Vision 2020

ZOOLOGICAL SURVEY OF INDIA 1916

Zoological Survey of India

(Ministry of Environment & Forests)

Govt. of India

October, 2011

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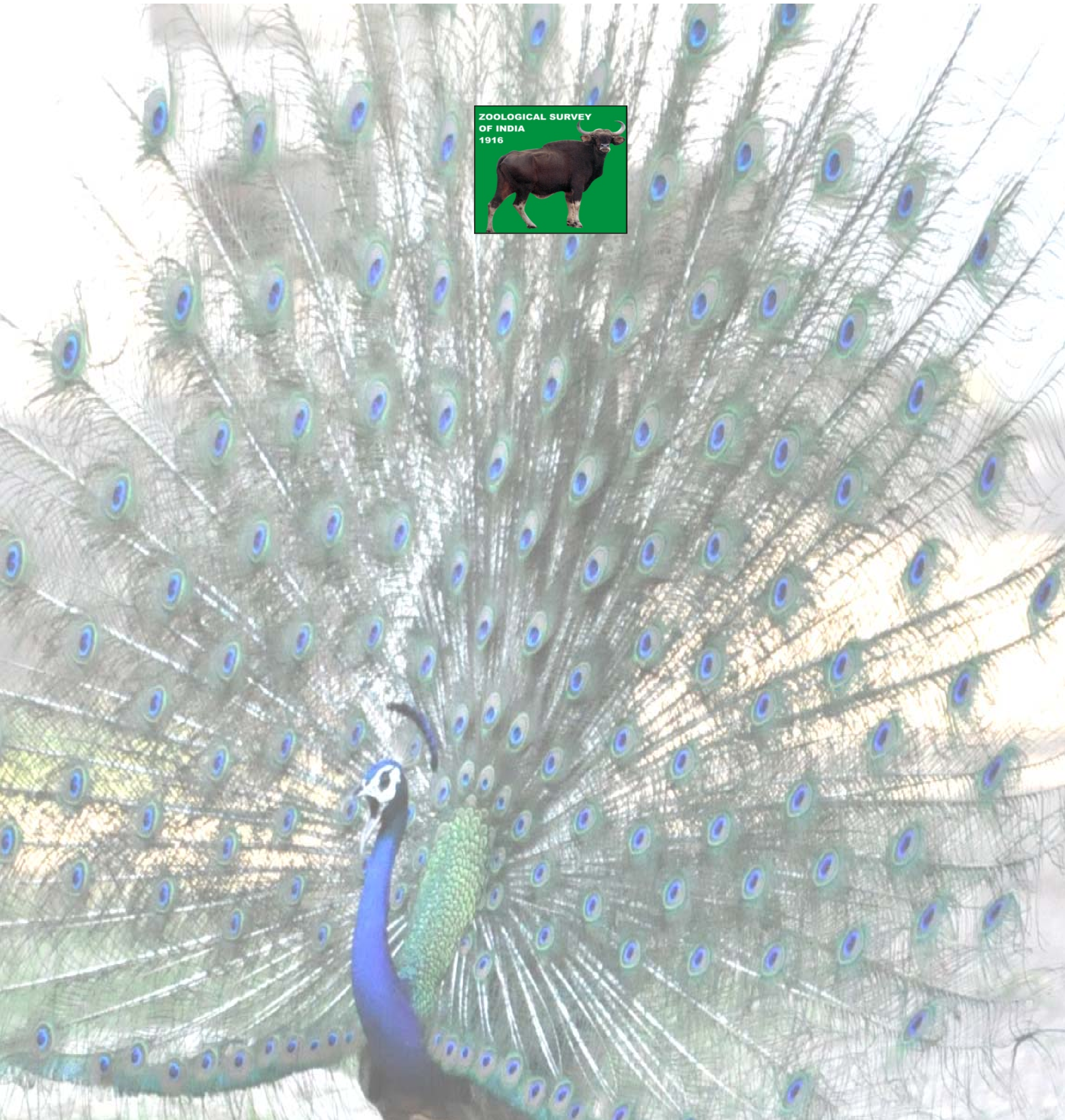
1916



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Foreword

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Vision 2020
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Preamble

The Zoological Survey of India (ZSI) was established in 1916, with a view to explore and identify the faunal resources (faunal diversity) of the country and to document the base line data with regards to taxonomy, distribution, bio-ecology, *etc.*, of the animal groups. During the last 95 years and particularly from the Second Five Year Plan period, the ZSI has grown from a small unit at the Indian Museum, Calcutta, to a premier National Institution with 16 Regional Centres spread across the country, with its Headquarters at Kolkata. Over the successive plan periods the functions of ZSI have also expanded gradually encompassing areas like the Environmental Impact Assessment with regard to fauna; survey of Conservation Areas; Status Survey of Endangered Species; Computerization of data on faunal resources; Environmental Information System (ENVIS) on faunal diversity, Identification and advisory services, National Designated Repository of type and voucher specimen, supporting enforcement of Wildlife (Protection) Act, 1972, Status surveys on endangered species, establishment of marine aquaria and Museum for awareness on conservation *etc*. The Organization also has a regular Training and Extension wing for generating public awareness for the conservation of environment and wildlife by conducting exhibitions, training programmes and interacting with different Government and NGO organizations, universities, colleges, schools and the stake holders.

The Zoological Survey of India also acts as a custodian of the National Zoological Collections which comprise more than two million specimens belonging to some 91,797 species including about 10,000 species of our neighboring countries like Myanmar, Pakistan, Bangladesh, Sri Lanka and also of Thailand.

The objectives and functions of ZSI were reviewed in 1987 and redefined in 1991. However, the scope and functions of ZSI have been considerably expanded, particularly in the light of the Convention on Biological Diversity, ratified by Govt. of India in 1994. The revised priorities of work suggested by the department were approved by the Ministry of Environment & Forests, Govt. of India, with the target proposed up to 2000 A. D. which was further reviewed by the Programme Advisory Committee (PAC) during 2001 with new directives. In the light of the above, the objectives and implementation strategies for the Eleventh Five Year Plan are redefined as follows.

A. Primary Objectives

1. Exploring, Surveying, Inventorying and Monitoring of faunal diversity in various states, selected ecosystems and protected areas of India.
2. Taxonomic studies of the faunal components collected.
3. Status survey of Threatened and Endemic species.
4. Preparation of Red Data Book, Fauna of India and Fauna of States.
5. Bio-ecological studies on important communities/species.
6. Preparation of database for the recorded species of the country.
7. Maintenance and Development of National Zoological Collections.
8. Training, Capacity Building and Human Resource Development.
9. Faunal Identification, Advisory services and Library Services.
10. Publication of results including Fauna of India, Fauna of States and fauna of Conservation Areas.

B. Secondary Objectives

1. GIS and Remote Sensing studies on recorded animal diversity as well as on threatened species.
2. Chromosomal Mapping and DNA fingerprinting.
3. Environmental Impact Studies.
4. Maintenance of Musea at Headquarters and Regional Centres.
5. Development of ENVIS and CITES Centers.
6. Research Fellowship, Associateship and Emeritus Scientists Programme.
7. Collaborative research programmes on Biodiversity with other Organizations in India and abroad.

New Programmes*

1. Surveying and Inventorying the Marine faunal diversity including minor phyla.
2. Establishment of a new unit of ZSI at Jamnagar, Gujarat, to assess the faunal diversity of Marine Protected Area and Hot Desert ecosystems.
3. Establishment of new unit of ZSI at Gangtok, Sikkim, to assess the faunal diversity of Kanchenjunga Biosphere Reserve, monitor the diversity and distribution of the faunal elements of the Eastern Himalaya which is one of the global Hot Spots of biological diversity, in India.
4. Monitoring the status of selected animals included in the Wildlife Schedules.
5. Development of Taxonomic expertise through Human Resource Development and database.

**** Achievement of the anticipated result out-put, subject to provision of requisite funds and man-power.***

Strategy

In order to achieve the above objectives, strategies including approach, coverage and manpower deployment have been examined and the appropriate methodology has been evolved. These will be adopted as proposed by Surveying, Inventorying and Monitoring of faunal diversity in various states, selected ecosystems and Protected Areas of India.

- ✓ The objectives of the programme are to explore the faunal resources of various States and Union territories of India, selected ecosystems and conservation areas.
- ✓ Nearly 80% of the freshwater fishes and amphibians have been identified and documented, reptiles, birds and mammals have been covered to the maximum extent, Invertebrates need to be investigated from the vast area of the country including coastal and marine ecosystems.

Vision Statement

"Taxonomy towards conservation and sustaining biodiversity/faunal diversity for future".

Mission Statement

"Our Mission is to contribute towards the judicious conservation of the fauna by conducting explorations, undertaking taxonomic studies and also documenting the country's vast diversity".

Vision 2020

Vision 2020 is the proposed action framework of ZSI till 2020.

Goals/Objectives of Vision 2020

1. Strengthening the faunal inventorying of the nation.
2. Integration of studies on Invasive Alien fauna of India.
3. Development of National Faunal Databases.
4. Digitisation of Natural History Collections.
5. Introduction and integration of Cyber Taxonomy.
6. Integration of DNA Barcoding studies on relevant taxa.

7. Geographical Information System cell in the Zoological Survey of India.
8. Launching Major Taxonomic Initiatives.
9. Capacity Building in Animal Taxonomy in India.

Why this Vision Document?

Biodiversity is considered as a nations' natural resource and is critical to human sustainability. Taxonomy is the science for documenting biodiversity globally, it is the key science needed to identify a species and to describe an unknown species (Kim and Byrne, 2006). We can only benefit from natural resources if they are known to us and we can conserve and protect only those natural resources that we are aware of. To determine what is being lost, we must have some idea of what is available at any point of time. Every nation should have an inventory of its natural resources or biotic assets.

The Zoological Survey of India (ZSI) is the premier taxonomic organization of the country to explore and identify its faunal resources. Vision 2020 is intended to serve as a help guide for ZSI, to attain the goals decided upon for the next 10 years. This framework focuses on nine different areas of action and is developed to achieve better planning so as to ensure a systematic implementation to achieve targets in time.

This document is developed in accordance with the various legislations that have been enacted and policies and action plans at the National Level and also the recommendations as well as reports of the special task force constituted at the National level, that have direct relevance with the faunal diversity of the country *i.e.,* Wildlife (Protection) Act, 1972; Biological Diversity Act, 2002; Coastal Regulation Zone Notification, 1991; National Forest Policy, 1988; National Environment Policy, 2006; National Biodiversity Action Plan, 2008; National Action Plan on Climate Change, 2008; India's Fourth National Report to the Convention on Biological Diversity, 2009; Report of the Task Force on Mountain Ecosystems and also on Grasslands and Deserts by The Planning Commission (Environment and Forests Division), 2006 and National Report on Wetlands, 2009.

Reference

Ke Chung Kim and Loren B. Byrne, 2006. Biodiversity loss and the taxonomic bottleneck: emerging biodiversity science. *Ecological Research.* **21**(6): 794–810.

1. Strengthening the Faunal Inventorying of India

The schemes and steps in Faunal Inventorying are revised and redefined in accordance with the legislations and national policies dealing on the conservation of natural resources and sustainable development of the country.

Major ecosystems in India are listed and the role of ZSI in conservation of each ecosystem is defined. Standardised survey procedures and methodologies are also included.

1.1. Survey Groups and Survey Units

ZSI has primarily been involved in developing a faunal inventory of the country and the approach has always been an 'All Taxa Faunal Inventory'. Documentation of the diversity with regard to well known taxa such as Aves and Mammalia among vertebrates and butterflies (Lepidoptera: Rhopalocera) and dragonflies (Odonata) among invertebrates are relatively easily achieved, but is an uphill task in the case of lesser known groups among invertebrates, where the magnitude of the diversity is very high and the taxa are rather poorly studied. The inventorying of the fauna is very much taxon dependant and is achieved through organized repeated sampling and ad hoc collecting.

- Various Ecosystems in the country are prioritised and are surveyed by the organisation in part or entire and a faunal inventory of multiple taxa in a region or habitat is brought out, through a series of publications.
- Lesser known taxa as in the case of most of the invertebrates are aimed to be dealt with in detail through Taxonomic studies and the research findings be published through a series of taxonomic monographs.
- The survey units chosen are ecosystem based and are geopolitical or conservation areas or other areas of special ecological/geological significance.
- The regions once surveyed if needed will be revisited after a gap of 10 years (varying as per the groups) for necessary revalidation of the results.
- The taxa dealt are usually in line with the available taxonomic expertise.
- Methodologies and procedures specifically standardized for a taxon are to be employed in a uniform way during survey and sampling.

- Though the organisation uses classical taxonomic procedures for its routine identifications, this is supplemented by standard molecular and ecological techniques, as and when the situation demands.

1.2. Ecosystem based Surveys

The faunal wealth of the country is assessed by ZSI by conducting numerous intensive and extensive faunistic surveys, which are usually ecosystem centered. The five major ecosystems of the world (*i.e.,* Coastal ecosystem, Forest ecosystem, Freshwater system, Grassland ecosystem and Agroecosystem) account for about 90 percent of the earth's land surface, excluding Greenland and Antarctica (The Pilot Analysis of Global Ecosystems (PAGE- WRI, 2000). ZSI has been surveying the representatives of these ecosystems in India. In addition, the Himalayan Ecosystem, the Desert Ecosystem and the Marine Ecosystems of the country are also surveyed. Since Wetlands in India include both marine and freshwater habitats, this ecosystem is often dealt separately. In case the area chosen are geographical, limited by political boundaries or in case they are areas of conservational importance, the survey units within the area are chosen based on the ecosystems already mentioned.

1.3. Major Ecosystems, their Survey and the roles of ZSI in their conservation

1.3.1. Forest Ecosystems

Forests are terrestrial ecosystems dominated by trees, where the tree canopy covers at least 10% of the ground area. Forests contain the greatest assemblages of species found in any terrestrial ecosystem, and the status of biodiversity is, in itself, an indicator of forest condition (PAGE, 2000). Large scale influences by man over the time has led to a decrease in both the spatial extent as well as the biological condition of forests. The deforestation and extinction rates are quite high in the tropical forests, where genetic and species diversity is the highest.

National Forest Policy (NFP, 1988) aims at maintaining a minimum of 33% of India's geographical area under forest and tree cover. Legal protection of forested land is often very much significant for conservation purposes. The forest cover of the India as per 2007 assessment is 6,90,899 km^2, which is 21.02% of the geographical area of the country (India State of Forest Report, 2009, Forest Survey of India). In India forests come under 16 major forest types and 251 subtypes. 679 Protected Areas (PA) established under the Wildlife (Protection) Act (WPA), 1972, which covers more than 4% of the total geographical area of the country. The topical evergreen forests of the two major biodiversity hotspots in India the Himalaya and the Western Ghats–Srilanka are known centres of faunal richness and endemism.

Legislations and action plans like Biological Diversity Act (BDA), 2002, National Wildlife Action Plan (NWAP) (2002-2016), National Environment Policy (NEP) 2006, National Biodiversity Action Plan (NBAP), 2008 and National Action Plan on Climate Change (NAPCC), 2008, ensure conservation and sustainable use of biological resources (India's Fourth National Report to the Convention on Biological Diversity, 4th report, 2009).

Role of ZSI in conservation of forest fauna

The faunal components of a forest are totally dependent on its floral counterpart, and are indicative of the latter. Hence, the measures of general biological conditions of the forests and the impact due to human modifications can be interpreted to a large extent based on the data on the diversity of faunal species. Developing a standardized baseline inventory of the forest fauna, along with depictions on their abundance status are essential for conservational needs and also to develop estimates on species extinction. The taxonomic strength of ZSI can contribute to:

- Develop baseline inventory of faunal diversity of different ecoregion based forest types.
- Identify species that can serve as indicators of diversity of other taxa.
- Inventorying species based on elevational and topographic parameters.
- Periodic monitoring of the population status of threatened/endangered species.
- Develop detailed faunal inventory of Conservation Areas.

References

http://www.wri.org/publication/pilot-analysis-global-ecosystems-forest-ecosystems

http://pdf.wri.org/page_forests.pdf

1.3.2. Himalayan Ecosystem

The Himalayan ecosystem is fragile and diverse. The Indian Himalayan Region (IHR), administratively covers 10 states entirely (*i.e.,* Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura and Meghalaya) and two states partially (*i.e.*, the hill districts of Assam and West Bengal) and over four Biogeographic zones *viz*., the Indian Trans-Himalaya, the Greater Himalaya, North-East India and parts of Upper Gangetic and entire Brahmaputra flood plains

The Task Force Report on Mountain Ecosystems, by The Planning Commission (Environment and Forests Division) 2006, helps to identify the gap areas in our knowledge regarding faunal diversity of this region. As per the report, data regarding smaller mammals, reptiles, amphibians, and fishes are much scanty, the insect diversity of this region have been largely ignored, with the exception of a few studies of the Himalayan Lepidoptera. Since the system of cultivation in the area is mainly slash and burn, the Jhum system, how the practice affects the faunal elements in the agroecosystem (soil as well as the aerial forms), will be worth exploring.

Recognizing the importance of the Himalayan region as a unique repository of biodiversity, especially the Eastern Himalaya, and also considering the regions' sensitivity to climatic and anthropogenic changes, a 'National Mission for Sustaining the Himalayan Ecosystem' has been constituted in 2010. One of the issues of the mission is to address Biodiversity conservation and protection.

Role of ZSI in conserving Himalayan Ecosystem

As a consequence of climate change, a change in distributional pattern of vegetation, with species in high-elevation ecosystems shifting to higher elevations (Escalator Effect) has already been observed. Since, range shift of the faunal components is also very much likely, the distribution of Himalayan fauna (including both vertebrates and invertebrates) needs to be monitored and periodically analysed as a priority study. Long-term studies on faunal elements of Himalayan forests are essential to monitor such changes. Long term monitoring plots need to be assigned for such studies.

- Status survey of the endangered fauna.
- Survey, exploration and inventorying of data deficient groups like smaller mammals, reptiles, amphibians, and fishes (vertebrates) and non-lepidopterous insects.
- Monitor the effects of climate change, like range shifts, with regard to distribution of varied faunal elements (vertebrates as well as invertebrates, including butterflies) of the region.

1.3.3. Grassland and Desert Ecosystems

Grasslands and desert are the most neglected ecosystems in India, and are often looked at as ‘wastelands’ on which tree plantation is suggested, or which can easily be diverted for other uses (Report of ‘The Task force on Grasslands and Deserts’ by The Planning Commission, Environment and Forests Division, 2006).

Grasslands are terrestrial ecosystems dominated by herbaceous and shrub vegetation and influenced by fire, grazing, drought and/or freezing temperatures. Of the 136 terrestrial ecoregions identified as outstanding examples of the world’s diverse ecosystems, 35 are grasslands, supporting some of the most important grassland biodiversity in the world (PAGE, 2000, http://pdf.wri.org/page_grasslands.pdf.). Rann of Kachchh flooded grasslands of India and Pakistan is one among them (http://wwf.panda.org/about_our_earth/ecoregions/rannofkutch_flooded_grasslands.cfm).

Some of the most threatened species of wildlife are found in the grasslands and deserts (*e.g.*, Great Indian Bustard, Lesser Florican, Bengal Florican, Swamp Francolin, Finn’s Weaver, Indian Rhinoceros, Snow Leopard, Nilgiri Tahr, Wild Buffalo, Pygmy Hog, Hispid Hare, Hog Deer and Swamp Deer *etc*.). Fifty seven species of animals and seven habitats/ecosystems belonging to 16 Indian states and 30 protected areas in 11 states are to benefit by granting better protection of Grasslands/Deserts (Appendix I, II and III, *Report of the Task Force on Grasslands and Deserts,* 2006).

In India, the dry desert lies mainly in Rajasthan and Gujarat, where as Ladakh in Jammu and Kashmir, Lahul-Spiti in Himachal Pradesh, and a small area of Sikkim comprise the cold desert. Lakes and marshes of this region, are mostly saline, and are important breeding grounds for many species of birds.

Tremendous changes in the avifaunal structure of the Thar Desert are taking place due to the Indira Gandhi Nahar Project (IGNP), aiming to dedesertify and transform desert waste land into agriculturally productive areas. Species never seen earlier are now regularly found near the canal (*Report of the Task Force on Grasslands and Deserts,* 2006) and needs documentation. The Task force on Grasslands and Deserts (2006), has identified grasslands as a key area of livestock dependency and also vital to poverty alleviation of the rural folks in India. Also, acknowledging the importance of grasslands and deserts for biodiversity conservation, it is demanded to set up a Grassland Development and Grazing Policy to ensure the sustainable use of grasslands and biodiversity conservation.

Presence of a huge livestock population of more than 500 million and with dependence of the rural population on it, the grasslands in India are under tremendous pressure. Since, modifications from conversion to agriculture and urbanization, as well as fragmentation and the introduction of invasive species have considerably altered the grassland biodiversity, protection, monitoring, and maintenance activities need to be tailored to suit the needs of each area to ensure that each continues to support grassland biodiversity.

Role of ZSI in conservation of Grassland and Dessert ecosystems

The Task force on Grasslands and Deserts by the Planning Commission (Environment and Forests Division, 2006), has identified ZSI as one of the major institutions that can contribute towards the key areas of Research and Development, by generating a 'Basic inventory of Fauna' as well as conducting 'Ecological studies' and contribute towards the conservation, development and better utilization of natural resources of grasslands and desert ecosystems.

- Inventorying and documenting the faunal diversity of different grasslands and deserts of India.
- Developing Datasets on exotic species.
- Status surveys of threatened /endangered grassland fauna like the Great Indian Bustard (*Ardeotis nigriceps*) of the Sewan grasslands and the Swamp Francolin (*Francolinus gularis*), Bengal Florican (*Houbaropsis bengalensis*), and Finn's Weaver (*Ploceus megarhynchus*) of the Terai grasslands in the Gangetic plains.
- Status survey of threatened/ endangered desert fauna like Snow Leopard (*Uncia uncia*).
- Inventory of Avifauna in Thar Desert.
- Monitor the changes in faunal composition, like the avifaunal structure of the Thar Desert due to the Indira Gandhi Nahar Project.

Reference

PAGE, 2000. http://pdf.wri.org/page_grasslands.pdf

1.3.4. Wetland Ecosystem

Wetlands, the transitional zones between permanently aquatic and dry terrestrial ecosystems are among the most productive ecosystems. Natural wetlands in India consist of high altitude wetlands in Himalaya, flood plains of the major river systems, saline and temporary wetlands of the arid and semi-arid regions, coastal wetlands such as lagoons, backwaters, estuaries, mangroves, swamps and coral reefs, and so on.

Presences of dense human population in catchments, urbanisation, and various anthropogenic activities have resulted in over exploitation of wetland resources, leading to degradation in their quality and quantity. To prevent the degradation and ensuring the wise use for the benefit of local communities and overall conservation of biodiversity, government of India has been implementing the National Wetlands Conservation Programme (NWCP) in close collaboration with the State/UT Governments since the year 1985-86. Under the programme, 115 wetlands have been identified till now (including the 25 wetlands of international importance under Ramsar Convention) by the Ministry which require urgent conservation and management interventions (National Report on Wetlands, 2009). As of now there is no specific legal framework for wetland conservation, management and their wise use. Draft regulatory framework for conservation and management of wetlands is being finalized to be notified under the Environment (Protection) Act, 1986.

National Forest commission, 2006 has demanded the launch of National Wetland Conservation Act, National Wetland Biodiversity Register, National Wetland Inventory and Monitoring Programme and National Wetland information system for checking the health of the wetlands.

Role of ZSI in wetland conservation

Information regarding the flora and fauna of wetlands is an important component of a wetland inventory that decides the status of the wetland, whether to be included as of national importance or not. ZSI being a premier taxonomic organisation, can develop need based faunal inventories of selected wetlands on a priority basis to be incorporated into the Wetland information system or it's Management Action Plan (MAP). Since it is very much essential that the data within the inventory remains current, periodic surveys are needed to collect new data, which later can be integrated with those existing.

Baseline information on the biodiversity of water bodies in the form of an inventory of the fauna including birds, fishes, reptiles, mammals and invertebrates is essential to identify the wetlands that are to be designated as Ramsar sites for inclusion in the 'List of Wetlands of International Importance', in preparing the MAPs, in the identification of the IUCN conservation categories like RET species, Endemic and Vulnerable species.

Of the eight Criteria listed for identification of wetlands of national importance under NWCP, the majority are evaluations of the floral/faunal components of the wetlands (National Report on Wetlands, 2009). Criteria 2-4 are based on data emanated by assessing species and ecological communities, 5-6 are specific criteria based on water birds and 7 to 8 on specific criteria based on fish.

The dynamic nature of wetlands leads to periodic drying and inundation varying in frequency and duration over time. Therefore all plants and animals that live in wetlands will not be present in them throughout. Hence seasonal surveys specific to individual wetlands are needed to pool in data on its seasonal faunal components. Such a baseline data is essential in assessing the health of the water body at any point of time.

- Develop baseline information on the faunal diversity of wetlands, that can act as a reference system. The species inventory may include data on various fauna including birds, fishes, reptiles, mammals and also invertebrates.
- The inventory needs to segregate the following and that can act as a reference system to yield significant information on the status of the wetland, as well as its faunal components.
    - the occasional visitors
    - residents
    - migrants
    - forms which totally dependant on the wetland throughout their life
    - those that use wetlands only for a specific part of their life cycle (for egg laying, as nurseries and as breeding grounds).
- Conduct seasonal surveys specific to individual wetlands for assessing seasonality of faunal components

Data emanating out of periodic faunistic surveys conducted and monitoring at the catchments areas and flood plains of wetlands are essential for ensuring the health of the ecosystem.

1.3.5. Freshwater Ecosystem

Freshwater systems are created by water that enters the terrestrial environment as precipitation and flows both above and below the ground, towards the sea. These systems encompass a wide range of habitats, including rivers, lakes, and wetlands, and the riparian zones associated with them. Their boundaries are constantly changing with the seasonality in the hydrological cycle.

An estimated 12 percent of all animal species live in fresh water (Abramovitz, 1996), while many others, including humans, depend on fresh water for their survival. More than 20 percent of the world's freshwater fish have become extinct or been threatened or endangered in recent decades. Freshwater species, such as fish, and wetland-dependent birds and amphibians are at high risk of imperilment in many regions of the world.

Further, the introduction of alien species has contributed to the extinction and imperilment of native fauna.

At the minimum, key indicator species and the presence or introduction of non-native species and their impacts on native fauna and flora (PAGE, 2000) need to be monitored.

The Western Ghats Rivers and Streams are among the global 200 ecoregions identified by the World Wildlife Fund (WWF) as priorities for conservation, under small river systems.

As per the report of National Bureau of Fish Genetic Resources, Lucknow, (NBFGR, 2010), 120 species of fresh water fishes are threatened in India, 12 species are listed in schedule I of the Wildlife (Protection) Act, 1972 and 6 species in the IUCN Red Data List, 2009.

The National River Conservation Directorate, under the Ministry of Environment and Forests is engaged in implementing the River and Lake Action Plans under the National River Conservation Plan (NRCP) and National Lake Conservation Plan (NLCP) (Annual report 2005-6).

The Government of India and the World Bank signed three agreements, May 2011, (of which 2 deals with biodiversity conservation) for cleaning Ganga River and to Strengthen Rural Livelihoods and Biodiversity Conservation in India.

For sustainable utilization of freshwater fishes, Karnataka State Biodiversity Board (KSBB, 2004) has demanded the creation of a policy and regulatory framework for the protection of fresh-water biodiversity (Karnataka State Biodiversity Strategy and action Plan, as a part of National Biodiversity Strategy and Action Plan– NBSAP, ENVIS Technical Report No. 15**)**

Role of ZSI in Freshwater Ecosystem Conservation

- Develop baseline information on the faunal diversity of water bodies in the form of an inventory of various fauna including birds, fishes, reptiles, mammals as well as invertebrates.
- Analyse the species population trends with respect to birds and amphibians.
- Evaluation of Threatened taxa.
- Documentation of the presence of exotic/Invasive Alien species.

References

http://www.wri.org/publication/pilot-analysis-global-ecosystems-freshwater-systems
http://pdf.wri.org/page_freshwater.pdf

1.3.6. Marine and Coastal Ecosystems

The National Environmental Policy (NEP), 2006 while defining the basic principles of environmental conservation and management, places mangroves among the Entities of Incomparable Value (EIV). National Biodiversity Action Plan (NBAP), 2008 proposes the need to conserve the stretches of mangroves like those in Sunderbans, as an element of the centrally sponsored scheme, 'Integrated development of wildlife habitats' for protection of wildlife outside PAs.

National Strategy and Action Plan, on the basic tenets of the National Environment Policy, (2006), drafted under the regional initiative, "Mangroves for the Future (MFF)" for coastal ecosystem conservation and livelihood sustainability.

The National Biodiversity Action Plan, 2008 is of the view that the information on biodiversity of coastal and marine areas of the country is highly fragmentary and protection of coastal belts and conservation of flora and fauna in those areas are listed among the action points.

Department of Biotechnology, Ministry of Science and Technology under an initiative, the 'Biotechnological Approaches to Biodiversity Conservation', has recommended bioprospecting of marine organisms for development of new products (National Biodiversity Action Plan, 2008).

Analysis of current inventory of coastal and marine biodiversity of India reveals that many groups that are commercially important are the ones that have been extensively inventoried, leaving out several groups, notably the minor phyla grossly understudied (India's Fourth National Report to the Convention on Biological Diversity, 2009) .

Coastal ecosystems, found along continental margins, are regions of remarkable biological productivity and high accessibility to man and are rich assets, vital for human well-being. Total coastline of India is 8,000 km long, spanning 13 maritime States and Union Territories (UTs) including Island UTs. Tidal/Mud flats, sandy beaches, mangroves, coral reefs, salt marshes, lagoons, estuaries, seagrass beds, aquaculture ponds , Salt pans, Creeks , Rocky coasts and back waters, provides its own distinct bundle of goods and services and faces somewhat different pressures. The resident and migratory bird diversity associated with coastal and marine ecosystems in India is very high.

Coral reefs are the protectors of the coastlines of the maritime states. The coastal populations of India mostly depend on the coral reef ecosystems. Coral reef areas in the country are protected by the Environment (Protection) Act, 1986 and the Coastal Regulation Zone

Notification of 1991 issued under the broad Environmental Protection Act as well as the Wildlife (Protection) Act, 1972.

Role of ZSI in conservation of Marine and Coastal ecosystems

- Providing descriptive information about the distribution and status of marine and coastal fauna.
- Faunal diversity assessments in less explored and unexplored coastal zones.
- Compilation of baseline data of fauna of coastal ecosystems, status of marine fauna as well as the alien invasive species.
- Basic inventorying of coastal and marine species by habitat type, fundamental to subsequent research, management, and conservation.
- Faunal inventory of Bhitarkanika (Orissa), since Government of India has recognized this area as a "*Mangrove Genetic Resource Centre*".

Reference

http://pdf.wri.org/page_coastal.pdf.

1.3.7. Agroecosystems

Agroecosystems are defined as "a biological and natural resource system managed by humans for the primary purpose of producing food as well as other socially valuable nonfood goods and environmental services (PAGE, 2000). Twenty to 30 percent of the world's forest areas have been converted to agriculture, resulting in extensive habitat loss/species loss. As per some global estimates, the world population will grow to 7.5 billion by the year 2020 and 9 billion by 2050, which means more pressure on natural ecosystems (DIVERSITAS, 2005). Agricultural expansion is expected to be greatest in developing countries and arid regions, while agricultural area will decline in industrial countries (Millennium Ecosystem Assessment, 2005).

India is primarily an agriculture based country and its economy largely is based on agriculture (http://www.iasri.res.in/ebook/EB_SMAR/e-book_pdf%20files/Manual%20III/17-Crop%20Estimation.pdf). This sector remains the principal source of livelihood for more than 58% of the population (Department of Agriculture and Cooperation (DAC), Annual report, 2010-11). About 43 % of India's geographical area is used for agricultural activity, while some Indian states like Punjab and Haryana have even upto 84% of their land area under cultivation. No doubt, Agroecosystems has gained the status of one of the prominent ecosystems of India.

Increasing agricultural production with limited natural resources in a sustainable manner for ensuring food and nutritional security are one of the major challenges before the Government (Department of Agriculture and Cooperation, Annual report, 2010-11). For sustainability and maintaining productivity, biodiversity remains vital to agroecosystems as much as to natural ecosystems. Biodiversity loss in agricultural landscapes affects not just the production of food, fuel, and fiber, but also a range of ecological services supporting clean water supplies, habitats for wild species, and human health (DIVERSITAS, 2005). Since most of the ecosystem services are rendered by a myriad of invertebrate fauna, health of an agroecosystem is largely dependent on the diversity of these components, broadly comprising of the nutrient recycling detritivores, carnivorous/predatory arthropods and also beneficial insects such as pollinators and natural enemies of pests. Both the above ground and the below ground diversity are crucial for proper ecosystem functioning, for agroecosystems in particular (DIVERSITAS, 2005).

Role of ZSI in conservation of Agroecosystems:

ZSI can contribute towards the conservation of Agroecosystems by delivering apt taxonomic output aiding the assessment of the impacts of man on the ecosystem structure and function. Faunal diversity of agroecosystems is largely crop specific and is influenced by land management practices. A baseline database of taxa encountered in specific agroecosystems will prove an aid to interpret such changes in diversity.

- Undertaking baseline inventories of above ground and below ground faunal diversity of different agroecosystems region wise/crop wise.
- Develop region specific or crop specific taxonomic tools to identify various key functional groups in agroecosysetms like pollinators, pests, natural enemies.

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Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC.

2. Studies on Invasive Alien Fauna of India

Invasive Alien species (IAS) are species whose introduction and or spread outside their natural habitats threaten biological diversity, negatively affecting the food, security, plant, animal and human health of a nation. Biological invasions by non-native species constitute one of the leading threats to natural ecosystems and biodiversity (CBD, 2009).

Presently, there is no exclusive legislation or policy in India to deal with the invasive alien species. The National Biodiversity Action Plan, 2008 in its objectives has enumerated ways for the regulation of introduction of invasive alien species and their management.

As per India's 4th National Report to the Convention on Biological Diversity (2009), India duly recognizes the importance of regulating introductions and managing Invasive Alien Species and also follows international quarantine. Introduction of a scheme on integrated forest protection to cover IAS, formulation of a set of regulations by Forest Invasive Species Cell, implementation of regulations laid by International Maritime Organisation (IMO) in ballast water exchanges in all major ports in India etc. are some of the measures adopted by the government to combat the issue of IAS.

A national strategy is required to assess the full scope of invasive non native species. Accessibility of information regarding invasive species on a global scale can be of some help in tackling the problem. Such databases cater information on distribution, pathways of introductions and management of species and help in designing ways to limit its spread. The Global Invasive species database (http://www.issg.org/database/welcome/) provide country wise and faunal/floral group-wise information of IAS.

Prevention of introduction, proper surveillance for the invasives, apt control/eradication methods and preventing reintroductions are steps vital for the containment of IAS. Survey methods need to be designed based on specific behaviour or characteristics of the invader. Many of the terrestrial animal invasives can be tracked, on observing the, droppings and feeding damage.

Role of ZSI in combating Invasive Alien Species

Taxonomy is a critical tool for combating the threats from invasives. Delivering all possible taxonomic tools to the best of the capacity with in the shortest timeframe possible to end-users is essential while responding threats posed by invasives. Packaging existing information as per the user needs is highly recommended. Since, combating invasives are always a priority, generating products and information required to confront invasives are important outputs of taxonomic institutions. Being the premier taxonomic institution of the country, ZSI can offer services as detailed below.

- Undertaking seasonally timed species specific surveys, site specific or habitat selective surveys.
    1. For larger mammals, annual or biennial survey by a specialist can detect the presence of any invasives in a given area.
    2. Group specific/species specific survey methods need to be used for early detection of small mammals, reptiles, and even invertebrates like insects.
    3. Invasive species of fresh water and marine fishes and other aquatic invertebrates can be detected during the routine sampling exercises.
- Collection of Data on invasives in a standardized format for incorporation in the National Database.
- Preparation of a national database of indigenous as well as non-indigenous species based on habitat/ecosystem.
- Preparation of a database on invasive alien faunal species of India.
- Provide a taxonomic kit with regard to the IAS in question, comprising of:
    - ➢ Taxonomic identification tools like field guides, pictorial keys, ID cards, interactive ID tools, or molecular probes.
    - ➢ Current scientific name of the organism, along with alternate names, common names and synonyms.
    - ➢ Data regarding current range ecological niche, time of activity associations with other species, potential range (invasive potential).
    - ➢ Reference collection for comparison of voucher specimens.
    - ➢ Expert support for identification of the species.
    - ➢ Impart training to taxonomists, extension/field staff for surveys and monitoring.
    - ➢ Details on global geographical distribution of the species, details on associated taxa (like natural enemies and hosts) and their possible pathways of intrusion.
    - ➢ Standardized survey and monitoring techniques.
    - ➢ Information to the public via posters, websites, leaflets featuring illustrations/photograph of the species of concern.

References

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3. Development of National Faunal Database

India is one among the mega biodiversity countries of the world. The varied ecosystems, topography and climatic factors have contributed towards this richness. The enormous data on the faunal elements of our country accumulated over the time remain scattered in various publications by different institutions and organisations. There is a need to bring together the scientific names of all the land and aquatic animals in one authoritative database. Making available a standardized, validated and collated data on all the known animal species of India is a challenging endeavour and will be an ongoing task as well.

Objectives

To develop, launch and maintain a web enabled free and open source searchable database of all animal species known to occur in India, highlighting the magnitude of our faunal diversity and thereby ensuring their protection and conservation at the highest possible level.

- To develop a faunal database, searchable at least by Family, Genus and Species names, common names and State/district names and also ideally by habitats/ ecosystems in which they occur.
- To develop a working knowledge on the scientific names and also on spatial distribution of animals in India.
- To identify precisely where the gap areas lie, regarding our information as well as the expertise on faunal groups (Animal Groups with feeble representation in the database necessarily reflects our gap areas).
- To identify areas less surveyed and plan future surveys accordingly.
- To develop novel taxonomic expertise and also to strengthen the available ones to deal with less studied animal groups as revealed by the National faunal database.
- To facilitate better identification of areas of conservational significance in relation to the status and distribution of animal species.

Proposed Action plan

- Select a few animal groups as a priority, formulate a working group under a Coordinator, set time frames, and work towards the target using systems of international parameters, standards and procedures. The phase on vertebrates to be completed by 2015 and the phase dealing with atleast 50 % of the invertebrates to be completed by 2020.

- The work group may ideally be of experts both from inside and outside the organisation. Organise occasional meetings/workshops (once or twice annually for each working group) of the members of the work groups for data validations.
- Well equipped Bioinformatics cells with adequate experts and support staff to be established in selected Centres of ZSI for the proposed databasing work, by 2012. The work primarily involves extensive literature survey and compilation, data entry, digital imaging of specimens and other computational works. The cell needs to have its own infrastructure including advanced computer systems with accessories and also high quality microscopes for digital imaging.
- Prioritise less surveyed /unsurveyed areas for future field studies in order to supplement the existing data.

  (Developed in accordance with Global Biodiversity Information Facility, 2008. *GBIF Training Manual 1: Digitisation of History Collections Data,* version 1.0. Copenhagen: Global Biodiversity Information Facility)

4. Digitisation of Natural History Collections

Digitising and databasing of biological collections increases the utility of biological data. Digitisation of Natural History Collections is all about extraction of metadata from the museum labels and records, in a uniform standardised format. This includes digital imaging of the specimens too. The use of internationally approved standard softwares ensures communication with the datasets by international initiatives such as Global Biodiversity Information Facility (GBIF), Biodiversity Heritage Library (BHL), Barcode of Life (BOL) and Encyclopaedia of Life (EOL).

Objectives

- To digitise the vast Natural History Collections at Headquarters (HQ) and Regional Centres of ZSI, as a searchable database and to develop an updated record of each of the nearly 3 lakhs identified specimens housed in the faunal depositories of ZSI, and also its incorporation into a searchable database.
- To develop 'Primary Type Information System' (PTIS), a web-based database for the primary types in the National Zoological Collections at ZSI HQ and its Regional Centres.
- To identify areas less surveyed and plan future surveys accordingly.

Proposed Action plan

- Digitisation of Natural history collections at ZSI to be achieved using international recognised softwares like SPECIFY®, a versatile collection/research data management system with provisions for web interface and Distributed Generic Information Retrieval (DiGIR) protocols (to be completed by 2020). The Primary Type Information System to be completed by 2017, in a time frame of 5 years after the launch of the Bioinformatics cell.
- Rest of the points same as under Development of National Databases.

  (Developed in accordance with Global Biodiversity Information Facility, 2008. *GBIF Training Manual 1: Digitisation of History Collections Data,* version 1.0 Copenhagen: Global Biodiversity Information Facility).

5. Introduction and Integration of Cyber Taxonomy

Taxonomy is the science central to exploring and understanding biodiversity. The demand on this science to cater the increasing need of biodiversity knowledge has resulted in the emergence of Cyber taxonomy. It is an assemblage of electronic taxonomic tools for accelerating species' discoveries and application of taxonomic knowledge in biodiversity studies.

Objectives

Introduction and integration of Cybertaxonomy at ZSI is aimed in dissemination of taxonomic information with regard to Indian fauna at a rapid pace, in a more efficient way.

- The user-friendly internet based interactive taxonomic keys and digital fact sheets on various faunal groups, can cater the needs of a broad spectrum of users than conventional taxonomists, that too at a faster pace, increasing the outreach of taxonomy by manifold.
- To develop Cyber taxonomy at ZSI, to keep pace with the recent trends and advances in the international scenario of taxonomy
- To develop and maintain region wise/habitat wise online interactive taxonomic keys and digital fact sheets on various faunal groups in India.
- Develop digital information systems on key groups like Invasive Alien Species, endemics, threatened and endangered species, groups of economic and ecological significance and also on most commonly encountered taxa under various groups.

Proposed Action plan

- Render Training and exposure to the field of Cyber taxonomy to all practicing taxonomists as well as to the new recruits of the organisation, through annual training programs, by 2016.
- Establish Cyber taxonomy units at selected Centres of ZSI by 2012, to assist the taxonomists in developing digital taxonomy products. The units need to have their own infrastructure including advanced computer systems with accessories and also high quality, advanced microscopes for digital imaging.

(Developed based on La Salle, J., Wheeler Q. D., Jackway, P., Winterton, S., Hobern, D., Lovell, D., 2009. Accelerating taxonomic discovery through automated character extraction *Zootaxa*. **2217**: 43–55 http://www.mapress.com/zootaxa/2009/f/zt02217p055.pdf).

6. Geographical Information System (GIS) Cell

The Geographical Information System and Remote sensing techniques are identified as one of the most important methods for the study of ecosystem and its faunal composition. It is proposed to establish and develop a Cell for GIS and remote sensing for the collection and analysis of data and to supplement it with that collected on ground for bringing out an integrated picture on faunal diversity of various ecosystems. These techniques have proven to be very important tools aiding rapid assessment and survey of flora and fauna.

Objective

The establishment of a GIS Cell in ZSI is aimed to facilitate incorporating GIS and remote sensing techniques in regular faunal surveys of the department, so that the end results of the surveys are more informative and user friendly to the policy makers.

Proposed Action plan

- By 2015, A fully functional GIS Cell need to start contributing to the routine survey results, helping in bringing out an integrated picture on animal diversity of the country.
- Scientists also need to be trained in the use of GIS and Remote sensing gadgets and softwares and integrating data in their taxonomic studies; the training has to be achieved by 2018.

7. Integration of DNA Barcoding Studies on Relevant Taxa

DNA Barcoding method is emerging as a significant tool in identification of species. Recent advances of molecular techniques like DNA sequencing, minisatellite, microsatellite, and RAPD (random amplified polymorphic DNA) procedures, PCR (polymerase chain reaction) amplification of mitochondrial DNA, nuclear DNA, ribosomal DNA are proven aids for redefining genera, species and subspecies and their phylogenetic relationships.

Objective

To initiate and integrate frontier areas of research like DNA Barcoding on faunal groups and taxa of immense conservation/ecological/economic importance.

Proposed Action plan

By 2017, ZSI need to develop full fledged expertise in DNA Barcoding techniques of relevant taxa.

8. Launching Major Taxonomic Initiatives for Taxonomists

- **Provision for taking up detailed taxonomic studies in the case of lesser known taxa.**

Revisionary and monographic studies are always considered as major contributions in the field of taxonomy and such works are essential to improve our knowledge and understanding of the lesser known taxa. The taxonomists at ZSI need to take up such detailed taxonomic investigations on groups which are less studied and underexplored.

- **Provision for short-term funded training in aspects of taxonomy, at institutes of international reputes abroad.**

Established Taxonomists at ZSI, with proven track record should be encouraged to undertake short term visits to reputed international museums and taxonomic institutes abroad, for achieving specialised training or for studying the type specimens, funded by the organisation.

- **'Fauna of India Series'**

Under the ongoing scheme of 'Fauna of India series', provision shall be made for undertaking short term study visits to major international museums, which houses the type specimens related to the study, on departmental funding.

9. Capacity Building Strategy in Animal Taxonomy

1. Identify taxonomic information and gaps and prioritize capacity building needs.
2. Generate new taxonomic information at state and national level.
3. Exchange taxonomic information at local, state, national and global level.
4. Incorporation of taxonomic information into the implementation of various programmes of work at local, regional and national level.
    - Organise a national level workshop on animal taxonomy by the end of 2013 to identify priority-areas for taxonomic capacity-building, human capacity and infrastructure needs at national level. Recommendations of this workshop to be included in updated National Biodiversity Action Plan (NBAP).
    - Organise state level training workshops on taxonomy to improve access to and sharing of knowledge, data and information on animal biodiversity. At least two such workshops shall be conducted by 2014 to facilitate cross sectoral communication and to set the basis for additional workshops until 2020.
    - Improve training in faunal taxonomy skills by holding workshops for members of the education sector in which they can share experiences and ideas.
    - Produce biodiversity identification tools in regional languages (*e.g.,* field guides, multimedia, online tools) such as selected protected areas, threatened species, invasive alien species, and species useful to agriculture such as pollinators, pests etc.
    - A review at state and national level by 2015 of human capacity and infrastructure requirements to maintain and develop taxonomic expertise to the next generation, in order to identify and monitor biodiversity, particularly on invasive alien species, under-studied taxa, threatened and socio-economically important species, including indicator species.
    - To build and maintain a national information systems and infrastructure on animal biodiversity at international standards to provide free and open-access to the results of biodiversity research and related activities, and to implement national targets by the end of 2015. This information infrastructure will be able to communicate with international initiatives such as Global Biodiversity Information Facility (GBIF), Biodiversity Heritage Library (BHL), Barcode of Life (BOL) and Encyclopaedia of Life (EOL).

- To procure human resources and capital infrastructure to build, modernize, and maintain the National Zoological Collections at ZSI and other animal biodiversity collections held at universities, national institutions etc by 2017.
- By 2020, assess the status of biodiversity at state and national levels by developing a comprehensive coverage of information on known species at the global level including information on abundance, distribution, functioning and conservation in the ecosystem.
- Initiate projects by 2020 to produce an inventory for all species in targeted priority areas such as biodiversity hotspots, protected areas, and community conservation areas and incorporate accurate information on animal biodiversity, regarding conservation and sustainable use, in decision making.
- Between 2018-2020, using appropriate indicators, monitor progress to ensure that national capacity-building action plans and initiatives are in place and can be sustained them beyond 2020.

Matrix for Implementation of Key Activities of ZSI and Projected Action Plans

1. States and Union Territories Faunal Surveys

There are 28 states and 7 Union territories in the country. Based on the survey and Taxonomic work carried out so far, ZSI has already published faunal documents pertaining to the States (including Union Territories) of Orissa (4 volumes), Lakshadweep (1 volume), West Bengal (12 volumes), Meghalaya (10 volumes), Andhra Pradesh (8 volumes), Delhi (1 volume), Tripura (4 volumes), Gujarat (2 volumes), Sikkim (5 volumes), Manipur (3 volumes), Bihar including Jharkhand (1 volume), Nagaland (1 volume), Arunachal Pradesh (2 volumes), Mizoram (2 volumes), Madhya Pradesh including Chhattisgarh (2 volumes), Goa (1 volume), Tamil Nadu (1 volume), Uttarakhand (3 volumes) under the State Fauna Series. However, further surveys are required to get at least a near total picture of the faunal distribution of those already known and yet to be known. Accordingly, the Headquarters wing and the Regional wings of the Survey will be involved in the field surveys as mentioned below.

Sl. No.	Names of States	Surveys		Completion of study	Publication of results	Remarks/ Assignees
		Date of start	Year of completion			
1	Haryana	Ongoing	2011	2012	2013	NRC/ZSI/ Dehradun
2	Chandigarh	Ongoing	2012	2013	2014	NRC/ZSI/ Dehradun
3	Punjab	Ongoing	2014	2015	2016	NRC/ZSI/ Dehradun
4	Himachal Pradesh	Ongoing	2014	2015	2016	Hqs. & HARC/ZSI/ Solan
5	Jharkhand	Ongoing	2015	2016	2017	Hqs. & GPRC/ZSI/ Patna
6	Andhra Pradesh	2012	2015	2016	2017	8 volumes already brought out Hqs., & SRC/ZSI, Chennai
7	Madhya Pradesh and Chhattisgarh	2012	2015	2016	2017	2 volumes already brought out CZRC/ZSI/ Jabalpur

8	Rajasthan	2013	2016	2017	2018	DRC/ZSI/ Jodhpur
9	Uttar Pradesh	2014	2017	2018	2019	Hqs. & NRC/ZSI/ Dehradun
10	Jammu and Kashmir	2015	2018	2019	2020	HARC/ZSI/ Solan

2. Ecosystems

2.1. Forest Ecosystem

India's forest cover ranges from the tropical rainforest of the Andaman Islands, Western Ghats, and North-East India to the coniferous forest of the Himalaya. Between these extremes lie the sal-dominated moist deciduous forest of eastern India; the teak-dominated dry deciduous forest of central and southern India; and the babul-dominated thorn forest of the central Deccan and western Gangetic plain. The forest cover of the India as per 2007 assessment is 6,90,899 km^2, which is 21.02% of the geographical area of the country, in that Very Dense Forest constitutes 83,510 km^2 (2.54%), the Moderately Dense Forest 3,19,012 km^2 (9.71%), Open Forest constitutes 2,88,372 km^2 (8.77%) of the geographical area. The Scrub accounts for 41,525 km^2 (1.26%) (India State of Forest Report, 2009, Forest Survey of India). The type of forest found in a given locality depends on the climate and the soil. Geographically India is a tropical country but the whole of Gangetic plains lies outside the tropics. The country has strong monsoonic climate and differs from other tropical regions of the world. Temperature and rainfall are the most obvious factors of climate. Temperature can be related to latitude giving a broader differentiation into four zones *i.e.,* Tropical, Subtropical, Temperate and Alpine. Based on the annual rainfall four zones, namely, Wet zone, Intermediate zone, Dry zone and Arid zone may be broadly differentiated. Sixteen important forest types are identified in India (Champion and Seth, 1968) *i.e.,* Tropical Wet Evergreen Forests, Tropical Semi-Evergreen Forests, Tropical Moist Deciduous Forests, Tropical Littoral and Swamp Forests, Tropical Dry Deciduous Forests, Tropical Thorn Forests, Tropical Dry Evergreen Forests, Sub-tropical Broad Leaved Hill Forests, Sub-tropical Pine Forests, Sub-tropical Dry Evergreen Forests, Montane Wet Temperate Forests, Himalayan Moist Temperate Forests, Himalayan Dry Temperate Forests, Sub-alpine Forests, Moist Alpine Scrub and Dry Alpine Scrub. The values of forest ecosystems are immense. Forests were the part and parcel of ancient people. Even today, they are the source of material progress and basis of spiritual and moral inspiration of human being.

2.1.1. Biodiversity ‘Hotspots’ and Tropical Rainforest Ecosystems

India is recognized as one of the twelve megabiodiversity countries of the world with three biodiversity hot spots, the Western Ghats, the Eastern Himalayas, and the hilly ranges bordering India and Myanmar, each having numerous endemic species. The two major Biodiversity ‘Hotspots’ in India are the Western Ghats (Western Ghats-Srilanka Hotspot; Sri Lanka excluded) and the Himalaya (Eastern Himalaya in particular). The main areas of tropical forest are found in the Western Ghats, greater Assam region in the north-east and the Andaman and Nicobar Islands, though small remnants of rain forest are found in Orissa state. There are substantial differences in both the flora and fauna between the three major rain forest regions. The Eastern Himalaya includes political boundaries of Sikkim, Arunachal Pradesh, Assam, Manipur, Meghalaya, Tripura, Mizoram, Nagaland and Darjeeling district of West Bengal. However, opinions differ regarding the limits of Eastern Himalaya as a biogeographic zone. The Eastern Himalaya with plains and hills of variable height, abundant rainfall, varied climatic features and lush vegetation provides wide gamut of habitats for numerous and diversified life forms. Richness in biodiversity is further enhanced as this region served as the biogeographic ‘gateway’ for much of the Indian flora and fauna. The Western Ghats, one of the major tropical evergreen regions in India possess exceptionally rich biodiversity owing to its climatic and geographic factors as well as its evolutionary continuity for more than 50 million years. The complex topography of the ghats with a wide range of microclimatic and soil conditions have resulted in a mosaic of plant communities and animal associations unique to itself. Besides being biologically rich in genera, species and endemicity as well as the threats its faces due to human’s interference in recent times have made the Western Ghats figure today as one of the ‘Hotspot’ in the world. Around 5626 species of Fauna so far recorded from Western Ghats, in that around 439 species are endemic by ZSI (Lakshminarayana *et al.,* 2001). Islands represent fragile, ecologically sensitive and biogeographically significant ecosystems. These are the living laboratories on earth for demonstrating the process of organic evolution, speciation and adaptive radiation. From geographical point of view, islands are land masses surrounded by water barriers. The Andaman and Nicobar Islands consist of an arcuate chain of more than 500 islands, islets and rocky outcrops running north to south in the Bay of Bengal extending over 800 Km. These islands are the summits of a submarine mountain range, lying on the great tectonic suture zone that extends from the Eastern Himalaya along the Arakan Yoma of lower Myanmar in the north to Summatra and Lesser Sundas in the South. They comprise main island chains of Andaman and Nicobar, Ritchie's archipelago and the two outlying volcanic islands- Barren and Narcondam. These islands usually have undulating terrain with spur hills and intervening valleys. The highest peak in the Andaman is the Saddle Peak (726m), located in North Andaman and that of the Nicobar group is the Mount Thullier (670m) lying in Great Nicobar. These islands are adorned with three natural ecosystems, namely, forests, mangroves and coral reefs. Surveys as detailed below are proposed on Biodiversity 'Hotspots' and Tropical Rainforest Ecosystems.

Sl. No.	**Biodiversity 'Hotspots' and Tropical Rainforest Ecosystems**	**Surveys**		**Completion of study**	**Publication of results**	**Assignees**
		Date of start	**Year of completion**			
1.	Eastern Himalaya, Arunachal Pradesh- Phase I	2012	2016	2017	2018	Hqs., NERC/ZSI/Shillong & APRC/ZSI/ Itanagar
2.	Western Ghats- Tamil Nadu- Phase I	2013	2017	2018	2019	SRC/ZSI/ Chennai
3.	Western Ghats– Maharashtra- Phase I	2013	2017	2018	2019	Hqs. & WRC/ZSI/ Pune
4.	Andaman and Nicobar Islands- Phase I	2014	2018	2019	2020	Hqs. & ANRC/ZSI/ Port Blair
5.	Western Ghats- Kerala- Phase I	2016	2019	2019	2020	WGRC/ZSI/ Calicut

2.1.2. Protected Areas

The Government of India has so far protected more than 4% of the geographical area, with 100 National Parks, 515 Wildlife Sanctuaries, 17 Biosphere Reserves, 43 Conservation Reserves and 4 Community reserves (MoEF Annual Report, 2010-11). India has the following kinds of protected areas, in the sense of the word designated by IUCN:

1. **National Parks** (IUCN Category II): India's first National Park was *Hailey National Park*, now Jim Corbett National Park, established in 1935. By 1970, India had 5 National Parks; today it has around 100.
2. **Wildlife Sanctuary** (IUCN Category IV): India has around 515 *Wildlife Sanctuaries*. Among these, the 39 Tiger Reserves in 17 States are governed by Project Tiger, and are of special significance in the conservation of the tiger and 32 Elephant Reserves in 14 States are governed by Project Elephant for the conservation of the Elephant. Some wildlife sanctuaries are specifically named *Bird Sanctuary*, *e.g.* Keoladeo National Park before it attained National Park status. Many National Parks were initially Wildlife Sanctuaries.
3. **Biosphere Reserve** (UNESCO designation roughly corresponding to IUCN Category V): The Indian government has designated 17 Biosphere Reserves, in that so far seven *viz.*, Nilgiri (Tamil Nadu, Kerala and Karnataka), Gulf of Mannar (Tamil Nadu), Sunderbans (West Bengal), Nanda Devi (Uttarakhand), Pachmarhi (Madhya Pradesh), Similipal (Orissa) and Nokrek (Meghalaya) have been included in the World Network of Biosphere Reserves of UNESCO. These reserves protect larger areas of natural habitat, and often include one or more national parks and/or preserves, along buffer zones that are open to some economic uses.
4. **Reserved Forest and Protected Forest** (IUCN Category IV or VI, depending on protection accorded): These are forested lands where logging, hunting, grazing and other activities may be permitted on a sustainable basis to members of certain communities. In reserved forests, explicit permission is required for such activities. In protected forests, such activities are allowed unless explicitly prohibited. Thus, in general reserved forests enjoy a higher degree of protection with respect to protected forests.
5. **Conservation Reserve and Community Reserve** (IUCN Category V and VI respectively): These are areas adjoining existing PAs, which are of ecological value and can act as migration corridors, or buffer zone. Conservation reserves are designated government owned land from where communities may earn subsistence, while community

reserves are on mixed government/private lands. Community reserves are the only privately held land accorded protection by the Government of India.

6. **Village Forest and Panchayat Forest** (IUCN Category VI): These are forested lands administered by a village or a panchayat on a sustainable basis, with the habitat, flora and fauna being accorded some degree of protection by the managing community.
7. **Private protected areas:** These are regions which are owned by an individual or an organization / corporation not affiliated to the government or a communal body. Even though Indian legislation does not provide for protection of such areas, some NGOs are using land trusts to help in the conservation effort, and providing limited means of protection.
8. **Conservation areas:** Conservation areas are large, well-designated geographical entities where landscape conservation is undergoing, and usually contains different kinds of constituent protected areas, as well as privately owned land.

ZSI has already brought out faunal documents pertaining to 44 conservation areas in India. Five conservation area documents are in press. Further surveys as detailed below are proposed.

Sl. No.	Protected Areas	Surveys		Completion of study	Publication of results	Assignees
		Date of start	Year of completion			
1.	Chail WLS, Himachal Pradesh	ongoing	2014	2015	2016	HARC/ZSI/ Solan
2.	Kalatop-Khajjiar WLS, Himachal Pradesh	ongoing	2013	2014	2015	HARC/ZSI/ Solan
3.	Kanyakumari WLS, Tamil Nadu	ongoing	2013	2014	2015	SRC/ZSI/ Chennai
4.	Malabar WLS, Kerala	ongoing	2014	2015	2016	WGRC/ZSI/ Calicut
5.	Kalakkad-Mundunthurai WLS, Tamil Nadu	2012	2015	2016	2017	SRC/ZSI/ Chennai
6.	Nongkhyllem WLS, Meghalaya	2012	2015	2016	2017	NERC/ZSI/ Shillong
7.	Noradehi WLS, Madhya Pradesh	2013	2016	2017	2018	CZRC/ZSI/ Jabalpur

8.	Sonanadi WLS, Uttarakhand	2013	2016	2017	2018	NRC/ZSI/ Dehradun
9.	Sunderban Biosphere Reserve, West Bengal	2013	2016	2017	2018	Hqs., Kolkata & SRC, Canning
10.	Thattekkad Bird Sanctuary, Kerala	2014	2017	2018	2019	WGRC/ZSI/ Calicut
12.	Baisapally WLS Orissa	2015	2018	2019	2020	Hqs., Kolkata
13.	Koyna WLS, Maharashtra	2015	2018	2019	2020	WRC/ZSI/Pune
14.	Sainj WLS, Himachal Pradesh	2015	2018	2019	2020	HARC/ZSI/ Solan
15.	Satkosia WLS, Orissa	2015	2018	2019	2020	Hqs., Kolkata
16.	Valley of Flowers NP, Uttarakhand	2015	2018	2019	2020	NRC/ZSI/ Dehradun

2.2. Himalayan Ecosystem

The Himalaya is the great range of mountains that spreads over a west-northwest to east-southeast distance of about 2500 Km, covering political administrative regions of Afghanistan, Pakistan, India, Nepal, Bhutan and China. Considering both geographic and biogeographic divisions, the Indian Himalaya is divided into four zones for the convenience of biodiversity analysis of the mountain ecosystems of India (*i.e.,* Trans-Himalaya which includes upper region of Jammu & Kashmir and Himachal Pradesh; North-West Himalaya which includes Jammu & Kashmir and Himachal Pradesh excluding the Trans-Himalayan part; Western Himalaya includes Uttarakhand and Eastern Himalaya, covering three biotic provinces *viz.,* Central Himalaya, East Himalaya and North-Eastern Hills under two biogeographic zones *viz.,* Himalayan (part) and North-East India). ZSI has brought out so far two documents on the fauna of Western Himalaya. All of them pertain to the Western Himalaya falling under Uttar Pradesh and Himachal Pradesh.

Sl. No.	Himalayan Ecosystem	Surveys		Completion of study	Publication of results	Assignees
		Date of start	Year of completion			
1.	North-West Himalaya (Pangi Valley, Himachal	ongoing	2013	2014	2015	Hqs. & HARC/ZSI/ Solan

	Pradesh)					
2.	Trans-Himalaya (Ladakh, Jammu and Kashmir)- Phase I	2012	2015	2016	2017	Hqs. & HARC/ZSI/ Solan
3.	Trans-Himalaya (Spiti Valley, Himachal Pradesh)	2012	2015	2016	2017	Hqs. & HARC/ZSI/ Solan
4.	Trans-Himalaya (Zanskar Valley, Jammu and Kashmir)- Phase I	2015	2018	2019	2020	Hqs. & HARC/ZSI/ Solan
5.	Trans-Himalaya (Sangla valley of Kinnaur, Himachal Pradesh)	2015	2018	2019	2020	Hqs. & HARC/ZSI/ Solan

2.3. Desert Ecosystem

Desert does not mean all sand. It may have sand, gravel, bare rock, sun-baked mud and clay. All the deserts are characterised by low rainfall, arid land and an expanse of sand, salt or rock, largely barren except for very sparse or seasonal vegetative cover. The Indian Desert is generally called Thar Desert, though it is one of the smallest deserts in the world, it exhibits a wide variety of habitats and biodiversity. It is considered to be a unique desert because of its location at the crossing where Palaearctic, Oriental and Saharan elements of Biodiversity are found. This desert has sustained great civilization particularly in Ghaggar and Indus River basins. Most of the animals are not visible on the surface. They prefer to live under stones, among the plant root and leaves and, in burrows and long tunnels. Most of them are nocturnal because they go inside their burrows during day time. Flashy footpads or special systems to conserve the water are special adaptations. Both Flora and Fauna species in the Thar region constitute an invaluable stock of rare and resistant germ plasm which are too valuable from biological point of view. Roonwal (1982) reported nearly 1100 species from the arid districts of Rajasthan. A multiauthored compendium ‘Faunal Diversity in the Thar Desert: Gaps in Research’ edited by Ghosh, Baqri and Prakash (1996) reports about 2043 species from single celled animal Protozoa to Mammalia. The desert being a fragile ecosystem is further threatened because of the rapid increase in human population and rapid increase in the population of livestock has also resulted in tremendous pressure on the grasslands, specially in Rajasthan state. Though the Indira Gandhi Canal has transformed more than 11% un-inhabitated desert grassland into a fertile land, the biodiversity is under threat because the canal has changed the soil moisture, soil texture and vegetation composition. Mining of stones and other natural resources without monitoring has also resulted in the loss of biodiversity.

The district Rann of Kachchh or Kachchh-Bhuj in Gujarat state forms of separate agroclimatic zone within the Thar desert of India. This region is also characterised by a low rainfall and sparse vegetation, however, it has a special and different topography from the rest of the desert because of its location near the sea and low-lying areas by which the marine water enters into its vast expanse. As a result, Rann of Kachchh is an admixture of saline, marshy and coastal desert where water and soils are extremely saline. This has made the area special from biodiversity point of view because it harbours populations of several endemic and threatened species of flora and fauna. The review of literature reveals that Rann of Kachchh has not been explored significantly for the invertebrates fauna, while significant work has been done on the vertebrate groups except the fishes. The marine and coastal fauna reported from the Gulf of Kachchh (which forms a separate ecosystem), but studies on terrestrial and freshwater fauna is meagre from this unique desert ecosystem.

Sl. No.	Desert Ecosystem	Surveys		Completion of study	Publication of results	Assignees
		Date of start	Year of completion			
1.	Desert of Rajasthan and Gujarat	2012	2015	2016	2017	DRC/ZSI/ Jodhpur

2.4. Marine and Island Ecosystem

The Indian mainland coast is divided into two parts: West coast and East coast. The West coast is fronted by the Arabian Sea and the East coast by the Bay of Bengal. Other than these mainland coasts, there are three island groups, such as, Lakshadweep in the south Arabian Sea and Andaman and Nicobar in the eastern Bay of Bengal. The East and West coasts are markedly different in their geo-morphology. The West coast is generally exposed with heavy surf and rocky shores and headlands. The East coast is generally shelving with beaches, lagoons, deltas and marshes. The Marine and Coastal biodiversity encompasses the enormous variety of marine and coastal species and their genetic variety, the global 'oceans' cornucopia of living resources, myriad coastal and open sea habitats and ecosystems, and the wealth of ecological processes that support all of these. The oceans cover over 70% of the planet's surface area and accounts for 99%

of the volume that is known to sustain life. Coastal ecosystems, such as, tidal flats (sea-shores), coastal wetlands, *viz.,* backwaters, estuaries, lagoons and mangrove forests also harbor significant diversity and are highly valuable for coastal communities. Much of the world's biodiversity is found in highly diverse marine and coastal habitats. These habitats range from tidal flats and shallow coral reefs to the dark ocean floor's soft sediments thousands of meters below the water surface. While the total number of described marine species is smaller than that found on land, scientists are continually discovering new concentrations of diversity. Coral reefs are already known to be among the richest habitats in species diversity on the planet. The deep sea bottom, dark and subjected to tremendous pressure, is now thought to be a dwelling pace for thousands, perhaps millions of species of small invertebrate animals including crustaceans, molluscs and worms. Until today marine biodiversity is less well known than terrestrial biodiversity due to the difficulty in access and expense. We know astonishingly little about marine life, even in the most familiar seascapes. For instance, scientists have identified twenty-two phyla of meiofauna, two of which were identified only in the past two decades. These animals, barely visible to the naked eye, live on grains of coastal and ocean-bottom sands. Up to 10,000 such animals can be found in single handful of wet sands. Yet only recently have scientists begun to suspect the important role they play in marine ecosystems. They are a major source of food for shrimp and bottom feeding fish and they consume detritus and pollutants in seawater that filters through coastal and near shore sands. Marine and coastal ecosystems and the diversity of species that compose their structure, provide a wide range of important resources and services. The multiple uses of the coastal zone, in general, and the mangroves in particular, like recreation, tourism, forestry, agriculture, aquaculture, housing and commercial fishing are all well known, as also the fact that this zone is very highly productive and also thickly populated. A major concern with the increasing use of this zone and its resources, not only for the present but also for posterity, relates to coastal pollution by domestic industrial, municipal and agricultural wastes and of late due to oil exploration. In the face of this increasing uncertainty, the adoption of a precautionary approach is a *sine qua non* to the conservation of marine and coastal biodiversity. The precautionary principle which is now widely recognized as a emerging part of customary international environmental law, requires that no harmful action be undertaken until all the effects on marine and coastal biodiversity have been clearly identified and weighed against the expected benefits. Moreover, this precautionary approach should cover all the activities of past, present and future, bearing in mind the cumulative impact that these activities combined will have on marine biodiversity.

On the marine ecosystem and the Island ecosystem, ZSI has brought two faunal documents. They are on the fauna of Chennai coast and the meiofauna of Lakshadweep. Further surveys as detailed below are proposed.

Sl. No.	Marine and Island Ecosystem	Surveys		Completion of study	Publication of results	Assignees
		Date of start	Year of completion			
1.	Andaman & Nicobar- Phase I	2012	2016	2017	2018	ANRC/ZSI/ Port Blair
2.	East Coast- West Bengal, Orissa, Andhra Pradesh – Phase I	2012	2016	2017	2018	MBRC/ZSI/ Chennai
3.	West coast- Gujarat, Maharashtra, Goa, Phase I	2014	2018	2019	2020	MBRC/ZSI, Chennai

2.5. Estuarine Ecosystem

Estuaries are beautiful areas of our planet, situated as they are, between land and sea, play a dynamic role in the mixing, circulation, sedimentation and water dynamics. Penetrated by the sea through the recurring tides and flushed by the freshwater outflows of the lotic systems an estuary is indeed a very dynamic ecotone where freshwater mix with the sea water and these areas witnessed by the lush verdure of mangal forests (mangroves) that fringe this area. Blessed by the fertile flows of the both sea and rivers, these fascinating biotopes are by far the most productive ecosystems on our planet, the abode of unique species of plants and animals, the cradle of several species of fin fish, the nursery of commercially important shrimps, prawns and crabs and the natural habitat of various other invertebrates (Balakrishnan, 1987). Estuaries have also been witnessing for ages and serving as high-ways for the phenomenal and spectacular instinctive migrations of such anadromous fishes as the Hilsa and salmon from the sea to freshwater and the catadromus fishes like the eels from freshwater to sea during the reproductive cycles. These fascinating semi-enclosed and sheltered bodies of water have been since the dawn of history, the focal points of maritime activities culminating in the commercial, social and cultural interaction between the nations. No wonder most of the great cities of the world have developed around the estuaries.

Being at the confluence of the river with the sea this environment naturally has the interaction of the sea, river and land characterized by variable gradients in physico-chemical factors. These in turn influence and determine the nature of living organisms of this area. The process of mixing of fresh and salt waters in the estuary determines the ecology of tidal streams so much so the distribution of salinity. The incidence and relative abundance of organisms, movement of planktonic populations, the fisheries, *etc.,* depend to a great extent on the nature of circulation of fresh and salt water.

Studies of ecology of estuaries are beset with difficulties since no two estuaries are alike. Interaction of so many variables and differences in the physic-chemical and meteorological parameters, that exist in different regions of the country considerably add up to the problem. This aspect makes generalization some what difficult necessitating detailed studies on each estuary. Since the estuaries are known for their high productivity, these help in large scale production of fishery wealth, both shell-fish and fin-fish, thus sustaining the fisherman population around these areas and helping in making available protein rich food to the populations around. Estuaries are the feeding and nursery grounds for several species of coastal marine organisms and thus contributing in maintaining faunal diversity of coastal waters. Since estuarine areas are inhabitated by varied fauna along with the associated fauna of the mangroves in their environs these areas assume high significance in respect of biodiversity. The vast mangrove forests developed along many of the estuarine areas act as breakers for coastal habitats to check wind speed during cyclones and high velocity land ward winds. The estuarine areas are also of recreational significance to the neighbouring urban population, since they provide water front along with sea, thick greenaries of mangroves, thus promoting tourism. During the recent times, many of the estuaries have been subjected to ruthless rampage, extensive damage and even total destruction as a result of great pressure of population, industrialization at the adjacent areas along the river bank and urbanization.

Six documents on the fauna of Estuaries have already been published by ZSI. They pertain to Rushikulia, Mahanadi, Hugli Matla, Godavari, Krishna and Vamsadhara-Nagavali estuaries.

Sl. No.	**Estuarine Ecosystem**	**Surveys**		**Completion of study**	**Publication of results**	**Assignees**
		Date of start	**Year of completion**			
1.	Brahmani & Vaitarini Estuary	ongoing	2013	2013	2014	Hqs. & EBRC/ZSI/ Gopalpur-on-Sea
2.	Cauvery Estuary	2012	2014	2015	2016	EBRC/ZSI/ Gopalpur-on-

						Sea
3.	Narmada & Tapti Estuary	2012	2014	2015	2016	EBRC/ZSI/ Gopalpur-on-Sea
4.	Pennar Estuary	2014	2016	2017	2018	EBRC/ZSI/ Gopalpur-on-Sea

2.6. Wetland/ Freshwater Ecosystem

Wetlands have been defined by more than fifty different ways to include a wide spectrum of habitats. The 1971 Ramsar Convention has defined wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters". The wetlands include a wide range of inland, coastal and marine habitats which should have the following three essential attributes *i.e.,* an area which is permanently or periodically inundated for at least seven successive days during growing season, an area which supports hydrophytic vegetation at least for some part of the year and an area which has predominantly hydric soils that are saturated for a sufficiently long period to become anaerobic (lacking in oxygen) in their upper layers. Wetlands are broadly classified into freshwater and saltwater wetlands defined by salinity. The freshwater wetlands include both standing water habitats, such as, small or large ponds, tanks, lakes and reservoirs, as well as running water habitats like rivers, streams, canals and drainage channels. Though freshwater systems *viz.,* lakes, reservoirs and rivers account for a small amount of about 2% of total water on the Earth, they are of great importance to all organisms including human beings. Freshwater wetlands are complex ecosystems and generally represent extremely important resources which change markedly and rapidly in response to fluctuations in climate and precipitation. The Freshwater wetlands support a significant proportion of the total diversity of organisms, representing almost all taxonomic groups. Besides fish, these wetlands are dominated by microscopic algal forms, protozoans and planktonic communities. Conservation of wetland ecosystem can be defined as the total management of the diversified features of a particular wetland for the fair and equal benefit of all groups which have a direct interest in its use. For conservation of wetland resources and for maintaining the maximum diversity of organisms in the ecosystem legislation is essential for effective management practices and to check adverse uses of wetlands. In India, declaration of Sanctuaries, National Parks and Biosphere Reserves even before independence helped to protect important wildlife and wetland habitat included in the reserve areas. In addition to Wildlife (Protection) Act, 1972, signing the CITES treaty also helped to check international trade of animals.

ZSI has already brought out faunal documents on 12 wetland ecosystems. They are on Chilika, Renuka, Ujani, Kabar, Asan, Sambhar, Nath Sagar, Pichhola, Kopili, Vembanad, Nal Sarovar, Pong dam and Pocharam. The faunal documents on the Micro-faunal diversity of Deepor beel (a Ramsar site, Assam), and avifauna of Khijadiya and Marine National Park are in press. Further surveys as detailed below are proposed.

Sl. No.	Wetland/ Freshwater Ecosystem	Surveys		Completion of study	Publication of results	Assignees
		Date of start	Year of completion			
1.	Urban & Peri Urban Lakes of Hyderabad, Andhra Pradesh	ongoing	2014	2014	2015	FBRC/ZSI/ Hyderabad
2.	Urban & Peri Urban Lakes of Kolkata, West Bengal	ongoing	2014	2015	2016	Hqs., Kolkata
3.	Govind Sagar, Himachal Pradesh	2012	2014	2015	2016	FBRC/ZSI/ Hyderabad & NRC/ZSI/ Dehradun
4.	Chandra Tal, Himachal Pradesh	2012	2014	2015	2016	FBRC/ZSI/ Hyderabad & HARC/ZSI/ Solan
6.	Tso Murari, Jammu & Kashmir	2014	2016	2017	2018	FBRC/ZSI/ Hyderabad & HARC/ZSI/ Solan;
11.	Bhoj, Madhya Pradesh	2015	2017	2018	2019	FBRC/ZSI/ Hyderabad & CZRC/ZSI/ Jabalpur;
12.	Sasthamkota, Kerala	2016	2018	2019	2020	FBRC/ZSI/ Hyderabad & WGRC/ZSI/ Calicut

2.7. Grassland Ecosystem

Grassland means a landscape in which the grasses are the dominant plants and they found in regions where climatic and edaphic conditions are such as to prohibit growth of trees. Lesser rainfall and frequent light showers keep the upper layers of soil moist so that grass continues to grow. Grasslands occupy about 20% of the earth's land surface and around 3.9% of the total area of our country is occupied by the grasslands. The grasslands of India are of great diversity, which include semi-arid and arid grasslands of Deccan Peninsula and Rajasthan, water-logged grasslands of Terrai belt, the rolling shoal-grasslands of hill tops of Western Ghats and the high altitude temperate-alpine grasslands of Himalaya. The grasslands in India, except for those occurring in the alpine regions, are seral in nature and are maintained at various successional stages by grazing and burning.

Grassland primarily supports a large number of herbivore species from minute insects to the largest land animal- the elephant. This is turn makes grasslands happy hunting grounds of various carnivorous species of different sizes. Most of the grasslands have some common mammalian species, such as, Tiger, Elephant, Deer, Hare, Rats and Mice and bird species, such as, Grass Warbler, Partridge, Munia, Streaked Baya and many others. However, depending upon the geographical locations, ecological set up and management practices, many of the grasslands possess some characteristic faunal elements. Grasslands are of considerable economic value. Whether natural or man-made these are used vastly for production of milk, meat, wool and hides. A good strand of grasses and legumes on the soil checks erosion, prevents the loss of nutrients by leaching, improves the physical properties of soil and maintains a well balanced water regime. Natural calamities like forest fires, floods, *etc.,* overgrazing and various socio-economic developmental activities are the factors threatening grasslands. The Programme is being introduced for the first time.

Sl. No.	Grassland Ecosystem	Surveys		Completion of study	Publication of results	Assignees
		Date of start	Year of completion			
1.	Shola grasslands of Western Ghats- Phase I	2014	2017	2018	2019	WGRC/ZSI/ Calicut
2	Temperate and alpine grasslands of the Himalaya-	2014	2017	2018	2019	Hqs. & HARC/ZSI/ Solan

	Phase I					
3.	Dry Grasslands of Thar desert	2015	2018	2019	2020	DRC/ZSI/ Jodhpur
4.	Terai grasslands of Gangetic plains	2015	2018	2019	2020	Hqs., Kolkata

2.8. Agroecosystems

An agroecosystem is the basic unit of study for an agroecologist, and is somewhat arbitrarily defined as a spatially and functionally coherent unit of agricultural activity, and includes the living and nonliving components involved in that unit as well as their interactions.

An agroecosystem can be viewed as a subset of a conventional ecosystem. As the name implies, at the core of an agroecosystem lies the human activity of agriculture. However, an agroecosystem is not restricted to the immediate site of agricultural activity (*e.g.* the farm), but rather includes the region that is impacted by this activity, usually by changes to the complexity of species assemblages and energy flows, as well as to the net nutrient balance. Traditionally an agroecosystem, particularly one managed intensively, is characterized as having a simpler species composition and simpler energy and nutrient flows than "natural" ecosystem. Likewise, agroecosystems are often associated with elevated nutrient input, much of which exits the farm leading to eutrophication of connected ecosystems not directly engaged in agriculture.

One of the major efforts of disciplines such as agroecology is to promote management styles that blur the distinction between agroecosystems and "natural" ecosystems, both by decreasing the impact of agriculture (increasing the biological and trophic complexity of the agricultural system as well as decreasing the nutrient inputs/outflow) and by increasing awareness that "downstream" effects extend agroecosystems beyond the boundaries of the farm. In the first case, polyculture or buffer strips for wildlife habitat can restore some complexity to a cropping system, while organic farming can reduce nutrient inputs. Efforts of the second type are most common at the watershed scale.

The Programme is being introduced for the first time.

Sl. No.	**Agroecosystems**	**Surveys**		**Completion of study**	**Publication of results**	**Assignees**
		Date of start	**Year of completion**			
1.	Agroecosysetms of Uttarakhand,	2014	2017	2018	2019	NRC/ZSI/Dehradun

	Punjab and Haryana- Phase I					
2.	Rice ecosystems of Kerala- Phase I	2015	2018	2019	2020	WGRC/ZSI/Calicut

3. Studies on Invasive Alien Fauna of India

Sl. No.	Actions	Purpose/ Theme	Time frame	Institutions involved	Goal
1.	Integrate studies on Invasive Alien Species.	Generating taxonomic products and information required to confront invasive.	2012 onwards	ZSI Hqs. & Regional Centres	To combat the invasive fauna in an efficient manner.

4. Development of National Faunal Databases and Digitisation of Natural History Collections

Sl. No.	Actions	Purpose/Theme	Time frame	Institutions involved	Goal
1.	Bioinformatics cells with adequate experts and support staff to be established in selected Centres of ZSI.	Extensive literature survey and compilation, data entry, digital imaging of specimens and other computational works.	2011-2012	ZSI Hqs.	To render assistance to the scientists at ZSI in digitizing faunal collections.
2.	Digitisation of Natural history collections at ZSI.	To develop an updated record of the identified specimens housed in the faunal depositories of ZSI, and also its incorporation into a searchable database.	2012-2020	ZSI Hqs. & Regional Centres.	For organizing the collections and recovery of data associated with them in a more efficient way.

3.	To develop 'Primary Type Information System' (PTIS), a web-based database for the primary types in the National Zoological Collections.	For maintaining a searchable and updated record of primary types.	2012-2017	ZSI Hqs.	To meet ICZN requirement and to serve the global taxonomic community in a better way.

5. Introduction and Integration of Cyber Taxonomy

Sl. No.	Actions	Purpose/Theme	Time frame	Institutions involved	Goal
1.	Establishment of Cyber taxonomy units at selected Centres of ZSI.	To assist the taxonomists in developing digital taxonomy products.	2011-2012	ZSI Hqs. & selected Regional Centres.	For dissemination of taxonomic information with regard to Indian fauna at a rapid pace, in a more efficient way
2.	Conduct Annual Training programs in Cyber taxonomy.	Training and exposure to the field of Cyber taxonomy to all practicing taxonomists as well as to the new recruits in ZSI.	2012-2016	ZSI Hqs. & selected Regional Centres.	For developing region wise/habitat wise digital Information System for key faunal groups like Invasive Aliens, endemics, threatened and endangered species, groups of economic and ecological significance and also on commonly encountered taxa under various groups.

6. Geographical Information System (GIS) Cell

Sl. No.	Actions	Purpose/Theme	Time frame	Institutions involved	Goal
1.	Establishment of GIS cells in ZSI.	To assist the taxonomists in developing digital taxonomy products.	2011-2015	ZSI and Indian Institute of Remote Sensing (IIRS), Dehradun.	For bringing out an integrated picture on faunal diversity of various ecosystems and to render the surveys reports more informative for the policy makers.
2.	Training programs for Scientists at ZSI in GIS & remote sensing.	Training in the use of GIS and Remote sensing gadgets and softwares.	2012-2018	ZSI and Indian Institute of Remote Sensing (IIRS), Dehradun.	For integrating GIS and remote sensing data in routine taxonomic studies.

7. Integration of DNA Barcoding Studies on Relevant Taxa

Sl. No.	Actions	Purpose/Theme	Time frame	Institutions involved	Goal
1.	Setting up of DNA Barcoding full-fledged facility.	For redefining genera, species and subspecies and their phylogenetic relationships.	2011-2017	ZSI	To integrate frontier areas of research like DNA Barcoding on faunal groups and taxa of immense conservation/ ecological/economic importance.

8. Capacity Building Strategy in Animal Taxonomy

Sl. No.	Actions	Purpose/Theme	Time frame	Institutions involved	Goal
1.	Organize one National level workshop on animal taxonomy by the end of 2013.	To identify priority/gap areas for taxonomic capacity-building, human capacity and infrastructure needs at national level.	2011-2013	Zoological Survey of India, ICAR, WII, BNHS, ATREE, SACON, CES, Fisheries Survey of India and universities.	Recommendations of this workshop are to be included in updated National Biodiversity Strategies and Action Plans (NBSAPs).
2.	Organize State level training workshops on taxonomy.	At least two such workshops will be completed by 2014 to facilitate cross sectoral communication and to set the basis for additional workshops until 2020.	2011-2014	Zoological Survey of India, ICAR, WII, BNHS, ATREE, SACON, CES, Fisheries Survey of India and universities.	Sharing of knowledge, data and information on animal biodiversity. To develop national level network of professional and amateur animal taxonomists.
3.	National and thematic workshops for members of the education sector and environmental education organizations.	Share experiences and ideas. Develop focused action plans to inculcate taxonomic knowledge among general public, conservation managers, schools and undergraduate teaching.	2011-2014	Zoological Survey of India, ICAR, WII, BNHS, ATREE, SACON, CES, Fisheries Survey of India and universities.	Improve taxonomic skills among conservation managers, general public, civil society organizations, undergraduate, post graduate and university teachers.
4.	To initiate short term internship/ summer fellowship/diploma/ post graduate degree courses in animal taxonomy.	To develop taxonomic capacity among next generation of students and teachers.	2011-2016	Zoological Survey of India with other institutions and Universities.	To transfer the taxonomic knowledge to next generation of students and create practicing

					professional taxonomists beyond 2020.
5.	Produce biodiversity identification tools in regional languages.	To develop taxonomic identification tools for selected protected areas, threatened species, invasive alien species, and species useful to agriculture such as pollinators, pests *etc*.	2011-2020	Zoological Survey of India, ICAR, WII, BNHS, ATREE, SACON, CES, Fisheries Survey of India and universities.	To develop good quality identification guides in regional languages using potential of print and electronic media.
6.	A review at national and state level by 2015 of human capacity and infrastructure requirements.	A scientific assessment of human resources and infrastructure requirements at national level.	2015	Zoological Survey of India, ICAR, WII, BNHS, ATREE, SACON, CES, Fisheries Survey of India and universities.	To maintain and pass-on taxonomic expertise to the next generation, in order to identify and monitor biodiversity, particularly on invasive alien species, under-studied taxa, threatened and socio-economically important species, including indicator species.
7.	To build and maintain a national information systems and infrastructure on animal biodiversity of international standards.	To provide free and open-access to the results of biodiversity research and related activities, and to implement national targets by the end of 2015. This	2011-2015	Zoological Survey of India, ICAR, WII, BNHS, ATREE, SACON, CES, Fisheries Survey of India and	This information infrastructure will be able to communicate with international initiatives such as Global Biodiversity

		activity includes digitally archiving published documents, illustrations, paintings *etc.* on animal diversity.		universities.	Information Facility (GBIF), Biodiversity Heritage Library (BHL), Barcode of Life (BOL) and Encyclopaedia of Life (EOL).
8.	To procure human resources and capital infrastructure.	To build, modernize, and maintain the National Zoological Collections at ZSI and other animal biodiversity collections held at universities, national institutions *etc.*	2017	Zoological Survey of India as a nodal agency with other collaborating partners.	To modernize existing national Zoological Collection to world standards.
9.	By 2020, assess the status of animal biodiversity at state and national levels.	Develop a comprehensive coverage of information on known species at national level including information on abundance, distribution, functioning and conservation in the ecosystem.	2011-2020	Zoological Survey of India as a nodal agency with other collaborating partners.	To develop a comprehensive data base on animal biodiversity of India.
10.	Initiate projects by 2020 to produce an inventory for all species in targeted priority areas.	Faunal documentation of biodiversity hotspots, protected areas, and community conservation areas.	2011-2020	Zoological Survey of India, ICAR, WII, BNHS, ATREE, SACON, CES, Fisheries Survey of India and universities.	To develop comprehensive database on animal diversity at priority areas and incorporate accurate information on animal biodiversity, regarding conservation and sustainable

					use, in decision making.
11.	Using appropriate indicators, monitor progress of capacity building strategy for animal taxonomy.	To ensure that national or regional capacity-building action plans and initiatives are in place and can be sustained them beyond 2020.	Between 2018-2020	Zoological Survey of India as a nodal agency with other collaborating partners.	To continuously monitor the progress of strategies for taxonomy capacity building.

9. Equipments and Infrastructure Requirements to meets Vision 2020 Targets

To meet the targets of Vision 2020, the equipments and infrastructure need to be procured, upgraded and modernized during the vision period. Projected requirements for ZSI head quarters and regional centers are follows.

Sl. No.	Item/s	Justification
1.	Global Positioning System (GPS)	GPS is essential for field surveys and geo-referencing the samples. Over 100 field surveys are conducted every year throughout India. Hence, state of art hand held GPS is very essential for recording the coordinates of the species distribution and for establishing the Geographical Information system for conservation and management of faunal diversity.
2.	Laptop/computers	Laptops/computers are essential for field surveys and data recording. Over 100 field surveys are conducted every year throughout India. Hence state of art laptop is very essential.
3.	Compact Digital Camera with Zoom and Macro lens.	Digital Camera is very essential for field work and digitization of collected specimens.
4.	Binoculars for status surveys	Binoculars are very essentials for field surveys to study the status of endangered mammals and birds. Over 100 field surveys are conducted every year and they are very essential.
5.	Underwater Camera for marine biodiversity studies	Underwater Camera is very important to document fauna of marine ecosystems. So far only species related to commercial importance have been documented.
6.	Computer Server for storage of digital documents and to connect to the website of ZSI	Computer server with storage facility is essential for fauna biodiversity databases and digitization of collection. The storage server is very important for disseminating knowledge on fauna of India as well as on further research on the Primary Type Information.
7.	Compact Storage System for collection holdings	Compact storage system is important for preservation of dry samples of vertebrates and invertebrates. ZSI being the National Designated Repository for fauna of India, the collection holdings of fauna of India is increasing day by day in ZSI Hqs. And it's regional Centres. Unless and until the modern storage systems are established there is going to be space problem for accommodations of voucher specimen of the collection holdings.
8.	Wet Collection Storage Almarah/Cabinet	Collections of samples stored in alcohol and formaldehyde need to be preserved good quality storage facility. Hence wet collection storage

		almarah/Cabinet is proposed.
9.	Microscope-Digital Stereo zoom and Compound Microscopes	Good quality digital stereo zoom microscope with digital photographs is essential for identifying samples of insects, invertebrates and small vertebrates *etc.* For such quality scientific work modern microscopes are being rep-laced by the conventional monocular and binocular microscopes. Good quality compound microscope is essential for identifying samples of insects, invertebrates and small vertebrates *etc.*
10.	Geographical Information System for conservation of fauna	GIS lab is integral part of Vision 2020 and GIS lab is proposed in head quarters and 4 regional centers. Geographical Information System is very much essential for conservation and management of fauna of India.
11.	Environmentally Controlled Collection holding facility	All collection holdings in head quarters and regional centers need to be kept in environmentally controlled facility for future studies. The traditional method of keeping the collection holdings in wooden almarah/Cabinet is not viable for the years to come. There are 200 years old collections available in ZSI and the holdings need to be preserved for many more years. At present it is estimated that ZSI is holding 20 million specimens.
12.	Multipurpose digital soil and water analysis kit	These soil and water digital probes are required to collect data on physico-chemical parameters of soil and water parameters during surveys.
13.	Bio-safety cabinets, Deep Freezers (-80 $^{\circ}$C), BOD incubators, Micropipette set and Dedicated Power Generator	ZSI has established the DNA Barcoding facility and DNA Extraction Centres. Bio-safety cabinets for 5 DNA labs are essential. The deep freezers are highly required for storing the fresh specimen for DNA Barcoding. The deep freezers are to be set up in all the Regional Centres as well as Hqs. Other equipments are also necessary to do the bar coding to be procured during the period. There is also a need for uninterrupted power supply for specimen kept under deep freezer. Facility for uninterrupted power supply is must for ZSI.
14.	Modernization of Regional Centres museum	All Regional Centers and head quarters museum is to be renovated and modernised. The museum specimens are to be kept uncontaminated for many years for further studies for the future. The displays in the museum have to be modernised.
15.	Modernisation and digitisation of Library and ZSI Publications.	ZSI has 200 years old books and periodicals from the time of Asiatic Society of Bengal and other books available in the library. More than one lakh books are to be degitised and made available to the public.

10. Statement of Sanctioned Strength, Men-in-Position and Vacancy Position in Respect of ZSI Headquarters Office, Kolkata as well as all ZSI Regional Centres

Sl. No.	Group and Category	Sanctioned Strength	Men-in-position	Vacancy position
	GROUP-A			
1.	Scientist – G (37,400 – 67,000) +GP-Rs.10000	1	1	
2.	Scientist – F (37,400 – 67,000) +GP-Rs.8900	135	6	
3.	Scientist – E (37,400 – 67,000)+GP-Rs.8700		2	
4.	Scientist – D (15,600 – 39,100) +GP-Rs.8600		7	
5.	Scientist – C (15,600 – 39,100) +GP-Rs.6600		55	
6.	Scientist – B (15,600 – 39,100) +GP-Rs.5400		5	
	Total	**136**	**76**	**60**

Sl. No.	Group and Category	Sanctioned Strength	Men-in-position	Vacancy position
	GROUP-A			
1.	Pub. Prod. Officer (15,600 – 39,100) +GP-Rs.6600	1	1	-
2.	Sr. Admn. Officer (15,600 – 39,100) +GP-Rs.6600	1	-	1
3.	Accounts Officer (15,600 – 39,100) +GP-Rs.6600	1	-	1
4.	Store Officer (15,600 – 39,100) +GP-Rs.5400	1	-	1
5.	Admn. Officer (15,600 – 39,100) +GP-Rs.5400	1	1	-
	Total	**5**	**2**	**3**

Sl. No.	Group and Category	Sanctioned Strength	Men-in-position	Vacancy position
	GROUP-B			
1.	Asstt. Zoologist (9,300 – 34,800) +GP-Rs.4600	69	36	33
2.	Jr. Admn. Officer (9,300 – 34,800) +GP-Rs.4600	9	3	6
3.	Asstt. Lib. & Inf. Officer (9,300 – 34,800) +GP-Rs.4600	1	-	1
4.	Hindi Officer	1	-	1

	(9,300 – 34,800) +GP-Rs.4200			
5.	Sr. Personal Officer (9,300 – 34,800) +GP-Rs.4200	1	1	-
	Total	**81**	**40**	**41**

Sl. No.	Group & Category	Sanctioned Strength	Men-in-position	Vacancy position
	GROUP-C			
1.	Senior Zoological Assistant. (9,300 – 34,800) +GP-Rs.4200	50	35	15
2.	Zoological Assistant (9,300 – 34,800) +GP-Rs.4200	82	47	32
3.	Lib. & Inf. Asstt. (9,300 – 34,800) +GP-Rs.4200	15	5	8
4.	Cataloguer (9,300 – 34,800)	-	1	-
5.	Sr. Artist (9,300 – 34,800) +GP-Rs.4600	5	4	1
6.	Artist – Gr.I (9,300 – 34,800) +GP-Rs.4200	11	6	5
7.	Artist – Gr.II (9,300 – 34,800) +GP-Rs.4200	18	2	16
8.	Microflim Operator (9,300 – 34,800) +GP-Rs.4200	1	1	-
9.	Cine – Technician (9,300 – 34,800) +GP-Rs.4200	1	-	1
10.	Taxidermist – Gr.I (9,300 – 34,800) +GP-Rs.4200	2	2	-
11.	Taxidermist – Gr.II (9,300 – 34,800) +GP-Rs.4200	5	1	4
12.	Taxidermist – Gr.III (5,200 – 20,200) +GP-Rs.2800	10	2	8
13.	Jr. Zool. Asstt. (5,200 – 20,200) +GP-Rs.2800	44	22	22
14.	Laboratory. Assistant (5,200 – 20,200) +GP-Rs.2000	48	11	37
15.	Field Collector (5,200 – 20,200) +GP-Rs.2000	29	20	9
16.	Sr. Statistical Asstt. (5,200 – 20,200) +GP-Rs.2800	1	-	1
17.	Photographer Gr.II (5,200 – 20,200) +GP-Rs.2800	4	3	1
18.	Photographer Gr.III (5,200 – 20,200) +GP-Rs.2400	13	11	2
19.	Jr. Draftsman (5,200 – 20,200) +GP-Rs.2000	2	-	2
20.	Electrician	1	-	12

	(5,200 – 20,200) + GP-Rs.2400			
21.	Copy Holder (5,200 – 20,200) +GP-Rs.2400	2	1	1
22.	Proof Reader (5,200 – 20,200) +GP-Rs.2400	2	1	1
23.	Sr. Insect Setter (5,200 – 20,200) +GP-Rs.2400	1	1	-
24.	Sr. Carpenter (5,200 – 20,200) +GP-Rs.2400	1	1	-
25.	Computor (5,200 – 20,200) +GP-Rs.1900	1	-	1
26.	Statistical Asstt. (5,200 – 20,200) +GP-Rs.2400	1	-	1
27.	Machine Man (5,200 – 20,200) +GP-Rs.1900	1	-	1
28.	Mechanic (5,200 – 20,200) +GP-Rs.1900	1	-	1
29.	Motor Driver Spl.Gr. (9,300 – 34,800) +GP-Rs.4200	1	1	-
30.	Motor Driver Gr.- I (5,200 – 20,200) +GP-Rs.2800	8	8	-
31.	Motor Driver Gr. – II (5,200 – 20,200) +GP-Rs.2400	8	5	2
32.	Motor Driver Ordy Grade) (5,200 – 20,200) +GP-Rs.1900	7	5	-
33.	Driver for Boat	4	-	-
34.	Jr. Hindi Translator (5,200 – 20,200) +GP-Rs.2800	11	4	7
35.	Compositor (5,200 – 20,200) +GP-Rs.1900	2	2	-
36.	Office Supdt. (9,300 – 34,800) +GP-Rs.4200	11	9	2
37.	Asstt. (O) (9,300 – 34,800) +GP-Rs.4200	31	27	5
38.	Accountant (5,200 – 20,200) +GP-Rs.2800	-	-	-
39.	Store Asstt. (5,200 – 20,200) +GP-Rs.2400	1	1	-
40.	Stenographer Gr.II (9,300 – 34,800) +GP-Rs.4200	7	6	1
41.	Stenographer Gr.III (5,200 – 20,200) +GP-Rs.2400	9	5	4
42.	Record Keeper (5,200 – 20,200) +GP-Rs.1800	1	-	1
43.	U.D.Clerk (5,200 – 20,200) +GP-Rs.2400	32	25	6
44.	L.D.Clerk/ LDC(Hindi Typist) (5,200 – 20,200) +GP-Rs.1900	61	33	24

45.	Telex Operator (5,200 – 20,200) +GP-Rs.1900	-	-	-
46.	Sr. Caretaker (5,200 – 20,200) +GP-Rs.2800	1	-	1
47.	Caretaker (5,200 – 20,200) +GP-Rs.2400	1	-	1
48.	Head Carpenter (5,200 – 20,200) +GP-Rs.1900	1	-	1
49.	Cook (5,200 – 20,200) +GP-Rs.1900	1	1	-
	Total	**550**	**310**	**240**

Sl. No.	Group and Category	Sanctioned Strength	Men-in-position	Vacancy position
	Multi Task Force Group			
1.	Collection Tender (5,200 – 20,200) +GP-Rs.1900	47	42	5
2.	Insect Setter (4,440 – 7,440) +GP-Rs.1800	20	8	12
3.	Asstt. Taxidermist (4,440 – 7,440) +GP-Rs.1800	2	-	2
4.	Jr. Gestener Operator (4,440 – 7,440) +GP-Rs.1800	1	-	1
5.	Marksman (4,440 – 7,440) +GP-Rs.1800	3	1	2
6.	Sorter (4,440 – 7,440) +GP-Rs.1800	8	-	8
7.	Book Binder (4,440 – 7,440) +GP-Rs.1800	2	-	2
8.	Laboratory Attendant (4,440 – 7,440) +GP-Rs.1800	56	46	9
9.	Jr. Caretaker (4,440 – 7,440) +GP-Rs.1800	4	-	4
10.	Jamader (4,440 – 7,440) +GP-Rs.1800	1	1	-
11.	Library Attendent (4,440 – 7,440) +GP-Rs.1800	3	1	2
12.	Duftry (4,440 – 7,440) +GP-Rs.1800	11	2	7
13.	Farash (4,440 – 7,440) +GP-Rs.1800	1	-	1
14.	Taxidermist-Attendent (4,440 – 7,440) +GP-Rs.1800	2	-	2
15.	Aquaium Attendent (4,440 – 7,440) +GP-Rs.1800	4	2	2
16.	Watchman (4,440 – 7,440) +GP-Rs.1800	31	27	4
17.	Messenger			

	(4,440 – 7,440) +GP-Rs.1800	45	27	19
18.	Peon (4,440 – 7,440) +GP-Rs.1800			
19.	Sweeper/Safaiwala (4,440 – 7,440) +GP-Rs.1800	13	6	7
20.	Tea Maker (4,440 – 7,440) +GP-Rs.1800	1	1	-
21.	Bearer (4,440 – 7,440) +GP-Rs.1800	2	1	1
22.	Mali (4,440 – 7,440) +GP-Rs.1800	2	1	1
23.	Deck Hand (4,440 – 7,440) +GP-Rs.1800	2	1	1
24.	Laskar for Boat	1	-	-
	Total	**262**	**167**	**95**

Zoological Survey of India

Expertise at the Headquarters and Regional Centres

Indian fauna is represented by about 35 animal phyla. Expertise is available for various groups, especially the terrestrial ones. However, for many groups, especially the marine taxa, there is very less expertise available in ZSI or any other organizations at national level. More over, for many taxa, only one or two experts are available at national level and many of them are in the verge of superannuation. This limited taxonomic human resource is seriously hampering extensive and intensive faunal surveys and documentation of lesser known taxa. India being a mega biodiversity it is imperative to document and monitor faunal diversity at various ecosystems and habitats. Hence there is an urgent need to develop taxonomic capacity for various taxa.

It is very important to note that Zoological Survey of India has acquired modern instruments such as Scanning Electron Microscopes, DNA barcoding instruments as well as proposed to establish Geographical Information System, ZSI Faunal Diversity Information System, Cataloging of Library books etc. These facilities shall be fully functional through establishing manpower either through recruitment on permanent or contractual basis.

S. No	Phylum	Class	Order	Family/Group	Experts Available	Regional Centre
			Kingdom Protista			
1	Protista				L.Bindu, Jasmine, R.Gosh	MBRC, Chennai
			Kingdom Animalia			
2	Cnidaria				K.Venkataraman, Ch.Satyanarayan, C.Raghunathan, Rajkumar Rajan	ZSI,Kolkata, ZSI,Kolkata, A&N RC, Port Blair, MBRC,

						Chennai
3	Porifera				J.G.Pattanayak G. Sivaleela	Kolkata MBRC, Chennai
4	Acoelomorpha					Not available
5	Acanthocephala					Not available
6	Brachiopoda					Not available
7	Bryozoa					Not available
8	Chaetognatha					Not available
9	Ctenophora					Not available
10	Cycliophora					Not available
11	Entoprocta					Not available
12	Gastrotricha					Not available
13	Gnathostomulida					Not available
14	Kinorhyncha					Not available
15	Loricifera					Not available
16	Micrognathozoa					Not available
17	Nematoda				Bhutia, Padma Bora, Vinita Sharma, Anjum Razvi, D.Sen, V.V.Gantait, S.Banerjee	Dehra Dun, Jodhpur, ZSI,Kolkata
18	Nematomorpha					Not available
19	Nemertea					Not available
20	Orthonectida					Not available
21	Phoronida					Not available
22	Placozoa					Not available
23	Platyhelminthes				A.Ghosh, S.Chakraborti	ZSI,Kolkata
24	Priapulida					Not available
25	Rhombozoa					Not available
26	Rotifera				Jayashree Tilak, Chitra	ZSI,Kolkata, MBRC, Chennai
27	Sipuncula					Not available
28	Tardigrada					Not available
29	Xenoturbellida					Not available
30	Annelida				Rinku Goswami, Pallival, Tulika Biswas	ZSI,Kolkata, HARC, Solan
31	Onychophora					Not available
32	**Arthropoda**					
		Crustacea			K. Venkataraman, M.K.Devroy, A. Gokul, OP.Srivastava, Valarmati, Chitra, P.D.Rane, Jayashree Tilak, Sameer Kumar Pati,	ZSI, Kolkata, WRC, Pune, MBRC, Chennai,

					S.Mitra	
		Arachnida			Sankar Talukdar, Shelley Acharaya	ZSI, Kolkata
		Diplopoda				Not available
		Chilopoda			P.M.Sureshan	Kozhikode
			Thysanura		G.P.Mandal A.K.Hazra	Kolkata
			Diplura		G.P.Mandal A.K.Hazra	Kolkata
			Protura		G.P.Mandal A.K.Hazra	Kolkata
			Collembola		G.P.Mandal, Requea Bano A. K. Hazra	Kolkata, Pune
			Ephemeroptera		K.Venkataraman K.A.Subramanian	Kolkata
			Odonata		K.A.Subramanian Rajappa Babu Gaurav Sharma Emiliyamma Jaffer Palot S.S.Talmale, S.Nandy	Kolkata, Jodhpur, Kozhikode, Jabalpur
			Plecoptera		K.A.Subramanian	Kolkata
			Orthoptera		G. Srinivasan, S.K.Mandal, Kavitha Yadav	Kolkata
			Phasmida		G.Srinivasan	Kolkata
			Embioptera		Kailash Chandra	Kolkata
			Blattariae		S.Prabhakaran S.K.Mandal,	Chennai, Kolkata
			Mantodea		P.M.Sureshan, Sreekanth Jadhav	Kozhikode, Pune
			Isoptera		Nivedita Saha, Jayati Basak	Kolkata
			Pscocoptera			Not available
			Hemiptera		G.Thirumalai Animesh Bal Hassan P.C.Saha Smt M.Ghosh B.Biswas	Kolkata, Chennai
			Thysanoptera		Vikash Kumar N.Pramanik	Kolkata
			Neuroptera		M.Majumdar	
			Coleoptera	Scarabaeidae	Kailash Chandra	Kolkata
				Inopelpidae Cucujidae	T.K.Pal	Kolkata
				Aquatic beetles	Deepa Jaiswal, K.A.Subramanian, S.K.Ghosh	Kolkata, Hyderabad
				Tenebrionidae Cerambycidae	V.D.Hegde	Kolkata

				Hydrophilidae Histeridae	P. Mukhopadhyaya	Kolkata
				Staphylinidae	Abha Sar	Kolkata
				Coccinelidae	S.K. Chakraborty	Kolkata
				Chrysomelidae	O.P. Srivastava	Kolkata
				Gyrinidae, Dytiscidae Noteridae	S.K.Ghosh	Kolkata
				Carabidae	S.K.Kushwaha	Kolkata
			Strepsiptera		P.K.Chaudhury	Kolkata
			Mecoptera			
			Siphonaptera			
			Diptera		Dhriti Banejee C.Radhakrishnan R.M.Sharma Bulganin Mitra K. Ilango Sweta Padma Dash R.S.Mirdha K.Bhattacharya	Kolkata, Kozhikode, Chennai, Gopalpur
			Lepidoptera	Microlepidoptra	Avtar Kaur Sidhu	
				Moths	Kailash Chandra S.Sambath Bulganin Mitra	Kolkata, Jabalpur,
				Butterflies	C.Radhakrishnan, Kailash Chandra, R.M.Sharma, Avtar Kaur Sidhu, Naresh Sharma, K.A.Subramanian, Gaurav Sharma, Pramod, Jaffer Palot	Kolkata, KozhikodeDe hradun, Solan, Jodhpur
				Arctiidae	M. Majumdar, Navneet Singh	
			Trichoptera		M.Majumdar, K.A.Subramanian	Kolkata
			Hymenoptera	Formicidae Chalcididae Sphecidae Encyrtidae	S. Sheela, S.I.Kazmi Girish Kumar	Kolkata
				Vespoidea	G.Srinivasan	Kolkata
				Pteromalidae	P. M. Sureshan,	Kozhikode
				Chalcidoidea	P. M. Sureshan, K. Rajmohana	Kozhikode
				Chalcidoidea	P.M.Sureshan	Kozhikode
				Proctotrupoidea & Platygastroidea	K. Rajmohana	Kozhikode
33	Mollusca				R.Venkatesan, Basudev Tripathy,	Chennai, Kolkata

					A.K.Mukherjee, A.Mahapatra, Md.Hafiz	
34	Echinodermata				C.Raghunathan	
35	Hemichordata					Not available
36	Chordata	Pisces			Rema Devi, K.C.Gopi, N.Sen, D.V.Rao, S.S.Mishra, S.S.Jadhav,S.Kar, S.C.Soren, A.Das, Indu Sharma, P.T.Rajan	Chennai, Kolkata, Shillong, Pune, Port Blair, Hyderabad
		Amphibia			C. Radhakrishnan, Dinesh, Kaushik Deuti, Anand Kumar	Kozhikode, Kolkata, Hyderabad
		Reptilia			C. Radhakrishnan, Angels, B.H.C.K.Murthy, Archana Bahuguna, Indu Sharma, Varadaraju, Jafer Palot	Kozhikode, Chennai, Dehradun, Solan, Kolkata
		Aves			P.C.Tak, J.P.Sati, Maheshwaran. G, Sanjeev Kumar, Anil Kumar, Uttam Saikia, Sivaperuman Jaffer Palot, K.A.Subramanian, R.Shakthivel	Dehra Dun, Itanagar, Solan, Kozhikode, Kolkata, Port Blair
		Mammalia			J.K.De, P.L.Kankane, S.S.Talmale, , Uttam Saikia, P.S.Bhatnagar, Archana Bahuguna, J.P.Srivastava, M.K.Gosh, N.K.Sharma	Kolkata, Jabalpur, Solan
37		Paleozoology			M.K.Naik, B.Talukadar, B.Baraik	Kolkata
38		Cytotaxonomy			S.Rath	Kolkata
39		Molecular Taxonomy			Vikas Kumar	Kolkata
40		Taxidermy			Arun Gupta	Kolkata