

NATURAL RESOURCES

Survey and Exploration

Flora

Exploration of plant resources of the country and identification of plant species with economic virtues is carried out by the Botanical Survey of India (BSI), established on 13th February, 1890 and its various circles. During the successive plant periods, the functional base of Botanical Survey of India was expanded to include various new areas such as inventorising of endemic, rare and threatened plant species; evolving conservation strategies; studies on fragile ecosystems and protected areas like Sanctuaries, National Park and Biosphere Reserve; monitoring of changes in floristic components; conservation; multiplication and maintenance of germplasm of plant genetic resources, endemic and threatened species, wild ornamentals etc., in Botanic Gardens and Orchidaria; ethnobotanical and geobotanical studies and development of National Database on Herbarium (including type specimens) and live collections, plant genetic resources, plant distribution and nomenclature.

Exploration, inventorisation and documentation of phytodiversity in general and protected areas, hotspots, fragile ecosystems and sacred groves in particular; publication of National, State and District Floras, monitoring Phytodiversity to evaluate the qualitative changes in species rich and sensitive areas; *ex situ* conservation of critically threatened taxa in botanical gardens, and identification of species with traditional economic uses and preparation of protocols for their conservation and sustainable utilization etc. are the primary objectives of BSI.

Botanical Exploration and Inventorisation of Phytodiversity

Seventy field/exploration/collection tours were undertaken by different circle offices and units of BSI covering:

- ❑ National Capital Territory (Delhi and its environ); Chittoor district of Andhra Pradesh; Twang and Upper Subansiri districts of Arunachal Pradesh; Mehasana, Jamnagar, Kutch and Palanpur (Banaskantha) districts of Gujarat; Raigarh district of Maharashtra; Ganjam district of Orissa; Jalpaiguri, Bankura, Howrah & North 24 Parganas districts of West Bengal and districts of Himachal Pradesh and Uttaranchal (North West Himalayas).
- ❑ Barren, Interview Snake, Rutland and Sound Islands of Andaman & Nicobar Islands.



Fig 1. *Gloriosa superba* Linn. - a medicinal and ornamental species

- ❑ Mount Saramati Wildlife Sanctuary of Nagaland, Nongkhylllem Wildlife Sanctuary of Meghalaya, Maeinum Wildlife Sanctuary of South Sikkim, Fumbonglho Wildlife Sanctuary of East Sikkim, Tansa Wildlife Sanctuary of Maharashtra, Parasnath Wildlife Sanctuary of Jharkhand and Rajgir Wildlife Sanctuary of West Bengal.

- ❑ Malavan Marine Sanctuary of Goa.
- ❑ Mahatma Gandhi Marine National Park of South Andamans.
- ❑ Wetlands of Himachal Pradesh (Renuka, Pong, Chandratal) and South India.
- ❑ Tendong Reserve Forest of South Sikkim and Panchmarhi Biosphere Reserve of Madhya



Fig 2. *Aegiceras corniculatum* - flowers being pollinated by insects

- Flora of India: Lauraceae (pro parte)
- Flora of India: Polygonaceae
- Flora of India: Genus-Strobilanthes
- Flora of India: Lamiaceae (Plectranthus group incl. Coleus)
- Flora of India: Leguminosae: tribe Galegae (excl. Astragalus)
- Flora of India: Lauraceae (excl. Litsea, Neolitsea & Lindera)
- Aphylliphorales of North West Himalayas
- Pteridophytic flora of Western Himalayas
- Monocot Flora of Dibang Valley, Arunachal Pradesh
- Flora of Uttar Pradesh, Vol. I
- Flora of Mizoram, Vol. II
- Flora of Gujarat State
- Flora of Karnataka State
- Flora of Tawang District, Arunachal Pradesh
- Moss Flora of Tawang District, Arunachal Pradesh
- Flora of Ganjam District, Orissa
- Flora of Nongkhylllem Wildlife Sanctuary, Meghalaya
- Botany of Tendong Reserve Forest, South Sikkim

Documentation of Phytodiversity

National Flora (Flora of India)

- Orchidaceae (Genera – *Oberonia*, *Microstylis*, *Liparis*, *Orcorchis* & *Corallorrhiza*) : Manuscript of 30 species completed.
- Lauraceae (*pro parte*): Completed five species. Description made for nine spp. of *Actinodaphne* based on herbarium specimens at Central National Herbarium, Howrah, West Bengal.

Pradesh.

During the field/exploration/collection tours, more than 9,500 specimens have been collected including lower groups of plants viz. algae, fungi, lichens, bryophytes and pteridophytes. About 3,500 specimens belonging to 720 species were identified by different circles/units of BSI.

The following revisionary and floristic studies were undertaken under National Flora and State/Region/District flora:

- Flora of India: Orchidaceae (Genera – *Oberonia*, *Microstylis*, *Liparis*, *Orcorchis* & *Corallorrhiza*)



Fig 3. *Strobilanthes kunthianus* (Nees) - a plant of Western Ghats that flowers once in 12 years

Habit sketches for different genera prepared.

- ❑ Ebenaceae : Project completed in all respect. Manuscript ready for publication.
- ❑ Polygonaceae : Completed 25 species.
- ❑ Cyperaceae (Genus – *Kyllinga*, *Pycneus*, *Mariscus* & *Courtoisina*) : Specimens are being procured from various circles of BSI and being studied.
- ❑ Smilacaceae: Completed description and nomenclature citation for 12 species.
- ❑ Orchidaceae (Two tribes & 321 genera excluding *Oberonia*, *Microstylis*, *Liparis*, *Orcorchis* & *Corallorrhiza*): Description of five species completed and studied 12 species.
- ❑ Thymelaeaceae: Completed studies on four species of the genus *Daphne*.
- ❑ Acanthaceae: Completed six species of *Lepidagathis* and studied five species.
- ❑ Leguminosae: tribe Galegae (excluding *Astragalus*): Finalisation of manuscript is in final stage.
- ❑ Lamiaceae (Plectranthus group including *Coleus*): Completed 15 species.
- ❑ Amaranthaceae: Completed description of 19 species belonging to the genera *Cyathula*, *Alternanthera*, *Celosia* and *Pupalia*.

Regional Flora

- ❑ Flora of Barapani Experimental Garden, Shillong: Completed Taxonomic description of 100 species of Orchidaceae.
- ❑ Pteridophytic Flora of Western Himalaya: 42 species completed.
- ❑ Aphylophorales of North West Himalaya: 55 species completed.
- ❑ Flora of Cold Deserts of Western Himalaya, Vol. II: 49 species completed.
- ❑ Flora of Maredumilli, East Godavari, Andhra Pradesh: Completed systematic enumeration of 937 species. Submitted the manuscript for computerization. Preparation of manuscript for introductory chapter is in progress.
- ❑ Flora of Indian Botanic Garden: Completed manuscript of 40 species.



Fig 4. *Saussurea obvallata* - commonly known as Brahma's lotus

State Flora

- ❑ Flora of Assam, Vol. II: Manuscript under finalization
- ❑ Flora of Mizoram, Vol II: Description of 70 species completed in all respect
- ❑ Flora of Sikkim: (Orchidaceae): 32 species completed
- ❑ Flora of Uttar Pradesh, Vol. II: 60 species completed
- ❑ Flora of Jammu & Kashmir, Vol. II (Rubiaceae, Dipsacaceae, Iteaceae, Morinaceae, Parnesiaceae,

Trapaceae, Araliaceae, Alangiaceae, Valerianaceae): 59 species completed.

- ❑ Flora of Karnataka (Asteraceae, Convolvulaceae, Piperaceae, Rubiaceae, Urticaceae, Gentianaceae, Flacourtiaceae, Polygonaceae, Staphyleaceae, Sabiaceae, Anacardiaceae, Moringaceae, Connaraceae, Passifloraceae, Bignoniaceae): Manuscript under finalization.
- ❑ Flora of Kerala, Vol. II (Mimosaceae, Araliaceae, Apiaceae, Hydrophyllaceae, Asteraceae, Asclepiadaceae): Completed rewriting of flora of two species each of Mimosaceae and Araliaceae and one species of Apiaceae as per new format. Prepared rough manuscript for Hydrophyllaceae. The specimens of *Wedelia urticaefolia* DC. [Asteraceae] in the herbarium of BSI – Southern Circle, Coimbatore with respect to distribution and phenological data with description was studied. Key for four species of *Wedelia* were prepared and references were added from floras published on Asteraceae of Kerala. Information for 12 genera and 28 species of the family Asclepiadaceae from herbarium specimens was collected. Citation for genera has been written on *Asclepias*, *Hemidesmus*, *Cryptolepis*, *Calotropis*, *Pergularia*, *Holostemma* and *Cynanchum*.
- ❑ Flora of Andaman & Nicobar Islands, Vol. II: Completed the family Orchidaceae, Goodeniaceae, Lobeliaceae and Cuscutaceae and the indexing of Herbarium specimens of the family Scrophulariaceae as well as the description of 29 genera and 32 species of the family Apocynaceae.
- ❑ Flora of West Bengal, Vol II (*Fabaceae* to *Aizoaceae* – 32 families): editing work of 350 species completed.
- ❑ Flora of West Bengal, Vol. III: Final manuscript of Gentianaceae and Caesalpiniaceae has been submitted. Completed description of 11 taxa belonging to Symplocaceae. Twelve species of Araceae and 40 species of Asteraceae were completed.



Fig 5. *Dipterocarpus griffithii* - pride of Andamans

- ❑ Pteridophytic Flora of West Bengal: A list of pteridophytic species in West Bengal has been completed. West Bengal represents 500 species under 129 genera and 49 families. Correct nomenclature, description, key to the genera and species is being worked out. Work on the family Thelypteridaceae and Aspleniaceae have been completed.

District Flora

- ❑ Flora of Lakshadweep: Work on the preparation of detailed description of 265 field numbers of specimens collected from Lakshadweep has been undertaken.
- ❑ Flora of Tawang District, Arunachal Pradesh: Manuscript under finalization.
- ❑ Flora of Medak District: Manuscript completed.
- ❑ Flora of Ganjam District, Orissa: 45 species completed.
- ❑ Lichen Flora of Howrah District, WB: Project completed and manuscript has been submitted.

Detailed description and comparative account of *Calotropis procera*, *C. gigantia*, *C. acia*, *C. affiprocera* (from Sudan) that are growing in the site of Botanic Garden of India Republic, NOIDA is being prepared by Conservation Research and Education Division (CRED).

An endemic species *Barleria gibsonioides* Blatt. (Acanthaceae) from an area other than type locality has been rediscovered.

New Species/Variety discovered

Dendrobium numaldeorii Deori, et al Family [Orchidaceae]; *Coelogyne pempahisheyana* Chowdhery Family [Orchidaceae]; *Silene gangotriana* Pusalkar P.K., D.K. Singh & P. Lakshinarasimhan [Caryophyllaceae]; *Eriocaulon balakrishnanii* Punekar, S.A., P. Lakshinarasimhan & M.K.V. Rao [Eriocaulaceae]; *Frullania larjiana* Singh, S.K. & D.K. Singh [Jungermanniopsida: Frullaniaceae – Bryophytes]; *Bulbophyllum trichocephalum* var. *wallongense* Agarwal, Sabapathy & Chowdhery [Orchidaceae]



Fig 6. *Medinilla* sp. - new record for India

New Records for India

Thottea paucifida Ding Hou [Aristolochiaceae]; *Pergularia tomentosa* L. [Asclepiadaceae]; *Medinilla quadrifolia* (Bl.) Bl. [Melastomataceae]; *Juncus spumosos* Noltie [Juncaceae]; *Pseudocyclosorus esquirolli* (Christ) Ching [Thelypteridaceae] – Pteridophyte; *Asterothyrium decipiens* R. Sant. [Thelotremataceae] – Lichens.

Plants collected after 50 years or more

- ❑ *Gymnocladus assamicus* Kanj. ex P.C. Kanj – a rare and endemic plant of North East India has been collected after 70 years from birang, West Kameng District, Arunachal Pradesh.
- ❑ *Phymatosorus banerjianus* (Pal et. Pal) – a rare and endemic plant from Howrah District, West Bengal.
- ❑ *Cleisostoma elegans* Seidenf. – a plant of Orchidaceae family collected from Andaman Islands.

New Record for State

- ❑ *Thelasis pygmaea* Lindl. [Orchidaceae] – Andaman group of Islands
- ❑ *Murdannia nudiflora* (L.) Brenan [Commelinaceae] – Delhi, established by scientists of BGIR
- ❑ *Myricaria albiflora* Grierson [Tamaricaceae] – North West Himalayas
- ❑ *Vernonia vivekananthanii* Uniyal [Asteraceae] – West Bengal
- ❑ *Bacidia olivaceorufa* Bacidiaceae [Bacidiaceae] – Nagaland

Ex-situ Conservation of Endangered, Endemic, Economic and Ornamental Plants

- ❑ Under the project *Procurement of Seedlings and seeds of endangered and other Species*, Botanic Garden of India Republic (BGIR) – NOIDA collected, introduced and maintained seventy seven rare/threatened/ medicinal/economic important/ornamental plants. Multiplication and propagation of *Chlorophytum tuberosum* Baker and the germination of *Cycas beddomei* Dyer is being monitored on regular basis; details of specific germination parameters are being noted by the Conservation Research and Education Division (CRED) of BGIR. Thirty two orchids belonging to eight nothospecies have been introduced in the orchid section of BGIR. A rare and endangered orchid *Paphiopedilum fairrieianum* flowered in the orchid section of the garden. This is the first report of flowering of *Paphiopedilum* in the National Capital Territory region.
- ❑ Two Field Tours were conducted under the Project *Micropropagation/multiplication of rare, endangered and economically important plants in the EBG, Barapani & National Orchidarium, Shillong* to Kulsi in Assam and Dibang Valley in Arunachal Pradesh and collected live plants for introduction, maintenance and propagation purpose in the Experimental Garden, Barapani and National Orchidarium, Shillong.
- ❑ Two rare ferns (*Pteris stenophylla* Wall. ex Hook. et Grev. and *Cheilanthus subvillosa* Hook.) have been introduced in the *Swarna Jayanti Udyan*, BSI – Northern Circle, Dehradun. Five species of medicinal/



Fig 7. A view of Loktak Lake

economic importance and 14 ornamental species have also been introduced.

❑ Seeds of six rare/medicinal/economic important plants and 24 rare/threatened species have been collected from Shevaroy Hills, Kodaikanal & Pulney hill ranges and introduced in Experimental Botanic Garden (EBG) Garden and National Orchidarium, Yercaud. Eighteen rare/threatened species and 10 medicinal/economically important species have also been multiplied. Transplantation/Replanting of nine rare/threatened orchid species and one medicinal/economically important species has also been done.

- ❑ Nine medicinal/economic important species and 90 cultivar roses collected from Madhya Pradesh and Chattisgarh have been introduced and maintained in the Experimental Botanic Garden of BSI – Central Circle, Allahabad.
- ❑ Twenty-nine rare/threatened species, 18 medicinal/economically important species and three ornamental species have been collected from Western Ghats, Darjeeling and Meghalaya and introduced and maintained in Indian Botanic Garden, Howrah. Saplings of *Frerea indica*, *Kaempferia galanga* and *Pterocarpus santalinus* collected from different places of Maharashtra and Andhra Pradesh have also been planted..
- ❑ Fifteen rare/threatened/endemic, nine medicinal/economically important, two ornamental and 15 other spp. collected and introduced and maintained in the office campus garden of BSI in its Western Circle, and Mundhwa Experimental Garden, Pune.

Bioperspective Assessments

Following pharmacognostical studies have been performed under the project *Pharmacognostic Studies on the selected plants of Negative List of Export*:

- ❑ Collected seeds of *Cycas beddomei* from Sri Venkateshwara National Park, Andhra Pradesh for pharmacognostic studies.
- ❑ The macromorphological features and organoleptic characters of stem barks of CITES negative listed *Coscinium fenestratum*, heartwood of *Pterocarpus santalinus* and rhizome of *Kaempferia galanga* were studied.
- ❑ The free hand sections of the aerial parts of *Frerea Indica* were studied under microscope and various histological features were recorded.
- ❑ The coarsely powdered stem



Fig 8. Bract fungi - an example of biological diversity

barks of *Cosciniium fenestratum*, heartwood of *Pterocarpus santalinus*, rhizome of *Kaempferia galangal*, aerial parts of *Frerea Indica* and seeds *Cycas beddomei* were examined under Ultra Violet radiation after treatment with various reagents and the characteristic fluorescence properties emitted were recorded.

Various chemical studies have been performed under the project *Isolation and Identification of Secondary Metabolites from Bauhinia Plants* and *Chemical Screening of Ethnobotanical Species (medicinal only) of Rubiaceae family*:

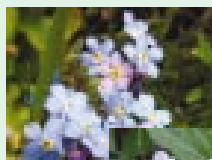
Pollen morphological studies of 36 samples from the family Combretaceae, and Nyctaginaceae have been made under Scanning Electron Microscope (SEM). Three crude drug samples have been studied for proper identification of the samples sent by Department of Customs, Government of India.

Work on the Ethnobotany of Eastern India (Sambalpur district and Darjeeling district) has been completed and manuscript has been prepared. Under the project "Ethnobotany of Jharkhand", 65 reference cards have been prepared and ethnobotanical information of 60 plants collected from published literature.

Related Programmes

- ❑ Hundred algae samples of different lakes, 30 samples of lichens and 10 samples of mosses were collected from Schirmacher Oasis, East Antarctica during 23rd Indian Scientific Expedition to Antarctica. The algae samples collected, from different lakes of Schirmacher Oasis, are examined under light microscope and nine fresh algae have been identified up to generic level.
- ❑ Under the project, 'Database development of Introduced Plants of Botanic Garden of Indian Republic – NOIDA' database structure with additional fields has been finalized. Data entry in various data fields, such as description, distribution, vernacular names, phenological data, known cultivation procedures, common uses, etc., of 55 species that were procured from the different parts of the country have been completed. Necessary measures have been taken for collection of seeds of the *Calotropis* species from Sudan.
- ❑ Various research papers were published in both Indian and foreign journals in addition to books and other related documents.
- ❑ An electronic book on Sunderban Biosphere 'Reserve' has been prepared by Industrial Section of Indian Museum, BSI, Kolkata to review all the available literature, identify the research gaps and formulating management plan for Biosphere Reserve.

UPDATES 2004-2005



- Seventy fields/exploration/collection tours were undertaken by the Botanical Survey of India (BSI) and its different circles during the year and more than 9,500 specimens including lower group of plants have been collected. About 3,500 specimens belonging to 720 species were identified by the BSI.
 - Three rare and endemic plants, one from North-East, other from West Bengal and another from Andaman Islands have been collected by the BSI after 50 years or more.
 - Ex-situ conservation of different endangered, endemic, economic and ornamental plants was continued by the BSI and Botanic Garden of India Republic.
- Under herbarium maintenance, 16,364 specimens of plants were mounted, 3,587 specimens were remounted, 2,688 specimens were incorporated, 2,374 specimens were sent on loan and 1,836 specimens and 581 specimens were identified in the different herbaria of the BSI.
- The BSI has developed databases on 45 food product plants, 36 fibre-yielding plants, 98 dye and tans yielding plants, 34 medicinal plants, 40 oil and oil seed plants and 49 gum and resin yielding plants.

- ❑ A list of identified specimens collected from Satkosia Wildlife Sanctuary was prepared.
- ❑ A workshop on 'Herbarium Technique and Methodology' was organized by the ENVIS Centre at BSI.
- ❑ Ten Environmental Impact Assessment (EIA) Studies in diverse sectors have been completed.
- ❑ Under herbarium maintenance 16,364 specimens were mounted, 3,587 specimens were remounted, 2,688 specimens were incorporated, 2,374 specimens were sent on loan and 1,836 specimens & 581 species identified in the different herbaria of BSI.
- ❑ Database on 45 food product plants, 36 fibere yielding plants, 98 dye and tans yielding plants, 34 medicinal plants, 40 oil and oil seeds, 49 gum & resin yielding plants, was developed.
- ❑ Assessment of Floristic Diversity in Hemis National Park, Ladakh, J & K, in Gangotri National Park, Uttarkashi, Uttaranchal and in Campbell Natural Park, Great Nicobar was carried out and report has been finalized.

Fauna

Survey, exploration and research leading to advancement of knowledge on the exceptionally rich faunal diversity of the country is carried out by the Zoological Survey of India (ZSI), established in 1916 with its headquarter at Kolkata and sixteen Regional Stations located in different parts of the country. ZSI in recent years, has reoriented its plan of work by grouping the survey and studies under five major programmes viz. a) Fauna of States, b) Fauna of Conservation Areas, c) Fauna of Important Ecosystems, d) Status Survey of endangered species, and, e) Ecological Studies/Environment Impact Assessment Survey.

Sixty four extensive faunal surveys were undertaken to different State/Union Territories including important ecosystems and some



Fig 10. False vampire bat, *Megaderma lyra* Geoffroy: A false vampire bat considered to be of medicinal value by the locals of Bannerghatta National Park, Karnataka



Fig 9. *Junonia almana* (Linnaeus) - a butterfly species

selected conservation/protected areas. Two status surveys one for Wild Buffalo in Western Orissa and another for Small Travancore flying squirrel in Kerala was also conducted. One Environment Impact Assessment Survey was conducted in connection with the extension of Damodar Valley Thermal Power Project and another in connection with the Hydroelectric project in Pithoragarh District (Dhaulti & Gauriganga of Uttaranchal State). Besides, several short duration intensive surveys for ecological studies were also undertaken. Detailed taxonomic studies were carried out on the material collected during these surveys as well as earlier surveys. Ecological studies including status survey of endangered animals were continued.

The National Zoological Collection was enriched by the addition of 15,239 identified specimens belonging to 698 species.

Faunal Exploration and Surveys

Ecosystems

Tropical Rainforest

Four extensive surveys were conducted to Western Ghats in Kerala State.

Wetlands

Five extensive surveys were conducted in Bhagwanpur (Bihar), Govind

Sagar (Punjab), Pocharam Lake (Andhra Pradesh), Wetlands of Gujarat and Dom Valley.

Marine/Coastal

Six surveys, one to Keelakarai group of Islands of Gulf of Mannar, three to Kerala Coast and one each to Maharashtra and Orissa Coast were carried out.

Estuarine

Three surveys were conducted to Behuda Estuary, Orissa.

Conservation Area

Biosphere Reserves

One survey to Amarkantak (M.P.) and another to Gulf of Mannar were carried out.

National Parks

A total of six surveys in Corbett (Uttaranchal), Bannerghata (Karnataka), Ranthambore (Rajasthan), Bandhavgarh and Vanvihar (M.P.) were carried out.

Wildlife Sanctuaries

One survey each to Ballavpur (W.B.) and Lonar (Maharashtra) and two surveys each to Talchhapar (Rajasthan) and Lunar Crator (Maharashtra) and Baghmara (Meghalaya) were carried out.

States and Union Territories

Thirty surveys were conducted in several districts of Andhra Pradesh, Goa, Gujarat, Madhya Pradesh, Maharashtra, Kerala, Uttaranchal and West Bengal.

Ecological/Status Survey

Two status surveys, one for Wild Buffalo in western Orissa and another for Small Travancore flying squirrel in Kerala were also conducted.

Environmental Impact Assessment Survey

In connection with the extension of Damodar Valley Thermal Power Corporation, one survey was conducted to Chandrapura of Jharkhand State and another in connection with the studies on the Fauna of Pithoragarh District (Dhauli & Gauriganga (NHPC)) of Uttaranchal State.

Research Work

Identification of New Taxa

During the year following taxa were discovered as new to science.

Phylum	Arthropoda
Class	Insecta
Order	Hymenoptera
Family	Pteromalidae

(*Grahamista gastris* sp. nov.)

Class	Crustacea
Order	Cladocera
Family	Daphniidae



Fig 11. Rhino in Kaziranga National Park - needs protection

(*Simocephalus goensis* sp. nov.)

Class Arachnida

Order Araneae

Family Theraphosidae

(*Poecilotheria mallamalai* sp. nov.)

Order Acarina

Family Haplochthoniidae

(*Haplochthonius antarcticus* sp. nov.)

H. maitri sp. nov.

H. longisetosus sp. nov.

Family Chaunoproctidae

(*Chaunoproctus orientalis* sp. nov.)

C. sisri sp. nov.

C. amarpurensis sp. nov.

Family Tegeocranellidae

(*Tegeocranellus punctatus* sp. nov.)

Family Oribatulidae

(*Zygoribatula beloniensis* sp. nov.)

Family Ascidae

Antemoseius orientalis sp. nov.

Taxonomic Studies

The research work carried out on the fauna collected from different states, conservation areas and other ecosystems are as follows:

Fauna of India

The following two volumes were published.

i) Scolytidae: Coleoptera Part I

ii) Gastrotricha

Fauna of States

Details of the number of specimens collected and species identified (in parentheses), based on collections made from different states are given in Table-1.

Fauna of Conservation Areas

Biosphere Reserve

Simlipal, Mayurbhanj, North Orissa

Three specimens belonging to three species of Amphibia were studied and identified.

Dehang Dibang

Twelve specimens pertaining to twelve species of Chilopoda were studied and recognized.



Fig 12. Sambar stag in its natural habitat

Table-1
Groups of Animal collected, Numbers of Specimens and species (in parenthesis)

States/UT's	GROUPS												
	Bryozoa	Rotifera	Nematoda	Annelida	Mollusca	Odonata	Isoptera	Hemiptera	Orthoptera	Dictyoptera	Lepidoptera	Coleoptera	Diptera
Andaman & Nicobar Is.	-	-	-	-	-	-	-	-	-	1(1)	-	-	-
Assam	-	20(20)	-	-	-	-	-	-	-	-	-	-	-
Andhra Pradesh	-	-	-	-	184(8)	-	-	522(24)	11(3)	-	-	543(22)	-
Arunachal Pradesh	-	-	-	-	-	-	-	-	-	-	-	-	-
Goa	-	-	-	-	126(8)	-	-	-	-	-	-	-	-
Gujarat	-	-	29(6)	-	-	-	-	-	-	-	-	-	-
Himachal Pradesh	-	-	-	-	-	-	-	-	-	-	-	-	-
Karnataka	-	-	-	-	169(6)	-	-	-	-	-	-	-	-
Kerala	-	-	-	-	-	185(21)	-	-	63(16)	-	-	-	-
Maharashtra	-	-	-	-	-	117(11)	-	99(8)	-	-	-	-	-
Manipur	-	-	-	-	-	-	-	-	-	-	-	-	-
Meghalaya	-	-	-	-	-	-	-	-	-	-	-	-	-
Mizoram	-	-	-	-	-	-	-	-	-	-	-	-	-
Nagaland	-	-	-	-	-	-	-	-	-	1(1)	-	-	-
Rajasthan	-	-	5(5)	-	-	-	417(19)	-	-	-	-	4544(19)	-
Tamil Nadu	54(3)	-	-	159(11)	65(8)	47(14)	-	-	13(6)	15(4)	-	-	-
Uttaranchal	-	-	-	-	-	-	-	296(15)	130(17)	-	47(20)	-	-
West Bengal	-	-	36(4)	-	-	-	-	-	-	-	-	-	-

States/UT's	Diptera	Hymenoptera	Crustacea	Acarina	Araneae	Scorpionida	Myriapoda	Pisces	Amphibia	Reptilia	Mammalia
Andaman & Nicobar Is.	-	-	-	-	-	-	-	-	-	-	-
Assam	-	-	-	-	-	-	-	-	-	-	-
Andhra Pradesh	-	-	81(7)	85(4)	172(11)	8(4)	-	445(19)	-	-	-
Arunachal Pradesh	-	-	-	228(16)	-	-	-	-	-	-	-
Goa	-	-	122(16)	-	-	2(1)	9(3)	2(2)	11(2)	-	-
Gujarat	-	-	-	-	-	-	-	-	-	-	-
Himachal Pradesh	-	-	-	-	-	-	-	-	-	-	5(5)
Karnataka	-	-	7(7)	-	11(3)	140(3)	-	135(13)	148(5)	-	-
Kerala	-	32(8)	-	-	80(4)	-	2(1)	92(12)	-	-	-
Maharashtra	-	26(3)	-	-	-	18(3)	-	3(1)	314(5)	-	5(3)
Manipur	-	-	-	-	-	-	-	-	-	-	-
Meghalaya	-	-	-	-	-	-	-	-	51(11)	3(3)	-
Mizoram	-	-	-	-	-	-	-	-	-	-	-
Nagaland	-	11(2)	-	-	-	-	-	-	-	-	-
Rajasthan	-	-	-	-	-	-	-	-	-	-	-
Tamil Nadu	-	-	11(3)	10(2)	-	-	-	-	-	-	-
Uttaranchal	-	-	-	-	750(30)	-	-	4(4)	5(3)	-	-
West Bengal	-	-	-	-	-	-	-	-	-	-	-

National Parks

Pench, Maharashtra

Seventy specimens pertaining to five species of Thysanoptera were studied and recognized.

Tadoba, Maharashtra

One hundred and thirteen specimens belonging to five species of Thysanoptera were studied and determined.

Sanjay Gandhi, Maharashtra

Nine specimens comprising two species of Mollusca, 30 specimens belonging to seven species of Odonata, 17 specimens pertaining to three species of Mantodea, two specimens belonging to one species of Cladocera, 32 specimens comprising nine species of Myriopoda, five specimens consisting of four species of Chilopoda, 86 specimens belonging to 28 species of Araneae, seven specimens pertaining to three species of Acarina and 70 specimens comprising four species of Scorpionida were studied and identified.



Fig 13. A pair of painted stork

Bannerghata, Karnataka

A total of 2,657 specimens belonging to 24 species of Pisces were studied and recognized.

Bandhavgarh, Madhya Pradesh

Eighteen specimens pertaining to four species of Odonata, 41 specimens belonging to 19 species of Coleoptera, five specimens comprising two species of Lepidoptera and 100 specimens consisting of two species of Acarina were studied and determined.

Gir, Gujarat

Eleven specimens comprising of five species of Coleoptera were studied and recognized.

Kangerghati, Chhattisgarh

Ninety five specimens belonging to 19 species of Lepidoptera were studied and determined.

Pin Valley, Himachal Pradesh

Four specimens pertaining to four species of Diptera were studied and identified.

Ranthambore, Rajasthan

Two hundred and four specimens consisting of nine species of Isoptera and two specimens pertaining to two species of Nematelminthes were studied and recognized.

Tiger Reserve

Tadoba, Maharashtra

Thirteen specimens belonging to four species of Thysanoptera were studied and determined.

Wildlife Sancturries

Ballavpur, W.B.

Seventy four specimens comprising four species of Oligochaeta were studied and identified.

Biligiri Rangaswamy Temple, Karnataka

Nine specimens consisting of two species of Crustacea were studied and recognized.

Talchhapar, Rajasthan

Thirty one specimens belonging to three species of Coleoptera were studied and determined.

Baghmara, Meghalaya

Nineteen specimens pertaining to four species of Rotifera, 20 specimens comprising six species of Cladocera, 57 specimens belonging to four species of Amphibia and two specimens consisting of one species of Reptilia were studied and identified.



Fig 14. Indian lioness at Gir National Park

Lonar, Lonar Crater, Maharashtra

Two specimens consisting of two species of Rotifera, nine specimens comprising two species of Mantodea, 51 specimens belonging to five species of Hymenoptera, 54 specimens pertaining to six species of Myriapoda and four specimens belonging to one species of Scorpionida were studied and recognised.

Reserve Forest**Baghmara, Meghalaya**

Nineteen specimens comprising four species of Rotifera, three specimens consisting of two species of Orthoptera, 37 specimens belonging to 10 species of Cladocera, 57 specimens consisting of four species of Amphibia and 12 specimens pertaining to seven species of Reptilia were studied and determined.

Fauna of Important Ecosystems**Mangroves****Kerala**

One hundred and twenty three specimens pertaining to 15 species of Pisces were studied and recognised.

Freshwater/Riverine/Wetlands**Korapuzha, Kerala**

Three hundred and ninety three specimens comprising 16 species of Pisces were studied and identified.

Nayar River, Uttaranchal

Nine specimens belonging to five species of Pisces were studied and determined.

Nath Sagar, Maharashtra

Two hundred and seventy seven specimens consisting of 13 species of Odonata, 201 specimens pertaining to eight species of Hemiptera (aquatic bugs), 134 specimens belonging to 22 species of Crustacea and 31 specimens comprising six species of Pisces were studied and recognised.

Nalsarovar, Gujarat

Ten specimens belonging to seven species of Rotifera, three specimens pertaining to three species of Diptera and five specimens comprising five species of Pisces were studied and identified.

Pocharam, Andhra Pradesh

The limnological studies on the fauna of this wetland were continued and 16 specimens consisting of 16 species of Rotifera, 18 specimens belonging to 12 species of Cladocera and 541 specimens pertaining to 19 species of Pisces were determined.

Estuarine

Vamsadhara Nagavali, Andhra Pradesh

Seventy eight specimens comprising six species of Crustacea were studied and recognised.

Bahuda, Orissa

As a result of studies conducted on the intertidal fauna of this estuary, 85 specimens belonging to eight species of Crustacea were identified.

Marine/Coastal

Tamil Nadu Coast

Two hundred and fifteen specimens comprising seven species of Porifera, 20 specimens pertaining to five species of Hirudinea, 11 specimens belonging to two species of Polychaeta and 203 specimens consisting of seven species of Crustacea were studied and identified.

Orissa Coast

Four hundred and nineteen specimens belonging to 50 species of Pisces were studied and determined.

Paddy field (manmade) Ecosystem

Chingleput, Tamil Nadu

Fourty nine specimens belonging to three species of Crustacea:Decapoda were studied and identified.

Hill Ranges

Kollihills & Javadhi Hills, Tamil Nadu

Five specimens comprising four species of Orthoptera were studied and identified.

Identification and Advisory Services

ZSI continued to render identification and advisory services free of cost of research and teaching institutes in India and abroad, Central and State Government/Agencies, Non governmental organisations, industries and individuals on zoological matters. During this period, 185 enquiries pertaining to different groups of fauna were attended to.

Development of National Zoological Collection

ZSI, which is a national repository of zoological specimens, maintains the collection of a large number of identified examples of species belonging to almost all groups of animals of the country. The National Zoological Collection was further enriched by the addition of 15,239 identified specimens pertaining to 698 species.

Training and Extension

Three training courses on i) Environmental awareness and wildlife preservation, ii) Collection, preservation and identification of insects and mites of economic importance and iii) Refresher course in collection and preservation techniques were organized.



Fig 15. An elephant - demands protection from poacher

Documentation

The following publications were released:

Fauna of India

□ Scolytidae: Coleoptera Part I

□ Gastrotricha

Records of Zoological Survey of India

□ Vol. 102, Part 1 to Part 4

□ Vol. 103, Part 1 to Part 4

Occasional Papers

□ Biomonitoring of soil quality in agroecosystem with mites as indicator – a preliminary study

□ A catalogue of mammalian exhibits of the Zoological Galleries of the Indian Museum

□ Ichthyofaunal diversity of Midnapore, Bankura and Hooghly Districts, South West Bengal

□ Studies on some spiders of the family Lycosidae (Araneae: Arachnida) from Madhya Pradesh

□ Animal remains excavated from Lothal archaeological site (Gujarat) and relevance of fauna to this ancient civilization.

□ Termite (Insecta: Isoptera) fauna of Gujarat and Rajasthan- Present state of knowledge

□ Bibliography of Rajasthan fauna

□ Ecology and distribution of Macro Zoobenthos of two urban Lakes (Rabindra Sarovar & Subhas Sarovar) in Kolkata.

□ Bibliography and checklist of corals and Coral Reef Associated organisms of India.

□ Spiders of Jabalpur, Madhya Pradesh (Arachnida: Araneae)

□ Catalogue of type species (Bivalvia, Scaphopoda & Cephalopoda) present in the Mollusca section of the Zoological Survey of India.

□ Key to the Genera of Pteromalidae of India and the adjacent countries (Hymenoptera: Chalcidoidea)



Fig 16. Wild Buffalo at Kaziranga National Park

UPDATES 2004-2005



- Sixty four extensive faunal surveys were undertaken to different States/Union Territories including important ecosystems and selected conservation/protected areas by the Zoological Survey of India (ZSI) and its various regional stations. Two status surveys were also undertaken during 2004-05 by the ZSI.
- The national zoological collection was enriched by the ZSI by addition of 15,239 identified specimens belonging to 698 species of fauna during 2004-05.
- Two hundred and seventy seven specimens consisting of 13 species of Odonata, 201 specimens pertaining to eight species of Hemiptera, 134 specimens belonging to 22 species of Crustacea and 31 specimens comprising six species of Pisces were studied and recognized.
- Two volumes of Fauna of India, namely, Scolytidae and Gastrotricha were published by the ZSI during the year.
- Various specimens of fauna of conservation areas, national parks, reserved forests and other ecosystems were studied and recognized during the year.

- ❑ Checklist of Calliphoridae (Diptera) of India.

Memoirs of the Zoological Survey of India

- ❑ A monograph on plant inhibiting predatory mites of India (Part-II – Mesostigmata)
- ❑ Annual Reports 1994-95, 1995-96, 1996-97

Fauna of Conservation Areas

- ❑ Faunal diversity of Mount Harriett National Park (South Andaman)
- ❑ Fauna of Govind Pashu Vihar
- ❑ Fauna of Melghat Tiger Reserve

State Fauna

- ❑ Fauna of Manipur, Part 2 & 3
- ❑ Fauna of Andhra Pradesh Part 2 & 6

Bibliography of Indian Zoology

- ❑ Vol. 32 (1995)

Special Publications

Threatened Fishes of India

Handbooks and Pictorial Guides

- ❑ Guide to Reef fishes of A & N Islands



Fig 17. A canopy of semi-evergreen forests

- ❑ A pictorial guide to Butterfly and Anemone Fishes of A & N Islands
- ❑ Shore birds of Kerala

Forests

Forests are not only important source of subsistence, employment, revenue earnings, raw material to a number of industries but also play vital role in ecological balance, environmental stability, biodiversity conservation, food security and sustainable development. The forest resources, in general, have been under mounting pressure owing to increasing human and livestock population. Excessive withdrawals of produce from the forests has resulted in the depletion and degradation of country's forests and has become a cause of serious concern.

Forest Survey of India (FSI) is engaged in generating information and database on forest cover and forest resources in the country besides providing services of training, research and extension. The present mandate of FSI is:

- ❑ To prepare a comprehensive State of Forest Report (SFR) including National Vegetation Map (NVM) once every two years. FSI will also prepare thematic map through use of remote sensing data with minimum essential ground truth verification (most ground truth verification would be done by the respective state governments) on a ten year cycle.
 - Vegetation mapping including thematic maps through use of satellite imageries/aerial photographs
 - Ground truth verification
 - Growing stock and volume assessment.
- ❑ To undertake work in regard to preparation of forest inventory in selected State/UPs on agency basis till the establishment of their own resources survey units.
- ❑ To impart training in modern forest survey techniques to foresters at various levels of responsibilities in the States/UTs/GOI.
- ❑ To advise the State/UTs on design and development of regional NBFIS.
- ❑ To support and oversee techniques/inventory work undertaken by State/UT Forest Departments.

Forest Cover Assessment

The most important mandate of FSI is to assess forest cover of the country on a two year cycle and to publish the information in the form of "State of Forest Report" (SFR). Its first assessment was published as SFR 1987. The latest assessment, ninth in the series i.e. SFR-2003 has been completed and the draft report has been submitted to the Ministry for approval. Steady improvements have been made in the forest cover assessments for preparation of each report by employing latest data with higher resolution and scale, with more intensive coverage under ground verification and by using superior techniques of interpretation. In the ninth assessment high resolution (23.5m×23.5m) data of IRS, LISS-III has been used and interpretation has been done on 1:50,000 scale.

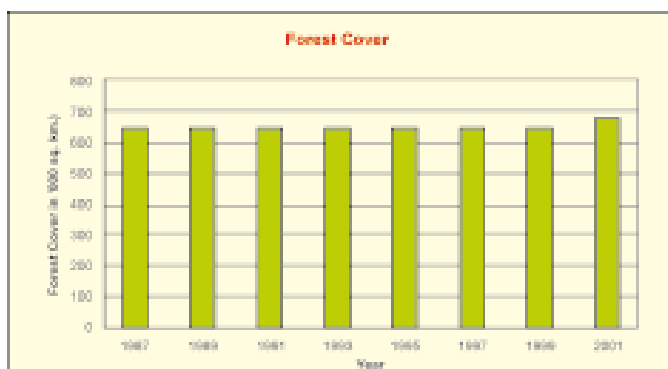


Fig.- 18 . Assessment of Forest Cover in different cycles

The SFR-2003 provides much more comprehensive status of Forest and Tree cover in the country than the previous eight reports.

The Draft report of ninth assessment contains wealth of statistics and spatial information about forest and tree cover in the country. Special significance in SFR-2003 are: introduction of an additional class of forest cover by splitting dense forest cover (canopy density above 40%) into two classes, namely, very dense forest (canopy density more than 70%) and moderately dense forest (canopy density >40-70%) while open forest cover having density 10-40% remains the same. The same criteria has been applied in the case of mangroves also.

Special projects of “Forest Type Mapping of India’s Forests” and “Monitoring of Changes in Forest Cover in Tiger Reserve of India” have also been initiated.

Forest Type Mapping of India’s Forests

Methodology of Forest Type Mapping has been finalized and consists of two stages. In stage I, Forest Type Reference maps are prepared by using existing information viz inventory records, thematic maps, forest type maps at 1:2 million prepared by FSI, ground truth information, maps prepared by French Institute, Pondicherry, Indian Institute of Remote Sensing, Dehradun, Wildlife Institute of India, Dehradun and stock maps prepared by State Forest Departments. Entire country is divided into 2½×2½ grids and on the basis of above information forest type is assigned to each forest grid. Work of State-I for 226 districts has been completed.

Preparation of final Forest Type maps by using satellite data, extensive ground truthing and ancillary data of soil, altitude, aspect, drainage, temperature, rainfall etc will be taken in Stage-II.

Status and Change in Forest Cover in Tiger Reserves of India

In 1993, a study was conducted for assessing the forest cover in Project Tiger Reserves for the periods of 1983 and 1989 for 18 Tiger Reserves by visual interpretation of Landsat data on 1:250,000 scale. With the creation of some more Tiger Reserves, present study has been undertaken to assess status and change in forest cover of 28 Tiger Reserve by digital analysis of IRS-LISS-III data on 1:50,000 scale for the two periods of 1997 and 2002. This study involves three steps viz. preliminary interpretation, ground verification and output of final maps with area figures. Preliminary interpretation for all the 28 Tiger Reserves has been completed and ground verification has been taken up.

Inventory of Forest/Tree Resources

FSI has been conducting field inventory for estimating the growing stock (volume) and other parameters of the forests by laying out systematic sample plots. So far about 80% of the country’s forest areas have been inventoried including some areas more than once and about 140 reports have been published. During 2002-2007, FSI is also conducting field inventory of forest resources inside and outside forest including vegetation survey and estimation of soil carbon in forest.

A methodology has been developed for a comprehensive assessment of forest resources inside and outside forest areas at national level by stratifying the country into physiographic zones and to take a sample of 10 percent districts for detailed inventory during a cycle of two years. This information, thus generated, will form a part of the biennial State of Forest Report. These estimates will be further improved in the subsequent reports as another set of 10 percent districts are sampled and surveyed, and so on. Together with forest inventory, assessment of herbs & shrubs (vegetation survey) is being carried out. In addition, assessment of regeneration status, biodiversity indices and soil carbon in forest areas are also being carried out.

Methodology

Forest Inventory

The country is stratified into 14 physiographic zones according to tree species composition and other physiographic and ecological parameters. In strata, districts are considered first sampling units and grids

of size $1\frac{1}{4}' \times 1\frac{1}{4}'$ as secondary sampling units. Ten percent of districts are being inventoried every year.

- 1:50,000 scale Survey of India toposheet is divided into 36 grids of $2\frac{1}{2}' \times 2\frac{1}{2}'$, further each are divided into four sub-grids of $1\frac{1}{4}' \times 1\frac{1}{4}'$ forming the basic sampling units. Two of these sub-grids are randomly selected and corresponding sub-grids in all the $2\frac{1}{2}' \times 2\frac{1}{2}'$ grids are selected to form the sample. The intersection of diagonals of such sub-grids are marked as centre of plot on the map. At the centre of selected sub-grid a plot of 0.1 ha area is laid out in each grid and data are collected from the plots falling in forest area only.
- For collecting data on soil, forest floor (humus & litter carbon), sub-plots of $1\text{m} \times 1\text{m}$ are laid at each corner within the 0.1 ha plot.
- The data regarding herbs and shrubs (including regeneration) are collected from four square plots of $1\text{m} \times 1\text{m}$ and $3\text{m} \times 3\text{m}$ respectively. These plots are laid out at 30 meters from the centre of 0.1 ha plot in all four directions along diagonals in non-hills area and along trails in hilly areas.

Data is collected from randomly selected sample plots. The data on checking is entered in the computer and after rectification it is processed for different parameters such as area estimation, stand and stock tables, standard error estimation etc.

Trees Outside Forests (TOF), Rural

Extensive tree wealth exists outside continuous forested areas, termed as TOF, in the form of small woodlots and block plantations, trees along linear features, such as roads, canals bunds, etc. and scattered trees on farmlands, homesteads, community lands and urban areas. Inventory of trees outside forest areas is of great importance as this, together with the forest inventory, provides a complete picture of wood/forest resources. FSI has been carrying out TOF assessments since early 1990s.

The study area for this survey is considered as rural areas outside forest areas of the district. Sampling frame for rural areas has been prepared with the help of remote sensing technique and Digital Image Processing (DIP). Protected Area Network (PAN) data for the respective districts taken up for assessment of TOF (Rural) is procured from National Remote Sensing Agency (NRSA), Hyderabad. Toposheets for the same district are identified and geo-referenced. These toposheets are then used to rectify panchromatic data. After rectification, these PAN data are used to rectify the multi-spectral data (LISS). The panchromatic and multi-spectral data are then fused together and classified into various classes to obtain the three stratum of TOF i.e. block, linear and scattered.

The relevant Statistical Techniques for selecting the Strata in hilly and non hilly districts are followed:

Trees Outside Forests (TOF), Urban

The study area for this survey is considered as urban centres as defined in district census book. The whole urban centres of a district in blocks called Urban Frame Survey (UFS) blocks are formed on the basis of 600-800 population or 120-160 households and cover the whole area within the geographical boundary of town including vacant lands.

The sampling technique, used is stratified random sampling and the relevant Statistical Techniques for surveying sample blocks are followed. After selecting the UFS blocks, data are collected, entered and processed in the same way as it was done in case of Forest Inventory/TOF Rural.



Fig 19. Trees Outside Forest Map of Punjab State

Preparation of Manuals for Forest and TOF Inventory Areas

The methodologies for forest inventory and TOF have already been evolved and a field manual has been prepared and communicated to the field units for carrying out inventory. The manual takes into account almost all aspects involved in the inventory right from the start of survey to the stage of final selection of data for entry.

Target of Inventory

FSI will be assessing forest and tree cover in 10% of the total districts of the country in a cycle of two years. Accordingly 60 districts will be inventoried during 2004-2005 and 2005-2006. Thirty two districts are being inventoried so far and the rest 28 will be taken up during 2005-06.

Preparation of National Forest Inventory Database System (NFIDS)

FSI is conducting National Forest/Tree Inventory along with vegetation survey. As per the revised methodology a National Forest Inventory Database System (NFIDS) based on database software (MS Access) using front end on Visual Basic has been prepared. The data base system has the following modules:

- ❑ National Forest Inventory/TOF Data Entry module
- ❑ National Forest Inventory/TOF Data Processing module
- ❑ National Forest Inventory/TOF Reporting module
- ❑ National Forest Inventory/TOF Result database module
- ❑ GIS interface with forest cover



Fig 20. Measurement of diameter during forest inventory

Work on the first two modules has already been completed and successfully installed in all the zonal offices. The activities for the remaining modules are being taken up.

The Andaman and Nicobar Islands Forest and Plantation Development Corporation Ltd.

The Andaman and Nicobar Islands Forest and Plantation Development Corporation (ANIFPDCL), a Government of India undertaking started functioning in 1977 and is a category 'C' Central Public Sector Undertaking. The main activities of the Corporation are timber logging and regeneration, oil palm cultivation and processing, and commercial management of rubber plantation.

As per Hon'ble Supreme Court's order the Corporation's functioning has come to a standstill. However, efforts are now made to revive/restructure the Corporation in public interest and handling over of timber harvesting work from the Forest Department to the Corporation.



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- The 9th Forest Cover Assessment in the form of "State-of-Forest Report" (SFR-2003) has been completed and draft report prepared. Latest data with higher resolution and scale and with more intensive coverage under ground verification has been employed in preparing the draft SFR-2003.
- SFR-2003 provides much more comprehensive status of forest and tree cover in the country than the previous eight reports. Introduction of additional clause of forest cover by splitting dense forest cover into two classes with canopy density more than 70% and greater than 40 – 70% respectively have been included in the latest report.
- 80% of the country's forest areas have been inventoried by Forest Survey of India (FSI) and about 140 reports have been published so far.
- The FSI is also in the process of carrying out assessment of Trees Outside Forest (TOF), both rural and urban for which necessary statistical techniques have been evolved by the FSI.