general awareness through direct interactions and live lessons. I take special care to dedicate time to explain everything we do and the value of urban wildlife to these attending people and would consider the PTTs' data a real blessing to improve our knowledge and efficacy in transmitting high-impact visual information to these self-assembling crowds of any age or socio-economic status.