

*Final Report*

*Review of state of environment in Keoladeo National Park,  
Bharatpur, Rajasthan and its catchment area: a historical analysis*

*Sponsored by*

**Socio-Economic Research Division, Planning Commission,  
Government of India**



*Conducted by*



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Salim Ali Centre for Ornithology and Natural History**

**Coimbatore, Tamil Nadu**

**February 2013**

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**Study Duration**

***January 2012 - August 2012***

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## EXECUTIVE SUMMARY

### 1. Introduction/Objectives:

Keoladeo National Park in Bharatpur, Rajasthan, is one of the early Ramsar sites of India and has been in existence for more than 285 years. There have been several attempts to understand its ecological functioning and threats to the ecosystem, which would help the management authorities to prioritize their management intervention. Scientific investigations on several ecological aspects of the wetland started in early 1980s by Bombay Natural History Society (BNHS), Mumbai, India. The study monitored several ecological aspects, i.e. flora, fauna (fishes, amphibians, reptiles, birds and mammals), limnology, bio-geochemical, environmental contamination and socio-economic studies. Additionally, the Park has witnessed scientific investigations in the form of several postgraduate, pre-doctoral and doctoral research works by researchers across the globe. Some of the recent scientific investigations of the KNP include *inter alia* ecological monitoring of KNP during 2002-2006 and study of ecology of Indian Rock Python by Sálím Ali Centre for Ornithology and Natural History (SACON), Coimbatore. The outcomes of the study clearly indicated drastic changes in the ecology of KNP driven by both natural and anthropogenic factors. It is also important to note that KNP has been reeling under water scarcity for several years and the frequency of droughts has increased in recent years. The Park experiences extremes of climatic conditions and often has been a victim of erratic and low rainfall. Till date more than 380 species of plants, more than 375 species of birds and 58 species of fishes have been reported from this national Park.

Vast agricultural fields of Bharatpur and Karauli district serve as the catchment and flood plains for two non-perennial rivers, i.e. Banganga and Gambhir and also serve as the catchment for Ajan dam, the dam that supplies water to the KNP wetland ecosystem for its very sustenance. Water changes in recent years related to drought, upstream water diversion, and possibly climate change in recent years have greatly reduced the water available to the Park, leading to drought conditions of the last 10-15 years. The frequent occurrence of droughts, owing to the increasing demand of water, in the region in the recent past has adversely affected the agro productivity of the region and consequentially the use of chemical fertilizers and pesticides in boosting the agro-productivity and containing the pest outbreak, respectively has become extensive and

rampant. There have been several attempts by Park management to bring in water to KNP for its sustenance, which has yielded little result as the water release to the wetland system depends more on the socio-political factors than the actual ecological requirement of the KNP wetland. Due to uncertainty in water availability and consequential migration of winter avian visitors to other wetlands and/or suitable sites, i.e. satellite wetlands around the Park spread across seven districts in Rajasthan (Alwar, Jaipur, Dausa, Bharatpur, Sawai Madhopur, Karauli and Dholpur) and two districts in Uttar Pradesh (Agra and Mathura). Around 27 wetlands have been identified as high value biodiversity areas (HVBA) by the Rajasthan Forest Department, which also serve as safe abode for migratory birds especially when KNP does not get enough water from Ajan dam.

Based on the above points, any effort to identify the threats and prioritize research matrix and management intervention in the Park would necessitate having a relook at the past scientific investigations in the Park and its catchment. This should include wetlands in the area, since its formation in general and specifically since 1980s (the year when scientific investigations started), as several changes in ecological set up of the KNP are observed over last 30 years of scientific explorations in the area. Though, KNP is the only protected area in India, which has witnessed thorough and frequent scientific studies and/or explorations with respect to different ecological components, there is no compilation on the actual number of species of various taxa known in KNP. It requires revisiting all the completed scientific investigations and compiling the existing information on ecology of KNP and its catchment. It would facilitate the Forest Department in general and Park management in particular to expedite conservation efforts for maintaining this unique ecosystem. Owing to the above specifics, it is intended to review the present scenario and revisiting all the completed investigations to ecological variables of KNP, which would facilitate preparing a regional scale Comprehensive Management Action Plan and strategy for environmental management.

The present work includes collating data sets and literature (published and unpublished reports) on KNP and its catchment to support future work in habitat change detection. The present study was attempted to accomplish the following objectives:

- i. Review of state of environment in KNP and its catchment area, and

- ii. Historical analysis of the information in view of the changing climate over time and anthropogenic pressures.

## **2. Methodology:**

The present study included collection and collation of existing secondary information, and generation primary information through appropriate means and following standard methodologies. The major approaches to be followed during the present exercise are:

- i. Macro level approach: Preliminary desk review; collection and collation of secondary information from various sources
- ii. Micro level approach: Generation of primary data using standard field methods and other tools such as questionnaire survey, and discussion with stakeholders.

The present exercise attempted to collate the published articles on various environmental components and variables, i) meteorological changes, ii) land use and land cover changes/details, iii) floral assemblage in KNP: phytoplankton and vegetation studies, iv) faunal assemblage: studies on various faunal groups (zooplanktons, insects & butterflies, ichthyofauna, herpetofauna, avifauna, and mammals), v) hydrological changes in the wetland system of KNP, vi) nutrient content and quality analysis in soil and sediment in the multiple habitat system of KNP, vii) geo-hydrological aspects and ground water quality, viii) agrochemicals and other contaminants in different trophic levels and various environmental matrices, and ix) socioeconomic status and resource utilization pattern in the villages in the surrounding villages of KNP and their dependency on the Park. As per the requirements of the project, attempt was made to visit various line departments of Govt. of Rajasthan and Govt. of India, and several organizations and colleges and university departments for collecting published and unpublished literature and research reports on Keoladeo National Park, and its surrounding areas. In total 22 different departments were visited and information and data on 12 different aspects related to KNP and its surrounding areas were collected.

The collected information was collated and segregated into blocks of 10 years or the nearest possible duration, whichever is possible. The Scientific literatures describing different biodiversity components of KNP and Bharatpur were reviewed and data describing the lists of the species were extracted and compiled. Each research

report/article was considered as a sampling unit for the purpose of the statistical analysis. Species accumulation curve was plotted and modelled using a best-fit logarithmic (regression) model, and other suitable estimators, i.e. Chao 1, Jackknife 1 and Bootstrap were also estimated. Further, threat status of the taxa under analysis was compiled as per IUCN red list categories. Data collected from different departments were subjected to several statistical tests using MEGASTAT 8.8.

### **3. Findings/Conclusions:**

The present compilation resulted in estimating the total number of reports and publication on KNP that stand around 409. This also helped us to estimate the number of species reported from KNP till date. During the compilation 23 key players were identified which could play a role in the ecosystem management of KNP and its surrounding areas. Of the various major taxa covered, the estimated number of plant species (compiled) reported from KNP and its surrounding areas are 403, for birds it is 380, and ichthyofauna 68 species. Comprehensive list of other groups (benthic organisms, herpetofauna) were also listed out. The meteorological analysis included rainfall, temperature, and water release to KNP, and made an analysis of periodicity of drought years. Quantum of chemical fertilizer usage from 1994 to 2011 and associated crop productivity in Bharatpur was also assessed. The present compilation also helped us to make a deliberation on ecological causalities around KNP in terms of mass bird mortality and possible causes. Agrochemical residues especially chemical pesticides were apparently caused the mortality. With the experience of the primary field survey, a customized questionnaire was made during March-June 2012 and reported. This survey reflected on a shift in primary source of resources and dependency of surrounding villages on KNP.

### **4. Recommendations**

The present attempt, though an eye-opener for the future researchers, made a compilation of all the possible published studies on various environmental issues on KNP, viz., birds, reptiles, fishes, insects, vegetation, invasive species, mammals, hydrology, social issues, impact of grazing, feral cattle, and pollution and contamination. The present compilation made a bibliography which contains 416 reports (both published and unpublished), research articles, conference proceedings, dissertations

and theses, and books and booklets. Findings of these studies have helped the management to undertake certain appropriate conservation interventions such as acquiring required water from the Ajan dam, control of feral cattle, creation of boundary wall around the Park. This compilation helped us in identifying research gaps and priority areas that need to be studied to help maintaining the ecological integrity of KNP, its surrounding ecosystems, and catchment areas. The research matrix as prepared by earlier researchers was referred during the present exercise, and accordingly, the research areas are divided in two major heads: i) those required to be undertaken for the first time and ii) those that require a revisit and comparison with earlier reported findings.

#### **4.1. Research gaps: initial assessments**

1. Seed-bank for KNP: Investigate the carrying capacity and minimum ecological requirement of seeds of both plants and fishes of the Park,
2. Assessment of health of satellite wetlands around KNP and their suitability as alternate habitats for both resident and migratory bird,
3. Flow regime and Environmental flow: Examine the flow regime of rivers supplying water to KNP, and assess the environmental flow as an aid in decision-making process,
4. Nutrient and contaminant budgeting in the upstream areas of KNP especially in the catchment areas of the rivers need to be examined. It is expected that sub-surface flow must be inducing the spatial movement of agro-chemical residues in the region,
5. Assessment of quality of inflow water from alternate sources such as Chambal river and Govardhan drain,
6. Investigate the co-existence and resources partitioning of major herbivores such as nilgai, sambar, chital, and feral cattle that would provide information which could help the management of habitat and population of these species in KNP in the present context,
7. Examine the changes in vegetation pattern and soil quality due to ongoing invasive species eradication programme. Investigate the role of KNP in carbon sequestration,

8. Cumulative Impact Assessment on land use changes, intensification of agriculture, hydrology and water regime, infrastructure development, ground water extraction, increase in visitors, etc.,
9. Identification of indicator species and its ecology needs to be studied for the long term conservation of the Park,
10. Assessment of Ecosystem services of KNP and its economic evaluation, and
11. Creation of research database and analysis on research-management interface.

#### **4.2. Research gaps: revisit and comparison**

1. Study the land use changes around the Park focussing on both urbanization and agriculture,
2. Revisit the vegetation cover of KNP and prepare a revised vegetation map for the Park,
3. Review the scenario on agriculture: intensification of agriculture, and use of organic fertilizers,
4. Assessment of levels of agrochemical residues in various environmental compartments across trophic levels,
5. Regular monitoring of water quality and pollutants levels inside the Park is to be carried out to monitor the health of aquatic ecosystem,
6. Assessment of ground water quality and impact of agrochemical inputs on aquifers and around Bharatpur,
7. Comprehensive Environmental Assessment and Monitoring for the KNP ecosystem and the adjoining areas with respect to biophysical and socio-economic aspects. This would help the PA Management to take corrective measures,
8. Periodic monitoring of status of Sarus Crane, Vulture and Python population and their habitats for their long term conservation inside the Park,
9. Bird migration study: Since thousands of migratory birds visit KNP, it provides ample opportunity for bird ringing and monitoring. Through such attempt it would be easy to examine spatial movement of contaminants through organisms such as birds,
10. Climate change and avian influenza: Study the impact of global climate change, avian influenza etc. on global bird communities and their migration to and from

KNP. This also provides an opportunity to study the epidemiology of avian influenza in India,

11. Aquatic-terrestrial habitat relationship: Due to changing climate and land use pattern the habitat relationship between aquatic and terrestrial ecosystems of the Park needs to be studied,
12. Growth of invasive species: Study the impact of wild and feral mammalian herbivores on the management of invasive species in the Park (seed dispersal),
13. Evaluation of the catchment area to understand the land use pattern and its impact on the Park environment,
14. Tourism and its impact: Assessment and inventorization of tourism resources for diffusing increasing tourism pressure from KNP. The impact of tourism on KNP and its habitat needs to be evaluated, and the completed studies need to be revisited, and
15. Socio-economic assessments and economic evaluation need to be undertaken for the surrounding areas of KNP.