

## **Draft Report of the Task Forces constituted to make Recommendations to the Government for Strengthening of Botanical and Zoological Surveys of India**

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## **1) Executive summary**

The strategic action plan, outlined in section 14, provides an Executive Summary of this report.

## **2) Terms of reference**

The terms of reference for the Task Forces are as follows:

- (i) Review the existing mandate, objectives, organizational structure, manpower and infrastructure in order to strengthen their scientific and technical capacities;
- (ii) Render suggestions for formulation of a strategic Action Plan;
- (iii) Provide recommendations for conceptualization of Vision Document, 2020;
- (iv) Redefine priorities and programme of BSI/ZSI; and
- (v) Suggest measures for strengthening of BSI/ZSI for effective utilization of special grants of Rs. 15 crores each allocated to BSI/ZSI during CFY, 2009-10.

## **3) Introduction**

We live in a land rich in diversity of life, India being one of the twelve megadiversity countries of the world. This biodiversity is vital to our well-being, for ours is still a biomass-based civilization. Many Indians cultivate a wide range of species and varieties, consume wild fruit and fish, use fuel-wood to cook their meals and grass to thatch their huts and cowsheds, extensively employ herbal remedies. Some even worship peepal trees, hanuman langurs, king cobras and a variety of other life-forms, while others protect sacred groves or ponds. We are also a nation rich in knowledge of uses of our living resources, ranging from the classical traditions of Ayurveda, Siddha and Yunani, to folk medicinal practices and uses of vegetable perfumes, cosmetics and dyes. But our country's biological diversity resource base is under threat, with

extensive destruction of natural habitats, widespread degradation of agro-ecosystems and a growing burden of air and water pollution. Simultaneously, India's knowledge base of uses of biodiversity is also being eroded, with the younger generation, even in rural and tribal tracts becoming increasingly alienated from the natural world. At the same time, teaching of biological diversity in our colleges and universities is on the retreat, with taxonomy and related disciplines being phased out of biology syllabi, and newer courses like biotechnology supplanting botany and zoology. There are glaring gaps in the taxonomic expertise available in the country, with no replacement in sight for experts on many groups retiring from Botanical and Zoological Surveys, the premier institutions of taxonomy in the country.

This is happening at a time when technological advances have greatly enhanced the potential of uses of biodiversity. We can now transfer genes across organisms, so that silkworms may be made to produce spider silk that is stronger than a steel fiber of the same diameter. All of this means that organisms thus far considered useless or worse may turn out to be of considerable applied value. Such organisms may be present anywhere, even in highly degraded habitats.

The wealth of strains of domesticated plants and animals on our farms and in the camps of our cowherds and shepherds also holds much promise. India's hardy cattle breeds saved Brazil's livestock industry from collapse in early decades of last century. Few decades ago, a variety of rice from Pattambi in Kerala saved South-east Asia's paddy crop from being devastated by an insect pest, brown plant hopper. Our hill chain of Western Ghats has a greater diversity of wild relatives of cultivated plants than any other region of comparable size in the

world. Much of this diversity of domesticated organisms and their wild relatives is also being rapidly lost.

Life in our rivers, lakes, estuaries and the seas is under even greater stress than that on the land. With all attention focused on culturing of a few species of economic interest like carps and tiger prawns, there has been little thought devoted to conservation and prudent use of India's aquatic biodiversity. Yet pharmaceutical companies now believe marine organisms to be the greatest treasury of bioactive compounds on the earth.

It is clear that we need to look after the ecological well being of our lands and waters, not only of the few remaining natural forest habitats, but also of our farm lands and irrigation tanks, of overgrazed pastures and eroded hill slopes. We need to carefully plan on conserving, sustainably using and restoring the biological diversity across the length and breadth of the Indian sub-continent. This calls for the many different components of our society working hand in hand. The center-piece of this effort will have to be scientific documentation of the biological diversity, led by experts from the Botanical and Zoological Surveys. But, it is important that these experts collaborate with taxonomists working in Universities and other research institutes, as also with scientists working in related areas of systematic biology, and even with common people dealing on a daily basis with biodiversity resources of their surroundings.

#### **4) Collaborative knowledge generation**

A few years ago, John Maynard Smith, one of the most distinguished evolutionary biologists of twentieth century wrote an important book called the 'Major Transitions in Evolution'. He proposed that the saga of life on earth may be visualized as involving a series of major transitions, with organisms evolving capabilities of handling ever larger quantities of newer and

newer kinds of information. This is now culminating in the present day Information and Communication Technology revolution that has brought us to the threshold of yet another major transition, namely from *Language based human societies –to- Human societies with global access to the entire stock of human knowledge*, and engaged in an endeavour of *collaborative knowledge generation*. IT-savvy Indians have begun to take advantage of such possibilities; for example, an excellent Indian attempt along these lines is the Google e-group- Indiantreepix, devoted to creating awareness, and helping in identification along with discussion on and documentation of Indian Flora. Here information is shared on a real time basis for the benefit of all stakeholders, minimizing delays and hastening information exchange. The group follows a multi-disciplinary approach with membership from diverse background. Anyone interested is welcome to join this e-group <http://groups.google.co.in/group/indiantreepix?hl=en> and post photos of a plant (along with place and date) for identification, discussion, and sharing. Every species discussed gets included in the Indiantreepix Database that currently covers more than 2100 species.

Naturally, taxonomists worldwide have begun to take advantage of these possibilities, and developed a number of web-based applications such as checklists, floras and faunas, and interactive identification keys. While the information is universally accessible, editors and authors with permissions can correct and update the data with the use of web forms, permitting world wide, yet well regulated, collaboration. An effort of particular interest to us is that of the Flora of China. This collaboration has involved several hundred botanists and computer experts, working in many different organizations worldwide and has made remarkable progress, generating excellent information on many Indian plant species as well.

### Flora of China experience

Now, through the World Wide Web, botanists are able to instantaneously provide checklists and floras to users worldwide and update them as the taxonomies of the groups are revised and further data are gathered. Several current flora projects provide online treatments: the *Flora of Australia* (Orchard & Thompson, 1999–), *Flora Europaea* (Tutin & al., 1993–), *Flora Zambesiaca* (Exell & Wild, 1960–), *Flora Mesoamericana* (Davidse & al., 1994–), *Flora of China* (Wu & Raven, 1994–), and the *Flora of North America* (Flora of North America Editorial Committee, 1993–). This web-based program called *eFloras* (URL: [http://www .efloras.org/](http://www.efloras.org/)) was developed to enable access to online “electronic” floras. Through a web interface to the data, users can browse online floristic treatments by volume, family, and genus, and can search by name, distributional data, and text. With the use of web forms, editors and authors with permissions can correct and update the data of the *Flora of China Checklists*.

Online checklists provide an invaluable source of plant names and publication data at local, regional, and global scales. The *Flora of China Checklist* is a database searchable via a web interface ([URL:http://mobot.mobot.org/W3T/Search/FOC/](http://mobot.mobot.org/W3T/Search/FOC/projsfoc.html) projsfoc.html) at Missouri Botanical Garden. It is a systematic reference that will contain all of the scientific names that have been published for China. The Checklist contains all of the scientific names of species, combined with their distributions in China (at the provincial level) and adjacent, bordering countries, the elevations at which the plants grow, botanical synonyms, bibliographic citations, and endemism. The scientific names are dynamically linked to other available data, such as volume: page and illustrations in the *Flora Reipublicae Popularis Sinicae* (FRPS) and FOC.

The FOC Project verifies the original citation of each name, and records the publication data according to recognized taxonomic standards. Many collaborators on the FOC project, and other botanists, who do not have access to all of the relevant literature, have found the checklist valuable for their work. Verification provides scientists with reliable citation information as to whether or not a name is validly published. It is estimated that the checklist will contain a total of about 135,000 botanical names, including synonyms.

The *Flora of China* Web (URL: <http://flora.huh.harvard.edu/china/>) provides a regularly updated newsletter, introductory information, floristic treatments (databased descriptions in HTML and PDF formats, and illustrations), interactive keys for identification, botanical papers pertaining to the FOC published in the journals *Novon*, *Annals of Missouri Botanical Garden*, and *Harvard Papers in Botany*, related searchable data (e.g., the FOC Checklist, the Hu Card Index), images, links to the FOC illustrations, guidelines for contributors, and information on editorial centers and the people involved in the Project.

Web-based interactive identification keys such as DELTAINTKEY (Dallwitz, 1980; Dallwitz & al., 1993–, 2002–); and ActKey (Brach & Song, 2005) present a simple alternative to lengthy, indented or bracketed keys. An online interface to interactive identification keys should enable users to select easily observable and readily available characteristics to identify a specimen.

It is imperative that Indian scientists look to the future, take full advantage of the possibilities opened up by such Web 2.0 technologies, as well as imbibe this inclusive spirit of sharing and generating knowledge in a collaborative fashion. Hence, a major focus of our Task Force recommendations will be on promoting institutional mechanisms and creating infrastructure to

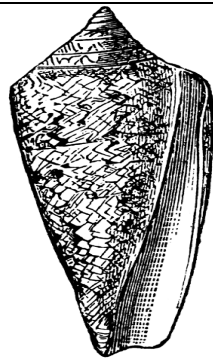
facilitate collaboration. After all, amongst areas of major interest to Botanical and Zoological Surveys are many inter-disciplinary areas such as plant-pollinator syndromes, parasitism, herbivore –plant interactions, keystone species, and mutualisms. The collaborations should be across scientific disciplinary boundaries, amongst institutions, and amongst individuals. In particular, the endeavour should embrace the more inclusive discipline, that of Systematics.

**Systematics** is the study of biological diversity and its origins, focusing on understanding evolutionary relationships among organisms, species, higher taxa, or other biological entities, such as genes, and the evolution of the properties of taxa including intrinsic traits, ecological interactions, and geographic distributions. Systematics is also concerned with the development of methods, including numerical methods, for various aspects of phylogenetic inference and biological nomenclature/ classification.

In other words, along with taxonomy, the Task Forces have kept in view cognate disciplines including evolutionary biology, biogeography, ecology, conservation biology, and behavioural biology, employing traditional as well as modern molecular and quantitative - computational techniques. Indeed, we recommend that Botanical and Zoological Surveys of India should build on their earlier experiments of working in synergy with collaborators as in the cases of the Silent Valley survey, the Grand Himalayan Expedition and great Nicobar Expedition with the Geological Survey. In fact, the Botanical and Zoological Surveys should become the hubs of a network of taxonomists and scientists working in related disciplines within India at two levels, that of scientists and of 'barefoot ecologists'. We may refer to this as the Biodiversity Network. Apart from the Surveys, the scientific institutions in the Biodiversity Network may include some

Ministry of Environment & Forest (MoEF) institutions like FRI, WII, SACON, National Museum of Natural History, Regional Museums of Natural History, ICAR institutions like IARI, University Departments like Departments of Botany and Zoology at Acharya Nagarjuna University, AMU, BHU, Calcutta, Calicut, Delhi, NEHU, Punjab, Patiala, and Shivaji, Universities, Forestry Departments in many State Agricultural Universities, state government institutions like KFRI, laboratories like CCMB, TBGRI, NBRI and NCBS, NGOs like BNHS and ATREE etc. It may be stressed that this is only an indicative, and by no means a complete list. The Biodiversity Network should also bring in individuals, retired scientists as well as amateurs, who may not necessarily have an institutional affiliation. This Biodiversity Network should play a key role in capacity building with a two-way interaction, of experts in allied disciplines, e.g. in molecular taxonomy from NCCS training BSI/ZSI taxonomists, and the BSI/ZSI taxonomists training fellow scientists like ecologists at NEHU. The Network should also extend beyond the national borders, and try to engage South Asian, as well as Southeast Asian countries.

The Information Management Systems of the two Surveys should also be linked to national networks like DBT's India Bioresources Information Network (IBIN) and NBA's India Biodiversity Information System (IBIS).



**Cone Collaboration**

Cone snails are marine gastropods that are amongst the most venomous organisms on earth. Their venom has immense medical importance. Our Indian coast is rich in cone snails with a large number of species. A team of scientists from TIFR and Centre for Fisheries Education and Research (Mumbai), Andhra University, Marine Biology Laboratory (Porto Novo), IISc, NCBS (Bangalore), St. Stephen's College (Kollam), Marine Research Institute (Tuticorin), Metavom Bioinformatics Pvt. Ltd., University of Barcelona, University of Utah and Dublin University are working on taxonomy, venom characterization, protein chemistry, molecular biology, pharmacology, genomics and molecular phylogeny cone snails. This team of scientists has published 18 internationally peer reviewed papers (including papers on taxonomy and morphology) on Indian cone snails and acquired two international patents since 2004. Many students have worked for their Ph.D. or post doctoral fellowships through this multi-institutional and multi-disciplinary collaboration.

Of course, we will have to bear in mind in the fact that the world is not an entirely open place and that there exist considerations such as Intellectual Property Rights, and sovereign rights of the country over its genetic resources as reflected in India's Biological Diversity Act. However, most of the activities sketched below can and should involve open and transparent collaboration, both within the country, as also internationally.

## 5) Barefoot ecologists

It is also important for us to take on board the folk knowledge of occurrence, uses and the traditions of conservation of this biological diversity. A significant amount of the knowledge of the status and dynamics of this biodiversity resides with masses of our people, who might be termed as 'barefoot ecologists'. For example, supplies of 700 out of 776 Indian plant species used commercially for preparation of medicines still come from natural populations. There is no proper information on their current status and possible levels of over-exploitation with either Governmental agencies or pharmaceutical industry. The only reliable information on these issues, albeit limited to their own localities, resides with forest produce collectors who are employed by agents of pharmaceutical companies, or with folk practitioners of herbal remedies. Similarly, there is no organized information on the status of the indigenous fish fauna of our freshwaters. Yet such fish constitute an important source of protein, especially for the weaker sections of the society. Again the only source of information on this issue, albeit limited to their own localities, is with our native fisher-folk. The Botanical and Zoological Surveys have some valuable experience of working with such barefoot ecologists, for instance, taking the help of fishermen in conducting surveys for insular biodiversity and coastal and marine biodiversity. This should now be further promoted.

### Indian Biological Diversity Act

The Biological Diversity Act aims to promote conservation, sustainable use and equitable sharing of benefits of India's biodiversity resources. With this in view it provides for the establishment of a National Biodiversity Authority, State Biodiversity Boards and Biodiversity Management Committees at the level of Gram, Taluk and Zilla Panchayats and Municipalities. It

stipulates that every local body shall constitute a Biodiversity Management Committee (BMC) within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animals and micro organisms and chronicling of knowledge relating to biological diversity. Most significantly, BMCs would serve to take science right down to the grass roots, since, the rules lay down that *“The main function of the BMC is to prepare People’s Biodiversity Register (PBR) in consultation with local people. The Register shall contain comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with them.”*

Of course, there are a number of constraints of inadequate infrastructure, and limited capacities of human resources that need to be kept in mind. Fortunately, the on-going rapid expansion of the modern facilities of communication and information technology is beginning to remedy the infra-structural deficiencies. Clearly, it will not be possible in a PBR exercise to go much beyond a limited range of biodiversity elements of human concern: mushrooms and plants that serve as sources of food, fuel, fodder, manure, medicines; honeybees, shellfish and fish, reptiles, birds and mammals that serve as sources of food or are a threat, insect pests of crops, species that attract attention or have a cultural or religious significance, cultivars of crop species and land races of domesticated animals and so on. Teachers and students from local schools, and colleges need to be encouraged to work closely with local communities to take this documentation process forward.

Obviously, it will be quite impossible to rely on the PBR process to get any information on groups of organisms such as litter and soil mites, although these represent some of the most species-rich groups of organisms. Investigations on such components of biodiversity will have to be the entire responsibility of experts. Nevertheless, a great deal of information of applied importance could be generated through focusing on species and varieties of which people are aware and for which they often possess distinctive names. Apart from generating information of direct applied value, as on useful species such as medicinal plants or fish, or harmful species such as insect pests, studies on these better known groups of organisms can, as surrogates, provide clues to the level of diversity in other groups of organisms, and indications of environmental health.

## **6) Turning challenges into opportunities: building district level capacity**

Evidently, people's familiarity and local names, along with support by students and teachers from local educational institutions, are not by themselves a sufficient basis for generating reliable information. We need to firmly correlate the information so collected with scientific names of species. We also need to make sure that people designate ecological habitats properly and record the information in a systematic fashion. Building capacity of community members and students and teachers from local educational institutions to do so and cross checking and validation of the information collected have to be important elements of the PBR process. The PBR process also has to look into building local capacity for computerizing the information, and accessing information through the media of CDs and the internet.

Such capacity building throughout the country at the district level is a challenge that can be turned into a major opportunity for nurturing taxonomy in the country. For this purpose, we need to develop good centers of taxonomy in selected colleges/ university departments covering all of 593 or so districts of the country. This is a task that needs to be jointly addressed by the Ministry of Environment and Forests (looking after the National Biodiversity Authority and the Botanical and Zoological Surveys of India) and the Ministry of Human Resource Development (looking after the University Grants Commission). These Ministries, perhaps with the help of the proposed *Coordinating Group on Systematic Biology*, will have to identify such centers of taxonomy in selected colleges/ university departments in each district, and make special provisions for promoting taxonomic expertise at these centers. These *District level centers of systematic biology* should be charged with building capacity and facilitating preparation of PBRs, as well as development and management of district level biodiversity databases, in collaboration with Zilla Panchayat level Biodiversity Management Committees. These centers may also be linked to the scientific activities of the proposed *Landscape level Biodiversity Monitoring Plots*. In turn these district centers may be linked to suitable *University level Centers of Excellence in Taxonomy*.

The web-based programme called *eFloras* (URL: [http://www .efloras.org/](http://www.efloras.org/)) developed to enable access to online “electronic” floras, and other related software mentioned above may be appropriately adopted for the purpose of developing district level biodiversity databases. The taxonomic expertise at the district level should, at a minimum, encompass biodiversity elements of human concern such as mushrooms and plants that serve as sources of food, fuel, fodder, manure, medicines; honeybees, shellfish and fish, reptiles, birds and mammals that serve as

sources of food or are a threat, insect pests of crops, and species that attract attention or have a cultural or religious significance. The development of such *District Level Centers of Systematic Biology* would require special grants to the identified centers, creation of special faculty positions in taxonomy and grant of pre-doctoral or post-doctoral research fellowships. This may be further backed by special support in form of special grants, creation of special faculty positions in taxonomy and grant of pre-doctoral or post-doctoral research fellowships at certain *University level Centers of Excellence in Taxonomy*. The fellowships may be granted through Botanical and Zoological Surveys of India. The proposed Education and Outreach wings of Botanical and Zoological Surveys may also help these centers through training and in many other ways.

## 7) Coordinating Group on Systematic Biology

To support such an inclusive approach, the MoEF should consider setting up a permanent, open, inclusive *Coordinating Group on Systematic Biology (CGSB)*, charged with building bridges amongst all institutions and individuals interested and active in different facets of Systematic Biology, as also pertinent international efforts such as GBIF. The CGSB, to be chaired by an eminent scientist, may serve as a Clearing House Mechanism to bring together and exchange information on all pertinent on-going scientific activities in the field of Systematic Biology within the country, facilitate such activities, for instance, through helping obtain research permits to work in Protected Areas, ensure coordination and promote collaboration. CGSB should not become another funding agency; that role can continue with existing funding agencies within MoEF, DoS, DST, DBT, UGC and so on, but rather serve to link different

agencies and investigators to enhance the quality of scientific effort. For example, today there is no mechanism to ensure that MoEF is aware of research funded by DBT on biodiversity in Eastern Ghats and vice versa, leading to unnecessary duplication, and even funding of the same work on ground by two agencies without being aware that an investigator is claiming funds twice over for the same piece of research. Nor are project reports readily available to interested researchers, many ending up merely as silverfish fodder on various steel racks in different ministries. CGSB may be served by a small secretariat within the MoEF and be funded for organizing a web-based information resource and clearing house mechanism, and group meetings and brain storming sessions. Specifically, CGSB may initiate its activities by facilitating the preparation of a *Vision document for Systematic Biology* for India. Beyond that CGSB should facilitate the identification and functioning of *District level centers of systematic biology* and *University level Centers of Excellence in Taxonomy* in selected colleges/ university departments, as also establishment and operation of *Landscape level Biodiversity Monitoring Sites* as proposed below. Botanical and Zoological Surveys would, of course, be key players in the functioning of such a Coordinating Group promoting collaborative efforts towards survey, collection, documentation (including the practical, folk knowledge associated with plants and animals) and *ex situ* conservation of wild plant and animal diversity of the country.

The Coordinating Group will also help inform the Minister about the medium and long term changes required in policy and strategy from a biological perspective. These will especially include desired changes in the education system and curricula, in measures to enhance research, conservation and enhancement of biological diversity and knowledge bases. The Group shall in particular also assist, enable and facilitate the ability of ZSI and BSI to meet their

mission by improving access to collections for bona fide researchers and upgrading the quality of their work.

## 8) Mandate

The current mandate of BSI/ZSI is: "Survey, collection, documentation (including the traditional knowledge associated with plants and animals) and *ex situ* conservation of wild plant and animal diversity of the country." It may be better to talk of practical or folk level rather than merely traditional knowledge, since people continually update their understanding of the natural world in course of their day-to-day attempts to obtain a livelihood.

The Botanical and Zoological Surveys should undoubtedly focus on this current mandate of survey, collection, and documentation of wild plant and animal diversity of the country, and to some extent on *ex situ* conservation of wild plant diversity of the country through Botanical Gardens. A thrust on complementary activities of monitoring should now be incorporated in the traditional survey and documentation efforts. Of course, Botanical and Zoological Surveys have, very rightly, never interpreted this to imply that survey, collection, and documentation of wild plant and animal diversity of the country is their sole prerogative. Many institutions, e.g. Bombay Natural History Society, as well as individuals outside the Surveys have made significant contributions in this field, and the two Surveys will continue to function as nodal agencies for the survey, collection, and documentation of wild plant and animal diversity of the country. Science progresses not by avoiding duplication, but by open scrutiny of any phenomenon under investigation by several independent investigators, exchanging the results of their investigations. So the Surveys should strengthen the culture of collaborative surveys, joint collections, and continue to welcome others to work on the BSI/ZSI collections, collaborative

investigations in related fields such as molecular taxonomy and conservation biology, and collaborative publications. This should be done at the level of institutions of advanced scientific education and research, as well as by creating a cadre for assisting grass-roots level Biodiversity Management Committees.

#### Namdapha flying squirrel

An interesting species such as the Namdapha flying squirrel *Biswamoyopterus biswasi* first described by ZSI scientists in 1981, needs to be studied, and widely examined. There is only a single specimen of the species collected in 1981 from one locality in Namdapha NP, and there has been no further study by ZSI. Yet the specimen is not easily accessible to other researchers to study it, and there has been no other investigation as well.

World-renowned experts on flying squirrels, including Dr. Richard Thorington at the Smithsonian Institution, have completed a phylogeny of all flying squirrel species. Sadly only the Namdapha flying squirrel has not been included. The reason: difficulty in access or obtaining permission to study the specimen or obtain a sample for genetic study.

So far as we are aware, no genetic study of the single specimen has been initiated by ZSI or any other institution in India. If this had been done and the gene sequences put up on the NCBI GenBank, then it would be available for study and comparison with other flying squirrel genera and species to understand a) its unique distinctiveness as a separate species, b) its phylogenetic status and relationship with other species, and so on.

The species has been placed in its own separate genus by the author who described it and it is accepted as a scientifically valid species and even listed as Critically Endangered in

IUCN Red Data book. It is also cited as an example of an extreme endemic, being known from only a single area. However, given all this, it is even more imperative that the specimen be studied further through collaboration with other scientists. In addition, as there are several other sympatric flying squirrels in the area, of similar size, it is necessary to assess the current status of this species in the wild, correctly figure out its actual global distribution, and whether it is indeed a separate genus and species. ZSI scientists should be open to collaboration with scientists from other organizations in India and international experts on this group to obtain a better comprehensive understanding of this species and carry their earlier work forward.

#### **Comments from Director, Zoological Survey of India**

As far as the Molecular phylogenetics of Namdapha Flying Squirrel is considered, we have not received any proposal from any one since last three years for its DNA fingerprinting. In fact, I have a MOU signed by Prof. Lalji Singh at the instance of Dr. Shivaji of CCMB for DNA Barcoding of birds and I have already supplied more than 150 samples for analysis. I have also received one request for DNA fingerprinting of the only holotype present in ZSI i.e., *Balaenoptera edeni* and we have given the material for analysis to CCMB. A team of Scientists (15 member team) expedition team was sent to Tawang area of Arunachal Pradesh in the month of October, 2009 for the faunal collection and to assess the distributional pattern of animals including the one described (*Macaca munjala*). Another team of scientists (12 members) were sent to Namdapha for a period of 15 days and just now returned collecting various aspects of faunal distribution. A final report will be made ready within 2-3 months incorporating all aspects. In other words, I am taking the

area (Arunachal Pradesh) and the animal you have already suggested in the report. I am also finalizing a multidisciplinary team for Arunachal Pradesh to be taken when once the winter is over in that area. I have already submitted a proposal and it is approved by MoEF.

## 9) Objectives

The objectives of BSI/ZSI may be classified under two heads, namely as high priority activities that are their main focus, and as activities to be undertaken largely through collaboration. Of course, collaboration should be welcome even while undertaking activities that are the main focus.

### High priority

- Exploration, inventorying and documentation of biodiversity in general and protected areas, hotspots, fragile ecosystems and sacred groves in particular
- Digitization of present collections, preparation of fine scale distribution maps based on primary occurrence data and making it available in a searchable format
- Publication of National, State and District Floras/ Faunas
- Taxonomic studies, revisionary/ monographic studies on selected plant/animal groups
- Identification of Red list species and species rich areas needing conservation and focus on data deficient species to collect more information on populations
- Development of a National database of Indian plants/ animals, including herbarium/ museum specimens, live specimens, paintings, illustrations etc. and maintenance of already existing collections with modern facilities and as per international standards of collection management
- Repatriation of information on Indian plants/ animals held by herbaria / museum collections abroad especially types, protologues, illustrations, paintings, other collections (eggs, nests etc.) and making it available in digital format. This implies creation of a

complete database, including images, for such specimens, and not physically bringing back the specimens.

- Developing and maintaining Botanical Gardens, Museums and Herbaria and using such facilities for conservation education for people especially students on the lines of Smithsonian and Kew Gardens
- Preparation of Seed, Pollen and Spore Atlas of Indian Plants
- *Ex situ* conservation of critically threatened taxa in botanical gardens
- Capacity building in taxonomy, nomenclature, specimen collection, preservation and maintenance through training programmes

### **Activities to be pursued through extensive collaboration**

- Capacity building in broader discipline of Systematic Biology through training programmes
- Survey and documentation of practical, folk knowledge (ethno-biology) associated with plants/ animals.
- Biogeographical and ecological studies
- Chromosomal mapping- DNA fingerprinting- molecular taxonomy. In fact, both BSI and ZSI should join the Barcode of Life Consortium.
- Computer applications in taxonomy
- Nutritional analysis of ethno-food plants/animals and other economically useful species.
- Environment Impact Assessment of specific localities
- *Ex situ* conservation of critically threatened animal taxa through techniques like cell culture

The proposed *Coordinating Group on Systematic Biology* may play a key role in facilitating such collaboration.

## 10) Programmes

### Surveys

As a high priority, BSI/ZSI should follow up on their earlier efforts, including activities related to AICOPTAX, and bring out an up-to-date comprehensive **State of Art Report** to help identify current gaps in knowledge of different taxonomic groups, in knowledge of different geographical regions and habitats and in the availability of expertise relating to different taxa and geographical regions. Based on such an exercise, further work should be specially directed towards under-explored/under-studied groups of organisms such as soil and aquatic invertebrates, helminthes, fungi, and marine microorganisms and plankton communities, and towards under-explored regions such as greater parts of the North-Eastern Region of the country, Eastern Ghats, or offshore marine realms.

It is now abundantly clear that teamwork yields far greater dividends in the world of science. A team of an ecologist, an algologist, and an ichthyologist surveying freshwaters of Nilgiris or Manipur river system can undoubtedly yield far more in terms of scientific insights, or a credible Environmental Impact Analysis, than the three of them working independently. Such collaboration would be of particular value in applied contexts such as assigning conservation priorities. The collaborations can also save a great deal in terms of financial resources required. Therefore, the Surveys should now take further their earlier initiatives at collaborative work and start proactively seeking partnerships and collaborative activities. The *Coordinating Groups on Systematic Biology* should play a key role in facilitating such partnerships.

World over research in systematics has undergone a paradigm shift, to take advantage of technological advances, as also in recognition of the fact that there has been a serious

depletion of biological diversity over much of the world. Such a shift involves a move from wet and dry collections to digital libraries, minimizing unwarranted collections, especially of common species; instead documenting their existence digitally using photographs, sound recordings, and collection of supporting evidence/voucher material, like feathers, quills, fecal matter, shells (mollusks), sloughs (snakes), etc. This should be coupled to digital photography of landscapes, habitats and microhabitats, and careful recording of the study locations with help of GPS instruments. BSI/ZSI have, of course, begun moving in these directions. This should now be promoted further ensuring that all scientists are equipped with digital cameras, portable tape recorders and hand held GPS instruments, and trained in relevant techniques.

A great value of the information collected by ZSI and BSI is to help in conservation - which means that this data should be of use for monitoring changes in biodiversity over time. At present, this is only partially possible, because the reports and outputs are neither completely spatial, nor explicitly temporal. There is a need to revise future collection strategies so each collection record has an explicit spatial location and time of collection attached to it. Consider some instances of when this may be important. For instance, if a study in Arunachal Pradesh has catalogued a list of species - and a new study comes along 5 years later and fails to record these. Unless we know the time, date and exact location - we don't know if these species have become locally extinct, or if we have just missed the breeding/migratory seasons, or it is a microhabitat specific species. Similarly, there is a critical need for new specimens to be collected with lat/long information using a GPS. Following this, in the collaborative research activities, it would of course be good to work with labs working on landscape ecology,

biogeography, GIS and remote sensing so that these activities can be used to add value to the current data.

## **Flora and Fauna of India**

The primary mandate of the BSI/ZSI is to document the plant/ animal resources of the country. Hence an important focus of their activity would be to complete the Flora/ Fauna of India. The web-based Flora of China project mentioned above suggests how we may effectively use new technologies and mount a collaborative effort, and this model should be carefully examined and adopted to suit our conditions. India has produced a large number of fine taxonomists, many of whom work outside BSI/ZSI, e.g., universities, research organizations and as emeritus scientists. Therefore, it is important that BSI/ZSI now take on the role of coordinating and pooling the expertise of all the taxonomists including those working outside this organization to consolidate the **Flora and Fauna of India volumes**. This is particularly important because the local field biologists and experts who have spent a considerable amount of time in a particular geographical area can add tremendous information on habitat, associations, biogeography and population status. Floras/ Faunas written by the individuals having limited field knowledge, merely based on the museum/ herbarium specimens lack in such information. Coordinated work on Flora/ Fauna of India should also include all the works on various taxonomic groups done through AICOPTAX Project of MoEF. Such coordination would of course require a strong editorial board and a few full time dedicated executive secretaries. This should be achievable in 10 years and should figure out as **Priority I** in BSI/ZSI's Vision 2020 document. The task could be organized either on a state-wise basis, or,

if possible, on the basis of biogeographical regions such as Indian desert, Eastern Ghats, or Andaman-Nicobar islands, and so on. The following steps are suggested to achieve this task:

- i. Establish a panel of experienced and active taxonomists for each state/ biogeographical region and obtain their consent to participate in Flora / Fauna Project.
- ii. Prepare an annotated checklist of vascular plants and other taxa under consideration for each state/ biogeographical region based on all published documents and herbaria/ museum collections, giving local names, if any, locality and habitat.
- iii. Make available the electronic version of checklists to the general public; and circulate it among the panel of botanists/ zoologists who would, in turn, check for omissions, ambiguities, localities and habitat through active consultation with other local botanists/ zoologists.
- iv. To begin with, state/ regional floras/ faunas should be published electronically giving correct names, basionyms, localities, habitat, sketches and photographs of important species on an interactive 'Flora/ Fauna of India website'. All naturalists, photographers and biological artists should be encouraged to contribute information on taxonomy, local names, distribution, natural history, biology, ethnobiology, etc. to this dataset. This will also act as an outreach programme for all the biologists, and other interested public. The ethnobiological surveys should be done mainly by the local biologists, college and university teachers, working with local Biodiversity Management Committees under technical guidance by BSI/ZSI.
- v. An editorial board may be constituted at the national level to decide the format of the flora/ fauna and also assign plant/ animal families for compilation which should include nomenclature, description, ecology, natural history, distribution, sketches and photographs.

### **Permanent Biodiversity Monitoring Sites (BMS's)**

It is notable that many recent conceptual advances in Systematic Biology such as the Theory of Island Biogeography, now an important element of Conservation Biology, can be directly or indirectly traced to permanent plot studies initiated in Panama and Costa Rica by a consortium

of international organizations starting in 1960's. Notably, Smithsonian Institution, which is extensively involved in taxonomic studies, has taken a lead in establishment of such plots, beginning with one on its own long term research site of Barro Colorado Island. Furthermore, these permanent plots have served as on field training centers for a whole new generation of ecologists, systematists and conservation biologists from many parts of the world. In addition, this model of a multi-disciplinary and-multi institutional collaboration has encouraged the establishment of permanent vegetation plots across the globe including in India. Such studies have made a major contribution to our understanding of biodiversity.

Moreover, in the present day context of anticipated climate change and its immediate and long term impact on biodiversity, as well as accelerating pace of other human interventions such as dams, it is essential to monitor the components of biodiversity across regions and ecosystems. The MoEF, which is already associated with the "Preservation Plots" of Forest Research Institute, should undertake the establishment of such plots, perhaps with the help of its proposed *Coordinating Group on Systematic Biology*. BSI and ZSI with their extensive experience in biosystematics and presence of regional centers in all the biogeographic zones of India should be important players in the selection, establishment and operation of this system of permanent landscape level *Biodiversity Monitoring Sites* (BMS's). These BMSs may be linked to the proposed *District Level Centers of Systematic Biology*, which should, in turn, be linked to the proposed *University level Centers of Excellence in Systematic Biology*.

The plots may be so selected as to cover all representative ecosystem and landscape types, both natural and human impacted, in such a fashion that the initial set begins by including representatives of all biogeographic subregions within the country, and is gradually augmented

by covering all the natural and human impacted ecosystem and landscape types of the country, then all the states, and finally every district. These BMS's can function as an on site training facility for students, amateurs and professionals in current techniques in systematics, ecology and conservation biology. Moreover, such plots should attract researchers from allied sciences streams such as climate science, sociology, anthropology etc., to address various questions pertinent to biodiversity conservation. The data generated through BMS's will have immense scientific and management value.

### **Information management**

1. All the regional centers and headquarters of BSI/ZSI should be interlinked through a computer network. Eventually such a computer network should come to link all centers working in systematic biology within the country.
2. BSI/ZSI should undertake digitization of present collections, prepare fine scale spatial and temporal distribution maps based on primary occurrence data (as gathered from specimen records). It should be ensured that: (a) Each and every specimen is properly incorporated, accessioned, digitally recorded. (b) Duplicate specimens are carefully maintained and protected for future studies. This information should be made available in a searchable format. In this exercise, high priority should be assigned to the oldest collections.
3. BSI and ZSI should develop a uniform geospatial data base for both the organizations. To extract biodiversity information on any spatial or temporal scale, BSI and ZSI databases can then be queried separately or together using web based search engines or interactive maps. The results so produced can be similar or compatible (using same map codes, indexes and other geographic standards) to the Survey of India top sheets at various spatial scales (1:25,000, 1:50,000 etc). The low spatial resolution data can be made available free and the high resolution data can be priced. The high resolution data will be very useful for EIA and other studies.

4. Electronic catalogues complete with various related information should be developed on urgent basis and continuously updated. Electronic catalogues of flora and fauna, accessible on the web with,
  - a. a standard hierarchy,
  - b. information on all (or at least as many as possible) specimens of the species and their location in diverse national and international collections,
  - c. previous name changes, protologues,
  - d. photos of type,
  - e. illustrations,
  - f. detailed high quality digital photographs showing key characters from specimens, a detailed all inclusive description, and
  - g. a precise distribution map-are minimum requirements.
5. Collection inventory and management should be computerized using open source softwares such as Specify 6.0 ([www.specifysoftware.org](http://www.specifysoftware.org)), or other appropriate software capable of handling the diversity and magnitude of data.
6. This inventory should be rigorously edited by national and international experts. The taxonomic hierarchy and nomenclature used should be updated and mappable with the international standard systems used in digital catalogues. Electronic searchable keys are a must for each group.
7. Unpublished data from earlier surveys, collection records should be reviewed and suitable ones made available to avoid work duplication and waste of survey money.
8. Archival material such as field diaries from the earliest times should be digitized and made available in a searchable format on the web.
9. Taxonomic hierarchy used should be rigorously reviewed as against the international standards
10. BSI/ZSI should consolidate their periodicals/journals into a few publications to bring out short and long papers/communications in taxonomy of both plants and animals. These journals should have an international editorial board, strong and transparent peer review mechanism, stringent quality standards and should go online in the

manner of Botanical and Zoological Journals of Linnaean Society, London. Hard copy publication may be retained only where essential as per requirements such as of International Code of Zoological Nomenclature. This will save a lot of time and financial resources.

11. Duplication of data in various publications for instance, publication of state floras, followed by district floras etc. should be avoided. Data such as regional checklists, range extensions within the country, should preferably be included only as digital database, which can be published on the web, and as CD/DVD periodically.
12. The journals and other occasional publications should go online and could be part of Public Library of Science (PLoS).
13. Heritage publications and drawings should be digitized and could be part of Biodiversity Heritage Library project.
14. There are many Ph.D. theses/ reports on district floras and revisionary works remain unpublished. These should be carefully updated and published.
15. BSI/ZSI may facilitate preparation of an inventory of collections at Colleges, Universities, and other institutions, as also with private individuals and organizing a computerized and geo-referenced database pertaining to these. Wherever essential arrangements should be made for acquiring these collections and funds should be earmarked for this purpose.
16. ZSI/BSI should support other collections of world repute like National Forest Insect Collection and Dehradun Herbarium, both at FRI, Dehradun; National Pusa Collection, IARI, New Delhi, etc. in term of taxonomic literature, sharing of knowledge, their enrichment and modernization.
17. BSI/ZSI must give a thrust to repatriation of Indian biodiversity information, especially types, protologues, illustrations, paintings, other collections (eggs, nests etc.) held in the Herbaria and Museums abroad. This information should be made available in digital format. A webinar should be carried out for identifying the priorities of data repatriation. It may be noted that this proposes repatriation of information, not of actual material.

18. BSI/ZSI must concentrate on developing a “Cybertaxonomy” base for Indian biota.  
This would entail creation of a database providing the original citation and full history of synonyms of each name, along with the publication data according to recognized taxonomic standards.
19. There are several significant on-going initiatives in India on developing Biodiversity Information Systems. CSIR has developed a database called INDFAUNA that can serve as a starting point for ZSI’s database activities. The Department of Biotechnology, Gol has established an Indian Bioresources Information Network (IBIN) and the National Biodiversity Authority is initiating the development of an Indian Biodiversity Information System (IBIS). The BSI/ZSI database activities should be closely linked to and developed in collaboration with these initiatives.
20. BSI/ZSI must enhance, improve and upgrade ease of access to their collections for bona fide researchers and students. The evolution of new and more user friendly procedures is a must given persistent reports of difficulties in accessing collections. Care is to be taken to ensure no misuse of the resources. The Surveys may review the procedures with adequate open consultation and in consultation with the CGSB put new procedures into operation at the earliest. The rules should be transparent and facilitate research.

#### Cyber-Taxonomy for India

Much of the taxonomic work relies on the ‘printed literature’, and protologues, most of which are often isolated from, and inaccessible to, most taxonomists (especially for those in developing countries). Most of the critical information needed for the taxonomic resolve is held up in old and scattered type specimens, which again are not always easily accessible. These difficulties have constrained the interactions among the taxonomic workers across the world in general and in developing countries such as India in particular. Thus taxonomic work is often isolated and or polarized, consequent to which the spirit of global taxonomy, a feature that

taxonomic work demands, is lacking. Taxonomists have frequently identified this as a limiting factor for their work.

With the advent of new tools for compiling, processing and serving information, several of the hurdles faced by the taxonomists, especially by those in the developing countries, can be greatly overcome by the establishment of a cyber-taxonomic space. Cyber-taxonomy is envisaged as a web based single platform where all the taxonomists working in a group of organisms can gain access to virtual *e-herbarium/museum* that has all the relevant images, data and information on specimens and literature (*e-types, e-data and e-library*). This virtual herbarium/museum would facilitate the global set of taxonomists working on that group to refer, interact, agree or disagree upon the taxonomic issues as a unified working group so that they can together arrive at a globally consensus list of checklists, names and associated features which will be kept track of continuously on the web. Making these details available in a single window would also help non-taxonomists to keep track of the names and details of the organisms so that the difficulties that are being faced at present can be avoided.

Such a facility is most immediately required for a country like India and we should assume leadership in setting up a cybertaxonomic space for the entire Asia given our IT strengths. To begin with, the efforts can be initiated on specific groups or families with a plan to eventually integrate them. BSI and ZSI can set the following specific objectives to begin with for this purpose:

1. Establishment of required hardware, software and interactive space for the cyber-taxonomic work.
2. Compilation and digitization of relevant datasets, type specimen, other images, taxonomic text, protologues etc., to create e-details (*e-types, e-data and e-library*).

3. Development of a *web-version* of the checklist of species and loading them with *e*-details on the web.
4. Capacity building among the taxonomists to use, and work on the Cyber-taxonomic space.
5. Facilitate the taxonomic work on the web version of the checklist.
6. Develop a system of updating the web-version of checklist and the *e*-details regularly.

## Survey Manuals

BSI/ ZSI should update and further standardize their survey manuals dealing with different taxa and ecosystems incorporating current quantitative and qualitative survey techniques through broad-based expert consultations, in light of modern scientific and technical advances. These standardized survey techniques should be implemented across regional centers and programmes for uniform data collection.

BSI/ ZSI may interact with University departments to promote development of a series of manuals relating to survey, documentation and monitoring of biodiversity. Such manuals may cover:

- Quantitative floral/ faunal diversity assessment techniques. Introduction to softwares for quantitative floral/ faunal diversity assessment. Stratified sampling techniques.
- Biogeography; focus on Indian subcontinent; major regions/provinces; history & endemism; adaptive radiation and vicariance
- Landscape ecology; the significance of geographic scale; basics of cartography and remote sensing; Using and interpreting toposheets and other maps.
- Introduction to Geographic Information System (GIS). Use of GIS in designing biodiversity surveys.
- Collection/survey; designing a field study; choosing sites; the importance of species-area/effort in deciding the area and intensity of surveys
- Sample size selection.

- Survey protocol selection.
- Surveying techniques for different groups of organisms
- Preservation techniques; dry collections, wet collections, taxidermy, hair samples, fecal samples, etc
- Field identification techniques; digital collections; secondary evidence of species presence
- Classical taxonomic procedures; codes of biological nomenclature; systematics
- Assessing rarity; simple ways of ranking species by their commonness or rarity
- Folk systems of classification; trade names
- Environmental Impact Assessment: biodiversity attributes; Invasive species and bio-indicators; species with high conservation value
- Processing and storing of data
- Data organization
- Data analysis tools-sofwares.
- Interpreting results and data presentation

## Field guides

The Surveys have so far not been very actively involved in production of field guides and field identification keys to groups of organisms of interest to general public; the many excellent field guides available today have all been written by outsiders, often amateurs, as in case of 'Trees of Delhi', or 'Birds of Western Ghats, Konkan and Malabar'. A new thrust will have to be on production of such field guides and keys, in printed as well as electronic versions, not just in English, but in all local languages to support the work of Biodiversity Management Committees at district, taluk and Municipality/ gram panchayat levels. For this purpose, assistance may be sought from the translation programme of the National Translations Mission and from state governments.

## Other activities

Surveys should organize revisiting the **Type Localities** of threatened or unique plants/ animals, revalidation of taxa and population estimation of species listed in Red Data Books, and drawing *in situ* conservation plans in collaboration with the State Forest Departments, Botany Departments, Regional Institutions, NGOs and NGLs. This would require a dedicated team within BSI/ZSI, who should be encouraged to collaborate with the state and local institutions, as well as grass roots taxonomists for long term monitoring of rare plant/ animal populations. This activity should be linked to the functioning of *District level centers of systematic biology* when these are established.

*Ex-situ* conservation programme of rare species would require revamping. All the Botanical gardens maintained by BSI as well as other agencies in the country need to be brought under a **National Network of Botanical Gardens and Arborata** for exchange of germplasm, rehabilitation of rare and threatened taxa within the gardens located closest to the natural habitat. Several volunteers, horticulturists, private land owners and biotechnologists in the country may like to join this venture, and should be welcomed.

## 11) Organizational structure

Science flourishes in a free atmosphere. Hence it is essential that we expeditiously move towards conferring autonomy on the Botanical and Zoological Surveys of India, on the pattern of the Council for Scientific and Industrial Research. We propose that this may be based on the following elements:

1. BSI and ZSI should be reorganized as a **registered, autonomous society** on the lines of Council of Scientific and Industrial Research (CSIR).
2. The Minister for Environment and Forest shall be the President of the Society.
3. The Deputy Minister for Environment and Forest shall be the Vice-President of the Society.
4. The Society shall have a governing body of which the Minister for Environment and Forest shall be the President.
5. Separate rules and regulations for the Society shall be framed by a duly appointed committee.
6. The committee shall in consultation with the scientists and administrative staff frame the rules and regulations regarding the service conditions and disciplinary aspects of the staff.
7. BSI and ZSI shall have a common Director General, who shall be either a Botanist or a Zoologist.
8. The Director General shall be appointed based on the recommendation of the duly constituted search committee.
9. The appointing authority of the Director General shall be the Prime Minister as in the case of CSIR.
10. BSI and ZSI shall have separate Directors at their head quarters.
11. BSI and ZSI shall have separate Research Advisory Committees (RAC).
12. All the research programmes of BSI and ZSI shall have the approval of RAC.
13. The RAC shall review the progress of the research programmes of all the centers under BSI and ZSI periodically.
14. Directors of BSI and ZSI shall be appointed from a panel provided by the search committee constituted for the purpose.
15. The appointing authority of the Director shall be the President of the Society.
16. The Director shall be assisted by an Officer of the rank of Joint Secretary in administrative matters.
17. The Joint Secretary shall be the Head of Administration.
18. Joint Secretary shall in consultation and with the approval of the Director run the administrative and financial matters.

19. To run the Organization, Director shall be assisted by the Joint Secretary, Controller of Administration, Controller of Finance and Accounts and Controller of Stores and Purchase.
20. The Director shall be the appointing authority of Scientists up to F level.
21. The advertisement for the recruitment of scientific staff as per vacancy will be advertised by the Director/ Joint Secretary and the scrutinizing committee appointed by the Director may scrutinize and short list the eligible candidates.
22. The recruitment of the Scientists will be monitored by a recruitment board appointed by the governing body of the Society in which the Director is the Secretary.
23. The recruitment body shall appoint a selection committee consisting of experts in the respective fields in consultation with the Director.
24. The Director or his nominee shall be a member of the Selection Committee.
25. All Scientists of BSI and ZSI shall be assessed for promotion to the next higher grade once in five years.
26. In the case of exceptionally qualified candidates the assessment for promotion to the next higher grade shall be conducted on completion of three years.
27. The Director or his nominee shall be a member of the assessment committee.
28. Officers of the rank of Additional Directors shall head the regional centers of BSI and ZSI.
29. Other stations shall be headed by the Officers of the rank of Joint Directors.
30. The recruitment of administrative staff in BSI and ZSI shall be in the pattern followed by the Ministry of Environment and Forest.
31. However, their service conditions, career advancement opportunities and disciplinary procedures shall be governed by the rules and regulations of the Society.

The recommended appointment of a common Director General, who shall be either a Botanist or Zoologist, for the two Surveys would be in conformity with the world-wide trend of unification of all life related sciences. In our educational system, the University Grants Commission attempted without success to merge the teaching of botany and zoology everywhere into a single subject of Life Sciences in early 1970's. Unfortunately, this did not

make progress. As a result, the option of Biotechnology as a subject at B Sc and M Sc levels, with its much narrower training and neglect of systematic biology, is now eroding into Botany and Zoology, and many colleges are closing the Botany and Zoology departments. In this context, it is notable that recently, a full-fledged sub-unit in CSIR-UGC NET under the title 'Systematics and Biodiversity' has been deleted. As a result there may be a real dearth of graduates in Botany and Zoology proper for recruitment to the Surveys in future. It is also notable that fungi, today looked after by the Botanical Survey, turn out to be biochemically closer to animals than plants and are now placed in an entirely separate kingdom. Furthermore, there is today no agency mandated to systematically explore the microbial diversity of the country. An agency under a single Director General can initiate moves correct these deficiencies.

Science flourishes in an atmosphere of working together. A study published in the prestigious journal 'Science' last year showed that collaborative publications have far more impact than single author works. Hence, the other set of organizational changes needed would be directed towards promoting collaboration, both at the level of advanced science and the grassroots. Such collaborations may involve both national and international partners, with special focus on South Asian and South-east Asian countries. One option would be set up a system of recruiting practicing scientists, for instance a Remote Sensing expert from NRSA, on a deputation basis to BSI/ZSI. As suggested above, the MoEF may set up a *National Level Coordinating Group on Systematic Biology* that will work closely with Heads of Botanical and Zoological Surveys to promote and support interaction with a network of taxonomists and scientists working in related disciplines within India at the levels of scientists as well as that of 'barefoot ecologists'. At the

same time, each Regional Station should set up its own *Regional Coordinating Group on Systematic Biology*, co-opting appropriately qualified members from within the region. These Regional Coordinating Groups should promote and support interaction, both in terms of research and capacity building, with a network of taxonomists and scientists working in related disciplines within their own regions at the levels of scientists as well as that of 'barefoot ecologists'. The Regional Coordinating Groups may closely work with *University level Centers of Excellence in Taxonomy* and *District Level Centers of Systematic Biology* when these are established.

## 12) Human resources

The level of expertise needed for Taxonomic Identifications currently stands at a very low point. During last 15 years a large number of Senior Scientists of both Botanical and Zoological Surveys have retired, and in many branches we do not have a single, trained scientist, even outside the Survey network. The Directors of ZSI and BSI should prepare a quick report to help identify the gap areas of expertise, and concerted attempts be made to plug these gaps. In this connection, it may be noted that the current policy of Govt. of India not to fill up sanctioned positions has already inflicted considerable damage to the Surveys. It is therefore necessary to ensure that scientific departments like ZSI and BSI are exempted from the routine ban. Of course, it may be difficult to implement this until the Surveys are made autonomous.

A relook into the recruitment criteria at the entry point of Taxonomist scientists is very much required. Unfortunately, while we are quite aware of the dearth of trained scientists in Taxonomy, while selecting them, the basic essential qualifications are often ignored. The MoEF has been running a prestigious programme- AICOPTAX, with a view to build capacity in

Taxonomy. However, the trained manpower coming out of such a programme does not receive any recognition when it comes to joining a position in BSI/ ZSI. Therefore, the current process of recruitment of scientists should be reexamined. The entry qualifications must reflect that the persons recruited at scientist's level (C) should have adequate background knowledge about the group of Taxa that he or she will have to work on both in the field and in the laboratory. The categories of Technical Supporting Staff and their entry point qualifications also need to be reviewed, so that with progress of time and experience one can go up the ladder. In view of good students now coming out of Biotechnology/ Environmental Science streams, and the possibility that very few students may obtain degrees in Botany or Zoology in future, it would be worthwhile considering Life Sciences/ Biotechnology/ Environmental Science students for recruitment as well.

Taxonomic training in the Universities is sadly falling behind and as a result both the surveys find it hard to get suitable human resources. MoEF should interact with MHRD to ensure that the UGC declares Taxonomy as a Thurst Area, with adequate funding support so as to facilitate the process of future recruitment. This may best be done in the framework of establishment of *University level Centers of Excellence in Taxonomy* and *District level centers of systematic biology* as suggested above.

The Committee is emphatically of the view that Life Sciences as a board degree at under graduate and graduate level is now essential. The old disciplinary boundaries of botany and zoology are less relevant than a century ago. Further, the Life Sciences degree should include a small, but significant measure of exposure to the interface of science and society, such as sociology, and law. The idea is to equip students with modern skills (such as mathematics)

while energizing traditional skill sets (such as taxonomy). Life Sciences will also convey the sense of a modern thrust area in the new century when biology will be at the cutting edge in different fields of human Endeavour.

#### Education in Life Sciences

It is imperative that the feedstock of fresh talented life sciences candidates with a high level of excellence not be in danger. It is a sad fact that in the last decade and more disciplines like Botany and zoology are not attracting adequate quality students across the country. This means that there are severe constraints to recruitment for organizations specializing in biology, especially so for taxonomy. While adequate and extra provisions for scholarships at all levels, both at a doctoral and postdoctoral level are essential, these may not in themselves be sufficient.

One reason is that the curricula and the very structures of Botany and Zoology as in the curricula of the Indian university system are inadequate to the modern age. It is possible for a student to graduate in these disciplines with a B Sc from a top class university in India with virtually no skills in mathematics and statistics and an inadequate grasp of new fields such as molecular biology. Further, the present curricula will barely equip such a student for an age when a basic idea of what patents are, and of the close and intimate significance of the biological sciences for policy and wealth creation, ecological well being and societal development are closer than ever before. This calls for involvement of social sciences pure (sociology) and applied (law) in a careful selective way in formulation of syllabi. While they might comprise a small part of the curriculum, these will give the student a sense of the wider world where their knowledge will be of relevance.

Since the matter has close bearing on the future of the biological science and this directly affects both the BSI and ZSI, the Committee is strongly and clearly of the view that MoEF should take up at the highest level with the HRD ministry and the UGC the issue of constituting a high level committee to prepare for Life Sciences B.Sc.'s that incorporate both botany and zoology. Both these fraternal disciplines will continue to thrive and grow, but the idea of Life Sciences will help attract students. It will retain and emphasize the best of the traditional skills such as taxonomy to be given high importance as Thrust area but it will also align these with new, emergent skills and disciplines.

This step –the constitution of Life Sciences in a new paradigm at the under graduate and graduate level is so essential that all else we have recommended hinges on this and allied measures to revitalize education and research by making these fields attractive and relevant to the best women and men of the new generation in our new century.

### **Capacity building: scientists**

The Botanical and Zoological Surveys have recently recruited a substantial number of young scientists, and it is appropriate to immediately address the challenge of capacity building of this vigorous group of up and coming workers. Measures should be undertaken to provide atmosphere for good scientific work especially for the young researchers; they should be encouraged to interact and participate in various related activities at other institutes, including those outside India, in particular in South and Southeast Asia. A program of institutional exchange for certain periods, internships etc should be developed. Libraries of all the centers should be updated, and web access should be easily available.

These young workers need manifold training, in taxonomy of the group on which they will focus, in curatorial duties, in field research methodologies and techniques ( such as digital photography of organisms, along with landscapes, habitats and microhabitats, recording of calls, and careful recording of the study locations with help of GPS instruments: Survey Manuals discussed above would be an important resource in this context), and in cognate disciplines of Systematic Biology (evolutionary biology, biogeography, ecology, conservation biology, and behavioural biology, employing traditional as well as modern molecular and quantitative - computational techniques). All young workers should, as in the IFS & IAS, be given training in trekking, mountaineering, diving and other physical exercises to prepare them for life in the jungles and harsh environments while studying and collecting biological samples.

The training should also focus on biogeographical zones e.g. Gangetic Plains, Western Ghats, Deccan Plateau, as well as biomes such as islands, high altitude, deserts, rainforests, coral reefs etc., bringing together regional stations of BSI/ZSI and local experts including NGOs. In this context, the country-wide network of *Permanent Biodiversity Monitoring Sites* can function as an on site training facility for the Survey scientists as well as other students, amateurs and professionals in current techniques in systematics, ecology and conservation biology.

It is, of course, very desirable that Botanical and Zoological Survey Research Fellows as well as new recruits should receive very systematic training in some selected taxa, in research methodology and techniques, and in other branches of Systematic Biology as well as areas like Remote Sensing and computer applications. Given the new technologies, such training should be imparted through a 'virtual university' drawing on human resources throughout the country

with the help of the *Coordinating Group on Systematic Biology*. Where essential, we may also induct foreign experts under mutually agreed terms to impart training, especially in the gap areas. This would help further strengthen the Biodiversity Network in the country and promote fruitful collaboration.

Botanical and Zoological Surveys offer a number of Research Fellowships, and this system should continue and be strengthened further. BSI and ZSI may also be encouraged to float post-doctoral fellowships. Many scientists employed in the Surveys also pursue research degrees. A case has been made for conferring a deemed University status on Botanical and Zoological Surveys, but the proposal does not appear to be justified. A University is a place with a broader horizon than can possibly be cultivated or created in the bounds of single discipline oriented survey. At the same time, it is highly desirable that the two Surveys work in conjunction with existing universities across a wide range.

### **Education and outreach**

Many leading taxonomic institutions in the world such as Missouri Botanical Garden and Smithsonian Institute have strong education and outreach programmes and it would be appropriate that Botanical and Zoological Surveys also promote such activities in a systematic and vigorous manner. Another good model is our own National Remote Sensing Agency that conducts many very well subscribed short term courses. The Botanical and Zoological Surveys should organize short term courses in identification of specific taxa (common ones like trees, birds and butterflies as well as rare taxa) aimed at undergraduate and M Sc students, as well as practicing scientists in other disciplines such as ecology. Such courses would also cater to the needs of *District level centers of systematic biology* when these are established. Botanical and

Zoological Surveys should also establish mechanisms for working with and encouraging members of groups like 'Indiantreepix' so that they can share their experiences on flora of a particular region with the Survey scientists.

The National Museum Natural History and Regional Museums of Natural History under the MoEF may play a very productive role in this context. Specializing in the regional ecosystems including fauna and flora; they are developing into good repositories and have rare collections.

### **13) Infrastructure**

The Botanical and Zoological Surveys need further strengthening of infrastructure, in particular, to better promote activities in all the different parts of the country. For this purpose, Hyderabad, which has a drier climate, and has Regional Stations of both Botanical and Zoological Surveys, as also a vibrant scientific culture would be an excellent choice. Hyderabad may therefore be made the focus of further major development of infrastructure for the Surveys. Hyderabad would also be a very good place for developing a joint BSI/ZSI DNA lab taking full advantage of the expertise available with CCMB. This should serve as a National Facility with provision for scientists for sending samples for molecular identification. A fee may be charged for this service. For instance, the RMNH (Bhubaneswar) has a good collection of the rare (dead) specimens which are washed ashore. A few years back a dead whale was washed ashore and although the skeleton could be salvaged, proper identification was not possible because of the state of decay and lack of common facilities for DNA fingerprinting. A common facility will be of great help in building up a database on such fauna on a regional basis.

## 14) Strategic action plan

This would follow the contours sketched above, visualizing BSI/ZSI activities as an integral component of the overall programme for Systematic Biology for India, both at scientific research level and at the grassroots level. At the same time, BSI/ZSI should proactively promote collaboration and partnerships. We recommend that the plan include the following components organized into short, medium and long-term goals. Each of these goals could be pursued as one or a group of time bound project(s). Each of the project(s) should be assigned to one team of scientists, technical experts, advisors and progress monitored regularly and dynamically managed.

### Short Term Goals (1-2 years)

1. MoEF should set up a permanent, open, inclusive *Coordinating Group on Systematic Biology* so that BSI/ZSI come to constitute the hub of a vibrant network of activities in all fields of systematic biology.
2. ZSI and BSI will be placed on par with the CSIR and be upgraded to autonomous organizations.
3. BSI/ ZSI should prepare an up-to-date State of Art Report to help identify gaps in knowledge of different taxonomic groups, in knowledge of different geographical regions and habitats and in the availability of expertise relating to different taxa and geographical regions. BSI/ ZSI should then make concerted attempts to plug these gaps.
4. BSI/ ZSI should establish a panel of experienced and active taxonomists for each state and take their consent on participation in Flora / Fauna Project.
5. BSI/ ZSI should set up an interactive 'Flora/ Fauna of India website'.
6. An editorial board may be constituted at the national level to decide the format of the flora/ fauna and also assign plant/ animal families for compilation.
7. MoEF should set up a system of permanent landscape level Biodiversity Monitoring Sites (BMS's) in all the biogeographic zones of India.
8. All the regional centers and headquarters of BSI/ZSI should be interlinked through a computer network.
9. BSI/ZSI must link their database activities with DBT's Indian Bioresources Information Network (IBIN) and the National Biodiversity Authority's Indian Biodiversity Information System (IBIS) initiatives.

10. BSI/ ZSI should update their survey manuals for different taxa and ecosystems.
11. MoEF should ensure that scientific departments like ZSI and BSI are exempted from the routine bans on recruitment.
12. BSI/ ZSI should reexamine the recruitment criteria at the entry point of Taxonomist scientists so as to encourage people who have already developed taxonomic expertise.
13. UGC may be asked to declare Taxonomy as a Thurst Area, to be particularly promoted in Colleges/ Universities identified to function as *University level Centers of Excellence in Taxonomy* and *District Level Centers of Systematic Biology* with adequate funding support so as to facilitate the process of future recruitment.
14. BSI/ ZSI should develop an effective in-service system of training.
15. BSI/ ZSI's in-service training should extend beyond taxonomy to the cognate disciplines including evolutionary biology, biogeography, ecology, conservation biology, and behavioural biology, employing traditional as well as modern molecular and quantitative - computational techniques, drawing upon expertise in various institutions in the country.
16. BSI/ZSI should organize short term courses in identification of specific taxa (common ones like trees, birds and butterflies as well as rare taxa) aimed at undergraduate and MSc students, as well as practicing scientists in other disciplines such as ecology on the model of NRSA.
17. BSI/ZSI should organize an immediate review of the procedures for access to collections for scholars and students with a view to evolve transparent and timely access. Such review should not be only in-house but should involve the Coordinating Group on Systematic and Biology. New rules should be put up on the web and revisions made after soliciting responses.
18. Fellowship for the post doctoral level and scholarships for the doctoral level, about a total 25 for each of the two surveys are imperative. These should be comparable to the best UGC level scholarships for Doctorates and the relevant level for the post doctoral level. The modus operandi suggested was to evolve these in such a way that the skills and expertise of the scholars is honed to a higher level by collaboration and if needed training in the centers of excellence in relevant disciplines. Publication in peer reviewed journals should be the criterion of evaluation at the relevant stage.
19. Immediate institution with adequate funding for prizes for quality research work at the doctoral and post doctoral level to be named after prominent and eminent zoologists and botanists. Special prizes may also be set up for women scientists to encourage and

recognize their efforts. Where such prizes already exist as with the Janaki Ammal prize, funds are immediately released. The Ministry may also consider asking India Post to release a series of stamps in the name of five famous taxonomists/ zoologists/ botanists such as Janaki Ammal.

#### Mid Term Goals (3-4 years)

1. Surveys should gear themselves to proactively seeking partnerships, welcoming others to work on the BSI/ZSI collections, and undertake collaborative surveys, joint collections, and collaborative investigations in related fields such as molecular taxonomy and conservation biology, and collaborative publications. This should be done both at the level of institutions of advanced scientific education and research, as well as *University level Centers of Excellence in Taxonomy* and *District Level Centers of Systematic Biology*.
2. BSI/ ZSI should prepare an annotated checklist of vascular plants and other taxa under consideration for each state / UTs based on all published documents, museums and herbaria, giving local names, if any, locality and habitat.
3. BSI/ ZSI should make available to the public, as also circulate the electronic version of checklists among the panel of botanists/ zoologists.
4. BSI/ ZSI should organize revisiting the Type Localities of threatened or unique plants/ animals.
5. BSI/ ZSI should streamline their system of publications, incorporating as far as possible on-line publications, to publish short and long papers/communications in taxonomy of both plants and animals.
6. Collection inventory and management should be computerized using open source softwares such as Specify 6.0 ([www.specifysoftware.org](http://www.specifysoftware.org)).
7. The BSI/ ZSI journals and other occasional publications should go online and could be part of Public Library of Science (PLoS). This will save a lot of time and financial resources.
8. All the Regional stations of the Surveys would have to gear up to conduct capacity building programmes for the district level centers of taxonomic expertise in selected Colleges/ Universities established in collaboration with Zilla Panchayat level Biodiversity

Management Committees. In turn these district level experts would have to engage in building capacity of the grassroots taxonomists in their own districts.

9. BSI/ ZSI should develop a joint DNA lab that would take advantage of the available expertise in CCMB at Hyderabad.

### Long Term Goals (5-12 years)

1. BSI/ ZSI should organize revalidation of ambiguous taxa and population estimation of species listed in Red Data Books, and drawing *in situ* conservation plans.
2. BSI/ ZSI should organize a National Network of Botanical Gardens and Arborata.
3. All the identified species records should be computerized and geo-referenced, with a high priority assigned to the oldest collections.
4. BSI/ZSI should facilitate preparation of an inventory of collections at Colleges, Universities, and other institutions, as also with private individuals and organizing a computerized and geo-referenced database pertaining to these. The *Coordinating Group on Systematic Biology* may oversee this activity. Wherever essential arrangements should be made for acquiring these collections, and funds should be earmarked for this purpose.
5. BSI/ZSI must give a thrust to repatriation of Indian biodiversity information (not physical specimens) held in Herbaria and Museums abroad.
6. BSI/ZSI must develop a "Cybertaxonomy" base for Indian biota.
7. BSI/ ZSI Heritage publications and drawings should be digitized and could be part of Biodiversity Heritage Library project.
8. BSI/ ZSI should develop field guides and keys, in printed as well as electronic versions, not just in English, but in all national and state languages to support the work of Biodiversity Management Committees at district, taluk and Municipality/ gram panchayat levels.
9. Hyderabad should be made the focus of further major development of infrastructure for the Surveys.

## 15) Vision

It should be a part of our vision that Botanical and Zoological Surveys organization should strategically position and develop scientific and technical capabilities to become lead

biodiversity institutions in SARC region, or the biogeographically Indian sub-region of Oriental region, so as to provide taxonomic services to the entire region and play a proactive role in biodiversity conservation.

The BSI/ZSI Vision document may be most appropriately developed as an element of an integrated vision for Systematic Biology for India, with the Surveys being a key component. This might be best organized as a collaborative effort of several institutions that are listed below.

Note that this is not a complete list, and that we need to draw up a comprehensive list and organize a well designed exercise, perhaps as the very first activity of the proposed

*Coordinating Group on Systematic Biology.*

1. Acharya Nagarjuna University Zoology Department
2. Aligarh Muslim University Zoology Department
3. ATREE
4. Calicut University Zoology and Botany Departments
5. Center for Cellular and Molecular Biology
6. Center for Conservation Biology, UAS, Bengaluru
7. Delhi University Zoology Department
8. Fisheries Survey of India
9. Forest Survey of India
10. FRI, Dehradun: Forest Insect Collection and Dehradun Herbarium
11. IISc: Centre for Ecological Sciences,
12. National Bureau of Animal Genetic Resources
13. National Bureau of Fish Genetic Resources
14. National Bureau of Plant Genetic Resources
15. National Institute of Oceanography
16. National Museum of Natural History
17. North-eastern Hill University
18. Punjab Agriculture University, Ludhiana
19. Punjab University, Chandigarh Zoology Department
20. Punjabi University, Patiala Zoology Department

21. Regional Museums of Natural History
22. Shivaji University Botany Department
23. State forestry colleges under SAUs with strength in Systematic Biology
24. Tropical Botanical Garden and Research Institute
25. Wildlife Institute of India
26. Nature Conservation Foundation, Mysore.

**16) Measures for strengthening of BSI/ZSI for effective utilization of special grants of Rs. 15 crores each allocated to BSI/ZSI during CFY, 2009-10.**

The Task Forces have made a positive contribution by ensuring that the BSI / ZSI are not obliged to spend this amount by March 31, 2010. Beyond that, given the way the system operates, the Task Forces are in no position to provide any constructive inputs as to how these special grants should be utilized. In the event, all that the Task Forces can do is to state that the matter is best left to the wisdom of MoEF.

To elaborate on this further are quoted below comments of Dr. Shruti Rai:

1. With reference to the Task Force's recommendations regarding creating provision for fellowship and scholarship in the special grant of Rs. 15 crore each for BSI and ZSI, undersigned has been directed to intimate that though the idea is excellent in terms of its expected outcome; considering the government procedure, its implementation would be an arduous task.

2. This is to bring to you notice that this is one time grant and it will not possible to create a separate grant out of this for initiating a scholarship programme which needs to continue forever. Accordingly, with this proposition it won't be possible to finalize the SFC during current financial year.

3. If desired and actively pursued by Director ZSI and BSI, Ministry can take up this recommendation of Task Force as a separate proposal and it can materialize in six months or so by opening a separate budget sub head under BSI and ZSI.

4. We hope you will appreciate our concern. At least some infrastructure and equipment facilities to BSI and ZSI can be made available during these two years. Accordingly, please convey your approval to the break up of Rs. 15 crore submitted by BSI and ZSI, so that the SFC can be finalized.

**And the response of Dr Mahesh Rangarajan:**

I welcome Dr Rai's mail and comment the thinking that has gone into it and fully appreciate her concerns. I am not however sure this is at all convincing.

A scholarship can be like the Jawaharlal Nehru Centenary Scholarship which was a one time scholarship. The idea of not doing this will undermine all other aims. It was broadly agreed by committee members that it is men (and women) and not machines or buildings that are the real constraint. Of course, a related funding proposal for follow up is also welcome but it cannot be a substitute.

This is an opportunity to be grasped and not to be avoided.

## **17) Annexure A: Constitution of the Task Forces**

F. No. 9/20/2009 - CSB  
Government of India  
Ministry of Environment and Forests

Paryavaran Bhawan,  
C.G.O. Complex, Lodhi Road,  
New Delhi – 110003

Dated: 22<sup>nd</sup> July, 2009

## Office Memorandum

**Sub: Strengthening of Botanical Survey of India □ Constitution of a Task Force for making Recommendations to the Government □ reg.**

The Botanical Survey of India (BSI) is one of the oldest institutions of the Ministry of Environment and Forests, Government of India, established during 1890 with the objective of undertaking survey, identification and documentation of plant life of the country. In order to strengthen the institutional mechanisms in BSI including infrastructural development, with the approval of the competent authority, it has been decided to constitute a Task Force to make recommendations to the Government.

2. The Task Force shall consist of the following members:

- (1) Prof. Madhav Gadgil, Pune – Chairman
- (2) Prof. A K Sharma, Kolkata University - Member
- (3) Prof. Pushpangadan, Former Director, NBRI, Lucknow - Member
- (4) Dr C R Babu, Former Pro-Vice Chancellor, Delhi University - Member
- (5) Dr S R Yadav, Kolapur University, Kolapur - Member
- (6) Prof Dayanandan, Madras Christian College, Chennai - Member
- (7) Dr G S Rawat, Wildlife Institute of India, Dehradun - Member
- (8) Dr Harini Nagendra, ATREE - Member
- (9) Dr K N Ganeshiah, University College of Agricultural Sciences, Bangalore – Member
- (10) Prof. Mahesh Rangarajan, University of Delhi-Member
- (11) Dr. S. Shivaji, Centre for Cellular & Molecular Biology, Hyderabad.-Member
- (12) Dr. Sanjappa, Director, BSI - Member
- (13) Shri A K Goyal, Joint Secretary, Ministry of Environment and Forests – Member Secretary

3. The terms of reference for the Task Force will be as follows:

- (vi) Review the existing mandate, objectives, organizational structure, manpower and infrastructure in order to strengthen their scientific and technical capacities;

- (vii) Render suggestions for formulation of a strategic Action Plan;
- (viii) Provide recommendations for conceptualization of Vision Document, 2020;
- (ix) Redefine priorities and programme of BSI; and
- (x) Suggest measures for strengthening of BSI for effective utilization of special grant of Rs. 15 crores allocated to BSI during CFY, 2009-10.

4. The tenure of the Task Force will be three months from the date of its constitution including submission of report.

5. The non-official members of the Task Force will be entitled to TA/DA and sitting fees for attending the meetings as per the rules of the Government of India and this will be arranged by the respective organizations. TA/ DA of official members of the Task Force will be met by their respective departments/ministries.

**(Dr. Shruti Rai)**  
Deputy Director  
F. No. 9/20/2009 - CSB  
Government of India  
Ministry of Environment and Forests

Paryavaran Bhawan,  
C.G.O. Complex, Lodhi Road,  
New Delhi – 110003  
Telefax: 24362434

Dated: 22<sup>nd</sup> July, 2009

## Office Memorandum

**Sub: Strengthening of Zoological Survey of India □ Constitution of a Task Force for making Recommendations to the Government □ reg.**

The Zoological Survey of India (ZSI) is one of the oldest institutions of the Ministry of Environment and Forests, Government of India, established during 1916 with the objective of undertaking survey, identification and documentation of animal life of the country. In order to strengthen the institutional mechanisms in ZSI including infrastructural development, with the approval of the competent authority, it has been decided to constitute a Task Force to make recommendations to the Government

2. The Task Force shall consist of the following members:

- (1) Prof. Madhav Gadgil, Pune – Chairman
- (2) Prof. T N Ananthakrishnan, Chennai - Member
- (3) Prof. T J Pandian, Madurai Kamaraj University - Member
- (4) Dr M Shamim Jairajpuri, Aligarh Muslim University - Member
- (5) Dr (Ms) Priyamvada Hejmadi, Vice-Chancellor, Sambalpur University - Member
- (6) Dr. Raghavendra Gadagkar, Bangalore - Member
- (7) Dr. Anindya Sinha, National Institute of Advanced Studies - Member
- (8) Dr. Aparajita Datta, Nature Conservation Foundation, Mysore - Member
- (9) Prof. Veena Tandon, North East Hill University, Shillong - Member
- (10) Prof. P.P. Majumdar, Indian Statistical Institute, Kolkata - Member
- (11) Dr. Ramakrishna, Director, ZSI - Member
- (12) Shri A K Goyal, Joint Secretary, Ministry of Environment and Forests – Member Secretary

3. The terms of reference for the Task Force will be as follows:

- (i) Review the existing mandate, objectives, organizational structure, manpower and infrastructure in order to strengthen their scientific and technical capacities;
- (ii) Render suggestions for formulation of a strategic Action Plan;
- (iii) Provide recommendations for conceptualization of Vision Document, 2020;
- (iv) Redefine priorities and programme of ZSI; and
- (v) Suggest measures for strengthening of ZSI for effective utilization of special grant of Rs. 15 crores allocated to ZSI during CFY, 2009-10.

4. The tenure of the Task Force will be three months from the date of its constitution including submission of report.

5 The non-official members of the Task Force will be entitled to TA/DA and sitting fees for attending the meetings as per the rules of the Government of India and this will be arranged by the respective organizations. TA/ DA of official members of the Task Force will be met by their respective departments/ministries.

(Dr. Shruti Rai)  
Deputy Director

## **18) Annexure B: Schedule of functioning of the Task Forces**

### **First meeting of the Task Force:**

20<sup>th</sup> August 2009: INSA, New Delhi.

Following this meeting a draft report was prepared after extensive e-mail consultations. This report was circulated on 6<sup>th</sup> September 2009, and a printout was made available to all BSI/ ZSI scientists participating in the second meeting at Jodhpur. This was also put up on the web and comments from all interested parties were invited.

### **Second meeting of the Task Force:**

11<sup>th</sup> and 12<sup>th</sup> September 2009, ZSI, Jodhpur

The meeting included an extended and vigorous discussion with some 30 BSI/ ZSI scientists of all levels ranging from Research Fellows to senior scientists. Based on the inputs during this discussion, and Task Force meeting, as well as extensive e-mail based discussion in response

to the web posting of the draft report a revised draft was circulated to the Task Force members by 3rd October 2009.

**Third meeting of the Task Force:**

6<sup>th</sup> October 2009, Van Vigyan Bhavan, New Delhi

**Fourth meeting of the Task Force, with Shri Jairam Ramesh, Hon. Minister:**

7<sup>th</sup> October 2009, Paryavaran Bhavan, New Delhi

The current report has been finalized based on the inputs received during the third meeting of the Task Force, as well as the fourth meeting of the Task Force with the Hon. Minister, followed by further extensive e-mail exchanges.

**19) Annexure C: Requirements on part of BSI**

**DETAILS OF THE PRESENT STRENGTH OF SCIENTISTS AND STAFF IN BSI**

Group	Sancti	Posts	Sanctio	Post	Posts	Present	Man	Vacancy
	oned	abolished	ned	abolished	abolished/	staff	in	
	strengt	after the	strengt	due to	surrender	strength	positio	
	h	implementa	h after	optimizati	ed		n	
	before	tion of	1999	on of				
	1999	Work	(WMC)	direct				
		Measureme		recruitme				

		nt Committee (WMC) report		nt of posts				
A	132	16	116	03	01*+05#	107	70	37@
B	78	06	72	08	01\$+12#	51	34	17^
C	608	78	530	60	07\$	463	296	167⊗
D	802	80	722	146	122#	454	434	20
TOTAL	1620	180	1440	217	148	1075	834	241
					*Posts abolished by MoEF \$ Posts surrender ed for revival # Posts deemed			

					abolished			

@ Recruitment process for 32 Scientist posts (14 Scientist C and 18 Scientist B) has been initiated by MoEF and UPSC

^ Recruitment process for 07 Botanists and 01 Garden Curator has been initiated by UPSC. DPC Proposal for rests of the posts are being sent to MoEF

⊗ Recruitment process for 44 posts has been initiated by SSC. DPC papers are being prepared for rests of the posts

To relieve scientists from administrative works, there is an urgent need for revival of 01 Group A post of Senior Administrative Officer, 02 Group A posts of Administrative Officers, 01 Group A Post of Finance Officer, 01 Group A post of Librarian and 05 Group B posts of Junior Administrative Officer.

DETAILS OF REQUIRED SKILLS/SPECIALISATION (SKILL MATRIX: AVAILABLE AND SHORTFALL)\*

Skills	No. of species recorded so far	Requirements	Available	Shortfall
Angiosperms	17561	60	43	17

Gymnosperms	68	02	01	01
Pteridophytes	1233	05	03	02
Bryophytes	2433	10	04	06
Lichens	2233	08	02	06
Fungi	14510	35	02	33
		(17 for Higher Fungi & and 18 for Lower Fungi)		(15 for Higher Fungi & and 18 for Lower Fungi)
Algae	7177	17	4	13
		(12 for Fresh Water Algae and 05 for Marine Algae)	(3 for Fresh Water Algae and 01 for Marine Algae)	(09 for Fresh Water Algae and 04 for Marine Algae)
Computer Applications including GIS studies	NA	05	01	04
Ex situ Conservation	NA	20	10	20
			(Not with required skill)	
Ethnobotany	NA	12	02	10

(To provide technical guidance to local biologists, college and university teachers)				
Ecology	NA	05	00	05
Palynology	NA	05	02	03
Phyto-chemistry	NA	04	02	02
Molecular Biology	NA	05	00	05
Chromosome Mapping	NA	05	00	05
Museology	NA	02	04	02
			(Not with required skill)	
Education and outreach programmes	NA	05	00	05
		205	80	125
			(including 14 requiring skill augmentation)	

\*To coordinate all the works of various taxonomic groups on Flora of India, including AICOPTAX project of MoEF which the task force projected to be achievable in ten years on priority basis, requires at least 20 dedicated taxonomists for vascular plants alone.

DETAILS OF THE BUDGET REQUIREMENT

*Rs. in Crores*

11 <sup>th</sup> 5 year Plan (2007 – 12)		Actual Expenditure of 2007 – 08		Actual Expenditure of 2008 – 09		Anticipated Expenditure of 2009 – 10		Proposed Outlay of 2010 – 11		Proposed Outlay of 2011 – 12	
Approved Outlay											
Plan	Non Plan	Plan	Non Plan	Plan	Non Plan	Plan	Non Plan	Plan	Non Plan	Plan	Non Plan
54.55	87.85	7.655	13.08	14.40	18.80	18.08	25.56	38.69	23.68	45.00	30.00
00	18	8	63	44	75	42	79	43	91	0	0

Note: The Budget requirements for the proposed additional scientific posts and infrastructure have to be substantially increased in the 12<sup>th</sup> 5 year plan

## 20) Annexure D: ZSI : Specific needs

- 1) Exposure of Scientific personnel of BSI/ZSI in International Museums and taxonomic institutions for updating the skills of Modern Trends in Biodiversity Research
- 2) A unit of ZSI/BSI in all State Biodiversity Boards, i.e., additional recruitment of scientists having taxonomic knowledge for updating Biodiversity Registers, EIA, and other State related subjects
- 3) Filling up of all vacant posts of Scientists of BSI/ZSI without further delay, periodic recruitment so that second line of scientists is developed in every field.
- 4) Increased allocation of funds under Plan and Non Plan ( at present 70% will go for the salaries and 15-18 % will go for maintenance ) and only 10 - 12 % is only for research, therefore, increase in allocation of funds for infrastructure and modernization regularly, Updating of database, library, etc
- 5) Incentives for research activities either as Fast track promotion or financial upgradation for those who are not covered under flexible complementing system
- 6) Free access in Protected Areas for research work, as at present many State Forest Authorities refuse/ delay in according permission for survey and observation
- 7) Removal of ban on the replacement of vehicles for survey work
- 8) Insurance policy for survey parties who undertake surveys in inaccessible areas and areas of disturbance
- 9) Deposition of Type Zoological Specimens described by outside agencies, as ZSI has been designated as the repository of Zoological specimens
- 10) Augmentation of skill in Administrative training, in addition to scientific training

- 11) Provision of Research Associates and Director to be entrusted in the selection of outstanding scholars in Taxonomic research as RA's
- 12) Participation in International conferences abroad, as ministry's representatives
- 13) Allocation of funds for the maintenance of the buildings for specimens (Zoological and Botanical Specimens) maintenance
- 14) Provision Diploma/ certificate course in collection, preservation and Identification of Zoological Specimens

## **21) Annexure E: ZSI : Background**

The Zoological Survey of India was established in 1916, primarily to explore and inventories the faunal resources (diversity) of the country and to collect and document the base line data with regard to taxonomy, distribution, bio-ecology, etc., of all available animal groups. During the last 91 years and largely particularly from the Second Five Year Plan period the Zoological Survey of India has grown from a small unit at the Indian Museum, Calcutta, to a premier National Institution with 16 Regional Centers spread all over India with Headquarters at Calcutta. Over the successive plan periods the functions of Zoological Survey of India 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, etc. This Organization also has a regular Training and Extension service for creating public awareness for the conservation of environment and wildlife through exhibitions,

training programmes and interaction with different Government and NGO organizations, as well as universities, colleges and schools.

Besides, Zoological Survey of India also acts as a custodian of the National Zoological Collections which comprise more than two million specimens belonging to some 81,000 species including about 10,000 species of other neighbouring countries like Myanmar, Pakistan, Bangladesh, Thailand and Sri Lanka.

Initially Zoological Survey of India set up nine Regional and Field Stations, namely, Northern Regional Station at Dehra Dun; Southern Regional Station at Madras; Eastern Regional Station at Shillong; Western Regional Station at Pune; Central Regional Station at Jabalpur; Desert Regional Station at Jodhpur; Gangetic Plains Regional Station at Patna; Marine Biological Station at Chennai and High Altitude Zoology Field Station at Solan to survey and study the fauna of different biogeographical zones of India. Subsequently during 1979-83 six more stations were established to conduct faunistic surveys in some important ecosystems: namely, Freshwater Biological Station at Hyderabad for freshwater fauna and limnological studies; Estuarine Biological Station at Berhampur and Sunderbans Field Research Station at Port Canning, for estuarine and mangrove fauna studies; Western Ghats Field Research Station at Kozhikode and Arunachal Pradesh Field Station at Itanagar for the fauna of tropical rain forests; and the Andaman & Nicobar Regional Station at Port Blair for insular and marine fauna. During the Seventh Five Year Plan periods the Marine Aquarium-cum-Research Centre at Digha (West Bengal) was set up mainly to cater to the needs of public education and awareness on marine fauna through a large aquarium and other ancillary research facilities.

The objectives and functions of ZSI were reviewed in 1987 and redefined in 1991. A revised time-frame and priorities in the programmes of work were fixed by the Ministry of Environment & Forests with the target proposed up to 2000 A. D. which was further reviewed by the PAC during 2001 and a new direction in this regard was given to the department.

During recent years, the scope and functions of the Zoological Survey of India have been considerably expanded, particularly in the light of the Convention on Biological Diversity, ratified by Govt. of India in 1994 with special reference to Articles 7, 8, 9, 10, 12, 13, 14, 17, 18, and 41 of the Convention. In the light of the above, the objectives and implementation strategies for the Eleventh Five Year Plan are redefined as follows.

A. Primary ( Priority )Objectives

1. Exploration, Survey, Inventorisation, Monitoring of faunal diversity in various states, some selected ecosystems and protected areas of India.
2. Taxonomic studies of all 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 some important communities/species.
6. Preparation of database for the recorded species of the country.
7. Maintenance & 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 and Fauna of States.

B. Secondary Objectives

1. GIS and Remote Sensing studies for recorded animal diversity as well as for selected threatened species.
2. Chromosomal Mapping and DNA finger printing.
3. Environmental Impact Studies.
4. Maintenance of Musea at Headquarters and Regional Stations
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 the Eleventh Five Year Plan period, the following on-going and new programmes have been proposed, largely to fulfill the objectives mentioned above:

**ON-GOING PROGRAMMES:**

1. Exploration and Survey of State Fauna (District-wise), (to be continued)
2. Studies on selected ecosystems of Indian Region ( To be continued)
3. Survey of Protected Areas including Tiger Reserves. ( To be continued, and to take up the programme on the principles of Rapid Assessment Survey to explore more number of Protected Areas within the time limit)
4. Taxonomic studies of Faunal Components. ( of all the above group)
5. Status Survey of Endangered species, including the revision of procedures for Schedule animals based on the IUCN Guidelines
6. Publication of Red Data Book and Fauna of Indian Volumes.
7. Computerization of data on Faunal diversity including National Zoological Collections, (Including the Digitisation of Type and National Zoological Collections)

8. Documentation and Publications.
9. Training and Extension Services.

ZSI: Future plans

## **22) Annexure F: ZSI: New Programmes:**

1. Survey and Inventorization of Marine Bio-diversity.
2. Establishment of new unit at Jamnagar, Gujarat to assess the faunal diversity of Marine Protected Area, Desert ecosystems.
3. Establishment of new unit 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 Indian Hot Spot.
4. Monitoring the status of selected animals included in the Wildlife Schedules.
5. Development of Taxonomic expertise in the form of Human Resource Development and database.

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 set forth below :

Exploration, Survey, Inventorisation, Monitoring of faunal diversity in various states, some selected ecosystems and Protected Areas of India.

- ✓ The objectives of this programme are to explore the faunal resources of various States and Union territories of India, selected ecosystems and conservation areas.
- ✓ Nearly 90 % of the freshwater fishes and amphibians have been surveyed and documented, birds and mammals have been covered to the maximum extent, reptiles need to be investigated ( as a large area of Western Ghats, Eastern Himalaya and Island are still to be surveyed and investigated thoroughly), from this vast area of the country measuring nearly 32,89,263 km<sup>2</sup>.

The State Fauna of the following have been completed:

- ✓ State Fauna : Orissa ( 4 parts)
- ✓ State Fauna Lakshadweep (UT) ( 1 part )
- ✓ State Fauna West Bengal ( 12 parts)
- ✓ State Fauna Meghalaya ( (10 parts)
- ✓ State Fauna Andhra Pradesh ( 8 parts)
- ✓ State Fauna Delhi ( 1 part)
- ✓ State Fauna Tripura (4 parts)
- ✓ State Fauna Gujarat ( 2 parts)
- ✓ State Fauna Sikkim ( 5 parts)
- ✓ State Fauna Manipur (3 parts)
- ✓ State Fauna Bihar ( 1 part)
- ✓ State Fauna Nagaland ( 1 part)
- ✓ State Fauna Arunachal Pradesh (2 parts)

- ✓ State Fauna Mizoram ( 2 parts in printing)
- ✓ State Fauna Goa ( 2 parts)
- ✓ State Fauna Madhya Pradesh ( 2 parts)
- ✓ Fauna of Tamil Nadu ( 1 part)

In collaboration with 16 Regional Centres of Zoological Survey of India located in different locations of the country have collected baseline data and are now in a position to undertake intensive and extensive programme to prepare an inventory of the faunal resources of the states along with the selected ecosystems and conservation areas. An extensive plan has been drawn to extensively explore the faunal resources of the remaining different states and union territories of the country.

State Survey & Inventorisation :

No	STATES	OFFICES OF ZSI
01	Andhra Pradesh	Hq's & SRC/ZSI/ Chennai
02	Arunachal Pradesh	Hq's & APFC/ZSI/ Itanagar
03	Assam	Hq's & NERC/ZSI/ Shillong
04	Bihar	Hq's & GPRC/ZSI/ Patna
05	Chandigarh	Hq's & NRC/ZSI/ Dehradun
06	Chattisgarh	Hq's & CRC/ZSI/ Jabalpur
07	Goa	Hq's & WRC/ZSI/ Pune

08	Gujarat	Hq's & DRC/ZSI/ Jodhpur
09	Haryana	Hq's & NRC/ZSI/ Dehradun
10	Himachal Pradesh	Hq's & HAFZC/ZSI/ Solan
11	Jammu & Kashmir	Hq's & HAFZC/ZSI/ Solan
12	Jharkand	Hq's & GPRC/ZSI/ Patna
13	Karnataka	Hq's & SRC/ZSI/ Chennai
14	Kerala	Hq's & WGRC/ZSI/ Calicut
15	Maharashtra	Hq's & WRC/ZSI/ Pune
16	Madhya Pradesh	Hq's & CRC/ZSI/ Jabalpur
17	Punjab	Hq's & NRC/ZSI/ Dehradun
18	Tamil Nadu	Hq's & SRC/ZSI/ Chennai
19	Uttar Pradesh	Hq's & NRC/ZSI/ Dehradun
20	Uttaranchal	Hq's & NRC/ZSI/ Dehradun

## Selected Ecosystems :

No	STATES	OFFICES OF ZSI
	Himalayan Ecosystem	

01	Western Himalaya	Hq's & HAFZC/ZSI/ Solan
02	Western Himalaya (Pangi Valley, HP)	Hq's & HAFZC/ZSI/ Solan
03	Western Himalaya (Zankar Valley, J &K)	Hq's & HAFZC/ZSI/ Solan
Désert Ecosystem		
01	Rajasthan (13 dist.)	Hq's & DRC/ZSI/ Jodhpur
02	Gujarat (12 dist)	Hq's & DRC/ZSI/ Jodhpur
Marine & Island Ecosystem		
01	Andaman & Nicobar	Hq's & ANRC/ZSI/ Port Blair
02	East Coast, Andhra Pradesh	Hq's & MBC/ZSI/ Chennai
03	East coast (Orissa & West Bengal)	Hq's & MBC/ZSI/ Chennai & MARC/ZSI, Digha
04	West coast Kerala	Hq's & MBC/Chennai; WGRS/Calicut
04	West coast Karnataka/Goa	Hq's & MBC/ZSI/ Chennai; WGRC, Calicut; WRC/ZSI/ Pune
05	West Coast (Maharashtra)	Hq's & WRC/ZSI/ Pune
06	West coast ( Gujarat)	Hq's & DRC/ZSI/ Jodhpur

07	Lakshadweep	Hq's & WGRC/ZSI/ Calicut
Tropical Rainforest Ecosystem		
01	Western Ghats, Kerala	Hq's & WGRC/ZSI/ Calicut
02	Western Ghats, Tamil Nadu	Hq's & SRC/ZSI/ Chennai
03	Western Ghats Karnataka	Hq's & WGRC/ZSI/ Calicut
04	Western Ghats Goa,	Hq's & WRC/ZSI/Pune
	Maharashtra	
05	Eastern Himalaya	Hq's & APFC/ZSI/Itanagar
	Arunachal Pradesh	
Estuarine Ecosystem		
01	Krishna Estuary	Hq's & EBC/ZSI/Berhampur
02	Cauvery Estuary	Hq's & EBC/ZSI/Berhampur
03	Pennar Estuary	Hq's & EBC/ZSI/Berhampur
04	Brhmani & Vaitarini	Hq's & EBC/ZSI/Berhampur
	Estuary	
05	Narmada & Tapti Estuary	Hq's & EBC/ZSI/Berhampur
06	Hoogly- Matla Estuary	
Freshwater Ecosystem		

01	Nalsarovar	CRC/ZSI/Jodhpur
02	Crater Lake, Buldana	WRC/ZSI/Pune;FBS/ZSI/Hyderabad
03	Govind Sagar	NRC/ZSI/Dehradun & HAFZC/Solan
04	Chandra Tal	HAFZC/ZSI/Solan
05	Tso Murari J & K	HAFZC/ZSI/Solan
06	Bhoj Madhya Pradesh	CRC/ZSI/Jabalpur ;
		FBC/ZSI/Hyderabad
07	Ropar Punjab	NRC/ZSI/Dehradun
08	Narayan Sarovar	DRC/ZSI/Jodhpur
09	Sasthamkota, Kerala	WGRC/ZSI/Calicut
10	Deeper Beel, Assam	ERC/ZSI/Shillong
		&FBC/ZSI/Hyderabad
11	Sultanpur	NRC/ZSI/Dehradun
12	Kannjili Punjab	FBC/ZSI/Hyderabad;
		NRC/ZSI/Dehradun
13	Urban & Peri Urban Lakes	FBC/ZSI/Hyderabad
	of Hyderabad	
14	Urban & Peri Urban Lakes	HQ's, Kolkata
	of Kolkata	

## Special Protected Area to be covered by the Scientists of Head Quarters &amp; Regional Centres

of ZSI

No	STATES	OFFICES OF ZSI
01	Badra WLS, Karnataka	WGRC/ZSI/Calicut
02	Kudremukh WLS, Karnataka	WGRC/ZSI/Calicut
03	Tattekad Bird Sanctuary	WGRC/ZSI/Calicut
04	Bannerghatta NP	SRC/ZSI/Chennai
05	Kalakkad-Mundunthurai WLS	SRC/ZSI/Chennai
06	Gulf of Mannar	MBCZSI/Chennai
07	Cape Comorin NP (Proposed)	SRC/ZSI/Chennai
08	Simbalpara WLS	HAFZC/ZSI/Solan
09	Hemis N P (J&K)	HAFZC/ZSI/Solan
10	Pin Valley Lahul & Spiti	HAFZC/ZSI/Solan
11	Valley of Flowers NP	HAFZC/ZSI/Solan
	Uttaranchal	
12	Parasnath WLS	GPRC/ZSI/Patna
13	Nadigam WLS Bihar	GPRC/ZSI/Patna
14	Koderma WLS	GPRC/ZSI/Patna

15	Gautam Buddha WLS Bihar	GPRC/ZSI/Patna
16	Dalma WLS	GPRC/ZSI/Patna
17	Rajgir WLS	GPRC/ZSI/Patna
18	Topchanchi WLS Jharkand	GPRC/ZSI/Patna
19	Lawalang WLS Jharkand	GPRC/ZSI/Patna
20	Palamau WLS Jharkand	GPRC/ZSI/Patna
21	Mahuadhar WLS Jharkand	GPRC/ZSI/Patna
22	Hazaribagh, Jharkand	GPRC/ZSI/Patna
23	Kodarma Wildlife Sanctuary	GPRS/ZSI/Patna
24	Dehang Debang Arunachal Pradesh	APFC/ZSI/Itanagar
25	Mahao FR Arunachal Pradehs	APFC/ZSI/Itanagar
26	Pakke WLS (Now TR)Arunachal Pradesh	APFC/ZSI/Itanagar
27	Eagles nest WLS Arunachal Pradesh	APFC/ZSI/Itanagar
28	Kamlang WLS Arunachal Pradesh	APFC/ZSI/Itanagar

29	Talley Valley, Arunachal Pradesh	APRC/ZSI/Itanagar
30	Itanagar WLS Itanagar	APFC/ZSI/Itanagar
31	Kame WLS	APFC/ZSI/Itanagar
32	Saddle Peak NP A&N Islands	ANRC/ZSI/Port Blair
33	Middle Button WLS, A&N Islands	ANRC/ZSI/Port Blair
34	South Button WLS A&N Islands	ANRC/ZSI/Port Blair
35	Radhanagiri WLS Kolhapur	WRC/ZSI/Pune
36	Chandoli WLS Kolhapur	WRC/ZSI/Pune
37	Tansa WLS Thane	WRC/ZSI/Pune
38	Koyna WLS Satara	WRC/ZSI/Pune
39	Bimashankar WLS Maharashtra	WRC/ZSI/Pune
40	Nawegao NP, Maharashtra	WRC/ZSI/Pune
41	Kaimur Mirzapur UP	NRCZSI/Dehradun
42	Samaspur WLS	NRC/ZSI/Dehradun

43	Kaleswar WLS Haryana	NRC/ZSI/Dehradun
44	Katarnia Ghat WLS	NRC/ZSI/Dehradun
45	Sohagbarua WLS UP	NRC/ZSI/Dehradun
46	Mahavir Swamy WLS UP	NRC/ZSI/Dehradun
47	Valley of Flowers	NRC/ZSI/Dehradun
48	Dudwa NP	NRC/ZSI/Dehradun
49	Corbet NP Uttaranchal	NRC/ZSI/Dehradun
50	Kaimur WLS U P	NRC/ZSI/Dehradun
51	Sonanadi WLS (UP)	NRC /ZSI/Dehradun
52	Srisailem-Nagarjunasagar TR	FBC/ZSI/Hyderabad
53	Rani Jhansi Marine NP A&N	ANRC/ZSI/Port Blair
	Isl.	
54	Inglis WLS A & N Islands	ANRC/ZSI/Port Blair
55	M G Marine N P A& N Islands	ANRC/ZSI/Port Blair
56	Great Nicobar BR Nicobar	HQ's &ANRC/ZSI/Port
		Blair
58	Campbel Bay NP A& N Islands	ANRC/ZSI/Port Blair
59	Galathea Bay A& N Islands	ANRC/ZSI/Port Blair

60	Barren Islands A&N Islands	ANRC/ZSI/Port Blair
61	Narcondam Sanctuary A& N	ANRC/ZSI/Port Blair
62	Bamboo Islands A & N	ANRC/ZSI/Port Blair
	Islands	
63	South Sentinel Sanctuary	ANRC/ZSI/Port Blair
64	North Reef	ANRC/ZSI/Port Blair
65	Sariska WLS Rajasthan	DRC/ZSI/Jodhpur
66	Jaisamand WLS Rajasthan	DRC/ZSI/Jodhpur
67	Valvadar NP Bhavnagar	DRC/ZSI/Jodhpur
68	Mt. Abu WLS	DRC/ZSI/Jodhpur
69	Sitamata WLS	DRC/ZSI/Jodhpur
70	Valsad WLS Gujarat	DRC/ZSI/Jodhpur
71	Ratan Mahal WLS	DRC/ZSI/Jodhpur
72	Kumbalgarh WLS	DRC/ZSI/Jodhpur
73	Kajaria WLS	DRC/ZSI/Jodhpur
74	Gulf of Katchchh	DRC/ZSI/Jodhpur + HQs
75	Ranathambore WLS	DRC/ZSI/Jodhpur
76	Talchappar WLS	CRC/ZSI/Jodhpur

77	Manas NP	ERC/ZSI/Shillong
78	Barnadi WLS Kamrup	ERC/ZSI/Shillong
79	Garampani WLS	ERC/ZSI/Shillong
80	Pabha WLS	ERC/ZSI/Shillong
81	Laokawa WLS	ERC/ZSI/Shillong
82	Orang WLS	ERC/ZSI/Shillong
83	Nongkhylllem Sanctuary	ERC/ZSI/Shillong
	Meghalaya	
84	Siju Sanctuary, Meghalaya	ERC/ZSI/Shillong
85	Saipung WLS Meghalaya	ERC/ZSI/Shillong
86	Baghmara, Meghalaya	ERC/ZSI/Shillong
87	Indravati NP Chattisgarh	CRC/ZSI/Jabalpur
88	Bandavgarh WLS, MP	CRC/ZSI/Jabalpur
89	Kangar Valley NP	CRC/ZSI/Jabalpur
90	Noradehi WLS Sagar Damoh	CRC/ZSI/Jabalpur
	MP	
91	Ker Gharial WLS	CRC/ZSI/Jabalpur
92	Panna WLS	CRC/ZSI/Jabalpur

93	Bori WLS Hoshangabad	CRC/ZSI/Jabalpur
94	Satpura WLS	CRC/ZSI/Jabalpur
95	Kanha NP & Balaghat MP	CRC/ZSI/Jabalpur
96	Pachamarhi, MP	CRC/ZSI/Jabalpur
97	Baisapally WLS Orissa	HQ's Kolkata
98	Kuldiya WLS, Orissa	HQ's Kolkata
99	Gahirmatha WLS Orissa	HQ's Kolkata
100	D Ering Memorial WLS,	HQ's Kolkata
	Arunachal	
101	Namdapha T R, Arunachal	HQ's Kolkata + APFC
	Pradesh	Itanagar
102	Sunderban Biosphere Reserve	HQ's Kolkata + SFC
		Canning

Time Frame :

No	STATES	SURVEYS		Completi on of study	Publicatio n of results	Publication for which Inventorisa
		Date of start	Year of completion			

						tion is in progress
01	Andhra	**	2007-2008	2008-	2008-	Part-V & VI during 2007-08
	Pradesh			2009	2009	
02	Arunachal	**	2010 -	2011-	2011-	Vol.2 (2010) Vol.3 (2011)
	Pradesh		2011	2012	2012	
03	Assam	2008-	2010-2011	2011-	2011-	
		2009		2012	2012	
04	Bihar	2007-	2008-2009	2009-	2010-	
		2008		2010	2011	
05	Chandigarh	2008-	2009-2010	2010-	2010-	
		2009		2011	2011	
06	Chattisgarh	2007-	2009-2010	2010-	2010-	
		2008		2011	2011	
07	Goa	**	2007-2008	2009-	2009-	Vol.1 (2008),
				2010	2011	

						Vol.2 (2009), Vol.3 (2010)
	Gujarat	**	2008-2009	2010- 2011	2011- 2012	Vol. 3 in 2009-10
09	Haryana	2007- 2008	2009-2010	2010- 2011	2011- 2012	
10	Himachal Pradesh	**	2009-2010	2011- 2012	2011- 2012	Vol. 1&2 completion in 2009-10
11	Jammu & Kashmir	2010- 2011	2011-2012	2013- 2014	2013- 2014	
12	Jharkand	2007- 2008	2010-2011	2011- 2012	2011- 2012	
13	Karnataka	2009- 2010	2011-2012	2013- 2014	2014- 2015	
14	Kerala	2010- 2011	2013-2013	2014- 2015	2014- 2015	

15	Maharashtra	**	2009-2010	2011- 2012	2012- 2013	2009-10 completion of vol. 1 &2
16	Madhya Pradesh	**	2008-2009	2010- 2011	2012- 2013	2008-2009 completion of first volume
17	Punjab	2012- 2013	2014-2015	2015- 2016	2016- 2017	
18	Tamil Nadu	**	2008-2009	2009- 2010	2011- 2012	2008-2009 completion of first volume
19	Uttar Pradesh	**	2009-2010	2012- 2013	2013- 2014	2009-10 completion of 2 volumes
20	Uttaranchal	**	2008-2009	2010- 2011	2011- 2012	2009-10 complétion

						s of vol. 1&2
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\*\* Already survey and inventORIZATION is in progress

Time frame for Selected Ecosystems

No	ECOSYSTEMS	SURVEYS		Completi	Publicati	Remarks
		Date of start	Year of complet ion	on of study	on of results	
Himalayan Ecosystem						
01	Western Himalaya Ladakh	**	2007-08	2008-09	2009-10	First volume during 2009
02	Western Himalaya (Pangi Valley, HP)	2007-08	2008-09	2009-10	2009-10	
03	Western Himalaya (Zankar Valley,	2010-11	2012-13	2013-14	2013-14	

	J &K)					
Désert Ecosystem						
01	Rajasthan (13 dist.)	**	2008-09	2010-11	2011-2012	Vol. III to be published during 2009-10
02	Gujarat (12 dist)	**	2008-09	2009-10	2009-10	Vol. III to be published during 2009-10
Marine & Island Ecosystem						
01	Andaman & Nicobar	**	2008-09	2009-10	2009-10	Vol.1,2,3 to be published during 2009-10
02	East Coast, Andhra Pradesh	**	2007-08	2008-09	2008-09	Vol. 1(2008-09)
03	East coast	**	2007-	2008-09	2008-09	Vol.1(2009-

	(Orissa & West Bengal)		08			10)
04	West coast	**	2007-	2008-09	2009-10	Vol.1(2009-10)
	Kerala		08			
05	West coast :	2007-	2008-	2008-09	2008-09	
	Goa and Karnataka	08	09			
06	West Coast	2008-	2010-	2011-12	20011-	
	(Maharashtra)	09	11		12	
07	West coast	2008-	2010-	2011-12	2011-12	
	(Gujarat)	09	11			
08	Lakshadweep	**	2010-	2011-12	2011-12	Vol.2 (2010-11)
			11			
Tropical Rainforest Ecosystem						
01	Western Ghats,	**	2009-	2011-12	2012-13	Vol. 1(2009-10)
	Kerala		10			
02	Western Ghats,	**	2009-	2010-11	2011-12	Vol.1(2011-12)
	Tamil Nadu		10			
03	Western Ghats	**	2007-	2008-09	2009-10	Vol.1(2011-

	Karnataka		08			12)
04	Western Ghats	**	2008-			Vol. 1 & 2
	Goa,		09			(2008-09-
	Maharashtra					Goa )
05	Eastern	**	2008-	2010-11	2011-12	One
	Himalaya		09			occasional
	Arunachal					paper to be
	Pradesh					brought in
						each year
Estuarine Ecosystem						
01	Krishna	**	2007-	2008-09	2008-09	
	Estuary		08			
02	Cauvery	2010-	2012-	2013-14	2014-15	
	Estuary	11	13			
03	Pennar Estuary	2012-	2015-	2015-16	2016-17	
		13	16			
04	Brahmani &	2009-	2010-	2012-13	2013-14	
	Vaitarini Estuary	10	12			
05	Narmada &	2008-	2011-	2012-13	2012-13	

	Tapti Estuary	09	12			
06	Hoogly- Matla	2012-	2015-	2016-17	2017-18	Vol. I published (1995)
	Estuary	14	16			
07	Bahuda Estuary	**	2007-	2008-09	2008-09	
	Orissa		08			
08	Vamsadara –	**	2007-	2008-09	2008-09	
	Nagavalli		08			
	(Andhra)					
09	Pulicat Lake	2007-	2008-	2008-09	2008-09	
		08	09			
Freshwater Ecosystem						
01	Nalsarovar	**	2007-	2007-08	2007-08	
			08			
02	Crater Lake,	**	2008-	2008-09	2008-09	
	Buldana		09			
03	Govind Sagar	**	2008-	2008-09	2008-09	
			09			
04	Chandra Tal	2010-	2012-	2012-13	2013-14	

		11	13			
05	Tso Murari J &	2009-	2011-	2012-13	2012-13	
	K	10	12			
06	Bhoj Madhya	2008-	2010-	2011-12	2011-12	
	Pradesh	09	11			
07	Ropar Punjab					
08	Narayan					
	Sarovar					
	Wyra lake	**	2008-	2008-09	2010-11	
	Andhra		09			
	Chauras of N	**	2008-	2008-09	2008-09	
	Bihar		09			
	Madhepura–	**	2007-	2007-08	2008-09	
	Bhagwan		08			
	Wetland , Bihar					
09	Sasthamkota,	2010-	2013-	2014-15	2014-15	
	Kerala	11	14			
10	Deeper Beel,	2008-	2010-	2011-12	2011-12	
	Assam	09	11			

11	Sultanpur	2009-	2011-	2013-14	2013-14	
		10	12			
12	Kanjili Punjab	FBS/ZSI/Hyderabad; NRS/ZSI/Dehradun				
13	Urban & Peri	FBS/ZSI/Hyderabad ( Continuous ongoing and publication regularly)				
	Urban Lakes of Hyderabad					
14	Urban & Peri	HQ's, ( Continuous ongoing and publication regularly)				
	Urban Lakes of Kolkata					

## GAP AREAS &amp; EXPERTISE

## Expertise Available and Shortfall

Group	No. of Species known	Experts available	Experts required
Protozoa	2577	3	6
Mesozoa	10	Nil	Nil
Porifera	486	2	3
Cnidaria	842	3	5
Ctenophora	12	1	1
Platyhelminthes	1622	3	6

Rotifera	330	2	2
Gastrotricha	100	Nil	2
Targigrada	30	1	Nil
Echinodermata	800	2	3
Hemichordata	12	Nil	1
Kinorhyncha	10	Nil	1
Nematoda	2850	11	5
Acanthocephala	229	1	1
Sipuncula	35	Nil	1
Mollusca	5070	10	10
Echiura	43	Nil	1
Annelida	840	5	3
Crustacea	3220	5	6
Arachnida	5818	5	10
Pycnogodia	16	Nil	1
Chilopoda	100	1	1
Symphyla	4	Nil	Nil
Merostomata	2	Nil	Nil

Phoranida	3	Nil	Nil
Bryozoa	200	Nil	2
Ectoprocta	10	1	Nil
Brachyopoda	3	Nil	Nil
Chaetognatha	30	Nil	1
Apterygota	300	2	2
Odonata	500	5	4
Ephemeroptera	106 (12)	3	1
Phasmida	150 (30)	0	1
Orthoptera	1700 (30)	8	5
Embioptera	31 (2)	-	1
Mantodea	161 (6)	1	1
Blattaria	186 (12)	2	2
Dermaptera	350 (7)	-	2
Isoptera	90 (16)	2	1
Plecoptera	113 (7)	1	1
Phthiraptera	400 (8)	-	1
Thysonoptera	693 (5)	1	1

Hemiptera	6500 (77)	8	10
Neuroptera	355 (13)	1	1
Coleoptera	15,500 (104)	11	25
Strepsiptera	18 (4)	-	1
Mecoptera	21 (2)	-	1
Diptera	6100 (84)	8	25
Lepidoptera	15,000 (84)	7	25
Trichoptera	1000 (19)	1	4
Siphonoptera	52 (8)	-	1
CHORDATA			
Protochordata	119	-	1
Pisces	2546	10	5
Amphibia	285	5	5
Reptilia	460	5	5
Aves	1232	7	5
Mammalia	397	6	5
Total	Requirement		225

MAN POWER REQUIREMENT:

Existing Staff Strength:

	Original	Post	Existing	Man in	Vacant
	Sanctioned	abolished	posts	position	posts
	Strength				
Gr. A	151	10	141	76	65
Gr. B	84	3	81	33	48
Gr. C	647	94	553	378	175
Gr. D	316	54	262	185	77

Note : Now there is no Group – D posts, as all vacant posts have been surrendered and all remaining ones are elevated to Group - C

Manpower Requirement : a. Filling up of all vacant posts b. Additional Requirement

	2010-11	2011-12	2012-13	2013-14	2014-15

Gr. A					
Scientific Posts	25	25	20	20	20
Gr. B					
	15	10	10	10	10
Gr. C					
	25	15	15	15	10
Research Scholars	25	10	10	10	10

FINANCIAL OUTLAY

(Amount in Crore Rupees)

Present Financial Outlay :

Head of Account	2004-05	2005-06	2006-07	2007-08	2008-09
Plan	6.46	6.62	7.9	9.80	12.07

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Non Plan	10.04	10.56	10.95	11.25	14.52

FINANCIAL REQUIREMENTS :

Head of Account	2010-11	2011-2012	2012-13	2013-14	2014-15
Plan	20.00	25.00	30.00	32.00	35.00
Non Plan	20.00	25.00	30.00	32.00	35.00