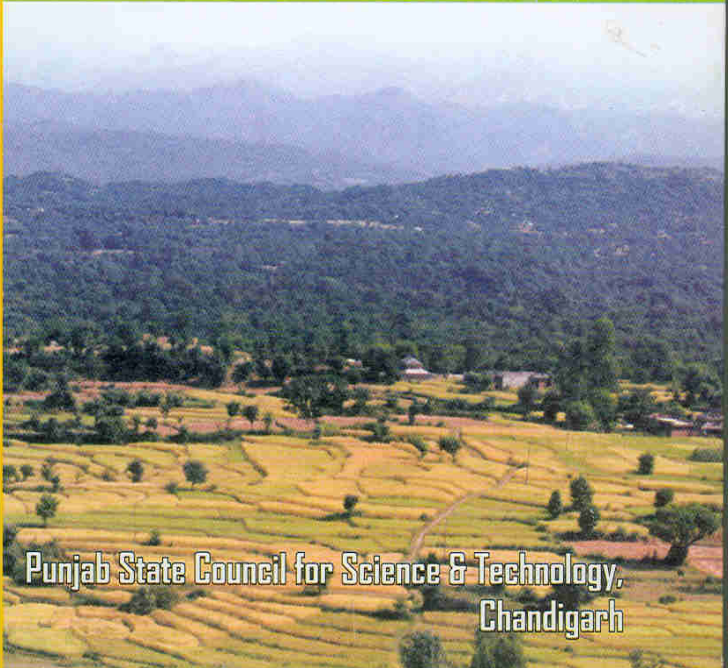


Biodiversity in the Shivalik Ecosystem of Punjab



Punjab State Council for Science & Technology,
Chandigarh

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Chandigarh**

In collaboration with

Zoological Survey of India, Solan & Dehra Dun

Botanical Survey of India, Dehra Dun

Punjabi University, Patiala

&

Indian Institute of Remote Sensing

(NRSA), Dehra Dun

Sponsored by

Ministry of Environment & Forests, Government of India

and

Department of Science, Technology and Environment, Government of Punjab

Published by



BISHEN SINGH MAHENDRA PAL SINGH

23-A, New Connaught Place

Dehra Dun - 248 001 (INDIA)

(Published in 2006)

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ISBN- 81-88362-15-8

81-211-0510-2

Citation: Jerath, Neelima, Puja & Chadha, Jatinder (Editors), 2006. Biodiversity in the Shivalik Ecosystem of Punjab, India. Punjab State Council for Science and Technology, Chandigarh.

Published by

Abhimanyu Gahlot for M/s Bishen Singh Mahendra Pal Singh
23-A, New Connaught Place, P.O. Box 137, Dehra Dun-248 001, India
Tel.: +91-135-2715748 Fax : +91-135-2715107
Email : bsmps@vsnl.com Website : <http://www.bishensinghbooks.com>

Printed at : Shiva Offset Press, Dehra Dun-248 001 Tel. : +91-135-2715748

EXECUTIVE SUMMARY

Biological diversity, comprising the variability of genes, species and ecosystems, is essential for maintaining the basic processes on which life depends and is a key to sustainable development. It not only provides food, medicine and products of commercial and non-commercial use, but also maintains life by providing environmental services like, air and water quality, soil fertility, pest and disease control, waste disposal, etc. However, human activities which have adversely affected the environment, are leading to loss of the planet's biodiversity. The Convention on Biodiversity, of which India is a signatory, makes it mandatory for all nations to inventorise their biodiversity. In this context, the present project was initiated by PSCST in collaboration with the Zoological Survey of India, Dehra Dun and Solan, Botanical Survey of India, Dehra Dun and Punjabi University, Patiala to enlist flora and fauna of Punjab Shivaliks. The Indian Institute of Remote Sensing (NRSA), Dehra Dun was also requested to conduct broad biodiversity characterization studies in the area. Useful inputs were provided by the Department of Forests and Wildlife, Government of Punjab.

The Shivalik area of Punjab with a geographical spread of 9448.97 km², is the hill tract lying in the north-eastern part of the state, running from north-west to south-east along the Himachal Pradesh border. The area has been identified as one of the micro-endemic zones of the country, and is also one of the eight most degraded rain fed agro-ecosystems.

During the present project the participating agencies conducted surveys in the region to record available plant and animal species and broadly assess their distribution with respect to their abundance/rarity of occurrence. The present document provides lists of major flora and fauna of the area, including information on their common/rare/threatened/endemic status, their diagnostic features, and general distribution within the Shivaliks. Data regarding the floral groups of Algae, Fungi and Bryophytes has been contributed by Botanical Survey of India, Dehra Dun. Information on Lichens has been provided by Dr. Kiran Rana on special request. Punjab State Council for Science and Technology carried out studies on Pteridophytes, Gymnosperms and Angiosperms. Similarly, data for the faunal groups Centipedes, Milipedes, Arachnida, Odonata, Isoptera, Piceses, Reptiles and Mammals has been contributed by Zoological Survey of India, Dehra Dun. Data for the groups Nematoda, Crustacea, Lepidoptera (Butterflies), Diptera, Hemiptera, Dermoptera, Orthoptera, Mollusca, Amphibia and Aves has been contributed by Zoological Survey of India, Solan. Studies on Hymenoptera and Lepidoptera (Moths) have been conducted by Punjabi University, Patiala. The broad Biodiversity Characterization Studies at landscape level have been conducted by IIRS, Dehra Dun through Remote Sensing and GIS.

The number of species of plants and animals recorded from the area are summarized as below:

S. No.	Plant/Animal group	No. of species	% age of species in India*	Agency
KINGDOM PLANTAE				
1.	Algae	104	1.6%	Botanical Survey of India, Dehra Dun
2.	Fungi	560	3.9%	Botanical Survey of India, Dehra Dun
3.	Lichens	21	1.1%	PSCST, Chandigarh
4.	Bryophytes	27	0.9%	Botanical Survey of India, Dehra Dun
5.	Pteridophytes	30	2.7%	PSCST, Chandigarh; BSI, Dehra Dun & IIRS, Dehra Dun
6.	Gymnosperms	1	0.01%	PSCST, Chandigarh; IIRS, Dehra Dun
7.	Angiosperms	526	3.1%	PSCST, Chandigarh; IIRS, Dehra Dun
KINGDOM ANIMALIA				
1.	Phylum Nematelminthes	34		Zoological Survey of India, Solan
2.	Phylum Annelida		1.3%	
	i Class Oligochaeta	18		Zoological Survey of India, Solan
	ii Class Hirudinaria	5		Zoological Survey of India, Solan
3.	Phylum Arthropoda	819	1.34%	
	i Class Arachnida	30		Zoological Survey of India, Solan
	ii Class Crustacea	12		Zoological Survey of India, Solan
	iii Class Insecta			
	a. Order Chilopoda	5		Zoological Survey of India, Dehra Dun
	b. Order Orthoptera	77		Zoological Survey of India, Dehra Dun
	c. Order Isoptera	6		Zoological Survey of India, Dehra Dun
	d. Order Odonata	41		Zoological Survey of India, Dehra Dun
	e. Order Thysanoptera	40		Zoological Survey of India, Solan
	f. Order Hemiptera	45		Zoological Survey of India, Solan
	g. Order Homoptera	39		Zoological Survey of India, Solan
	h. Order Dermaptera	8		Zoological Survey of India, Solan
	i. Order Coleoptera	63		Zoological Survey of India, Solan
	j. Order Lepidoptera			
	j-i Moths	135		Punjabi University, Patiala
	j-ii Butterflies	89		Zoological Survey of India, Solan
	k. Order Diptera	31		Zoological Survey of India, Solan
	l. Order Hymenoptera	198		Punjabi University, Patiala
4.	Phylum Mollusca	31	0.6%	Zoological Survey of India, Solan
5.	Phylum Vertebrata			
	i. Class Pisces	55	2.2%	Zoological Survey of India, Dehra Dun
	ii Class Amphibia	9	0.1%	Zoological Survey of India, Solan
	iii Class Reptilia	20	4.1%	Zoological Survey of India, Dehra Dun
	iv Class Aves	396	32.2%	Zoological Survey of India, Solan
	v Class Mammalia	19	5.1%	Zoological Survey of India, Dehra Dun

* Calculated from MoEF, 1998

Microbial flora and fauna was not studied under the project. Further, no studies were conducted on Phyla Coelenterata, Platyhelminthes, Porifera and Echinodermata as the species are either marine (hence, not found in Punjab) or are parasitic. Within large Phyla certain orders have also been missed out either due to non-availability of specimen or due to inaccessibility to experts for conducting these studies.

For the present study, a district was taken as a geographical unit. The area was divided into specific zones identified by experts from Department of Forests & Wildlife, Govt. of Punjab. The importance of these areas from the biodiversity rich/poor angle was validated through Remote Sensing and GIS data through Biodiversity Characterization techniques and species inventorization was conducted using stratified random sampling. During the project ZSI carried out 35 surveys spending a total of 330 days in the field covering different localities of the area (Survey areas marked in map no.1) and Punjabi University carried out 15 surveys spending about 50 days in the field. Similarly, PSCST carried out nine surveys spending about 40 days in the field and BSI carried out 3 surveys in the region spending about 45 days in the field.

As per the present study the recorded forest area of the Shivalik hills of Punjab is 1599.42 km² constituting 16.93% of the total geographical area (as per the Department of Forests and Wildlife, Government of Punjab). The non-forest area such as agricultural, grasslands, water bodies, canals, settlements, riverbeds and barren land together contribute 7849.55 km² constituting 83.07% of the total geographical area.

Four major forest types have been recorded. These are Dry Deciduous, Moist Deciduous (including Khair-Sisoo and Dry Bamboo Brakes), Dry Deciduous Scrub (including Euphorbia) and Chir Pine forests. Out of these the Dry Deciduous forest areas showed maximum biodiversity (high Importance Value Index and high Shannon-Wiener Index) whereas Chir pine forests showed minimum diversity. The Scrub forests have been found to show maximum degree of fragmentation, an indicator of high anthropogenic activity. *Lantana* and *Parthenium* are major exotics occurring in the area, which need immediate management.

The floral studies highlight that a considerable number of cryptogams exist in the area, the number of fungi being especially high. Out of these three species of Algae (*Spirogyra jassiensis* (Teodoresco) Czurda, *Zygnema carterae* Czurda, *Z. mucigenum* Randhawa), two species of Fungi (*Orbilbia sarraziana*, *Calvatia coelata*) and five species of Pteridophyta (*Actinopteris radiata* (Swartz) Link., *Pteris cretica* Linn., *A. lunulatum* Burm., *Ceratopteris thalictroides* (Linn.) Brong., *Asplenium dalhousiae* Hook.) are found to occur very rarely in the area. Further, though earlier studies have recorded only 448 species of both macro and micro fungi from the state of Punjab, during the present study 560 species were recorded from the Shivalik area alone. Further, 21 species of Lichens have also been reported to occur in the study area. Out of these 12 species are crustose, seven species are foliose and one species each is of fruticose and squamulose type. However, further studies need to be conducted on Lichens in the area. Similarly, there appeared to be no record of mosses and only 10 species of liverworts were known from Punjab earlier. However, the present study records nine species of mosses and 17 species of liverworts. The present study also reports five new records of Pteridophytes from Punjab out of which one species

(*Adiantum lunulatum* Burm.) occurs very rarely. Another important observation has been the presence of a single species of Gymnosperm (*Pinus roxburghii* Sarg.) in the study area, though earlier studies report presence of 21 species of Gymnosperms from Punjab (out of which some were from cultivated areas).

Amongst the Angiosperms, c 355 herbs, c 70 trees, 70 shrubs or undershrubs, 19 climbers and 21 twiners were recorded from the study area. Families like Poaceae, Papilionaceae, Asteraceae and Cyperaceae are the dominant families. Out of a total number of 562 angiospermic species of plants recorded from the study area, two species (*Hibiscus hoshiarpurensis* Paul & Nayar and *Argyrolobium album* Bhattacharyya) are found endemic to Punjab Shivaliks, 11 species are new reports from Punjab, 44 species are found to occur very rarely (only 1-2 specimens were observed from the study area) and about 145 species occur rarely (occasionally seen) in the area. The area also harbours 28 wetland plants and 214 plants of economic importance out of which 132 are medicinal plants. Some of the economically important plants are *Acacia catechu* (Linn.f.) Willd., *Bombax ceiba* Linn., *Cassia fistula* Linn., *Pinus roxburghii* Sarg. and *Euphorbia royleana* Boiss. Some of the important medicinal plants are *Adhatoda zeylanica* Medik., *Bacopa monnieri* (Linn.) Wettst., *Azadirachta indica* Juss., *Ricinus communis* Linn. and *Abrus precatorius* Linn.

The Total Importance Value (TIV) for major angiospermic species was also calculated based on known uses and analysed using GIS by IIRS considering 10 important parameters. The TIV of different vegetation types based on 214 economically important plants and 132 medicinal plants recorded by IIRS, Dehra Dun alone, was recorded as under:

Forest Type	TIV (% age)
Dry Deciduous (DD)	10.53
Moist Deciduous (MD)	10.46
Deciduous Scrub forest (DS)	9.75
Chir-pine forest (PN)	8.01

An overview of percent utilizable species within each forest type has also been recorded by IIRS, Dehra Dun and is presented below:

Uses	Forest types				Total
	Dry Deciduous	Moist Deciduous	Dry Deciduous Scrub	Chir Pine	
Food	11.15	12.7	10.05	0	33.9
Fuel	0.79	2.36	2.21	0	5.36
Fodder	9.09	6.94	9.06	8.56	33.61
Fiber	9.8	7.91	9.31	0	27.02
Timber	10.2	2.6	9.55	0	22.35
Medicinal	31.66	32.1	31.61	20.78	116.15
Oil	5.02	0.65	6.37	0	12.04
Gums/ Resin	3.5	0.86	3.18	0	7.54
Tannin	5.18	1.3	6.61	0	13.09
Others	9.83	8.45	8.09	2.35	28.72

As the fauna of an area depends upon its flora, as expected, the area is also found to be quite rich in faunal diversity especially bird fauna (two important wetlands exist in the area out of which Ropar wetland is a Ramsar site). A total of 396 species of birds have been recorded from Shivaliks.

Results indicate that five species of Lepidoptera, 44 species of fish, 18 species of reptiles, 156 species of birds and 19 species of mammals are listed under different categories of conservation status of IUCN, CITES, CAMP and IW (P) Act.

Further, two Annelid species (*Perionyx bainii* and *P. simlaensis*) have been found to be endemic to North-Western Himalayas including Punjab Shivaliks and three species (*Amyntas alexandri* Beddard, *Perionyx excavatus* Perrier and *Perionyx sansibaricus* Michaelsen) have been found to have good vermicomposting potential. Furthermore, all the five leeches recorded from the area are new records for Punjab.

One species each of the Orders Homoptera, Thysanoptera and Lepidoptera (*Vesiculaphis punjabi*, *Heliethrips siwalik*, *Campsoctena robinsoni*, respectively) are new additions to science. Two genera of Coccid insects (Order-Hemiptera) *Humococcus* Ferris and *Drepanococcus* Willium & Wattson, are reported for the first time in the Indian Literature. Similarly, one species each of Orders Thysanoptera and Lepidoptera, Class Insecta (*Moundinothrips robustus* Bhatti and *Ethmia praeclara* Meyrick, respectively) have been reported for the first time from India. Another species of Order Hymenoptera, Class Insecta i.e. *Vespa himalyana* Smith is found to occur very rarely and seems to be endangered in the area as only one specimen of the same could be collected during the entire project (from Dunera, district Gurdaspur).

The study has also recorded four Endangered (En) species (*Ompok pabda* Ham.-Buch., *Tor putitora* Ham.-Buch., *Eutropiichthys vacha* Ham.-Buch. and *Botia lohachata* Chaudhuri), 12 Vulnerable (Vu) species, 24 Lower Risk near threatened (LR/nt) species and three Lower Risk least concern (LRlc) species of Fish. Further, two species of Reptiles, which are globally threatened under IUCN-LR/nt category (*Kachuga smithi* Gray and *Python molurus* Linn.) and two vulnerable species of lizards (*Varanus bengalensis* Linn., *Varanus flavescens* Gray) as per CAMP have been reported. Furthermore, one species of snake *Python molurus* Linn., three species of turtles (*Kachuga tecta* Gray, *Lissemys punctata punctata* Lacepede and *Trionyx gangeticus* Cuvier) are under Sch. I of IW (P) Act.

Four species of birds have been found to be Globally threatened as per IUCN-LR/nt category (*Anhinga melanogaster* Pennant, *Aythya nyroca* Guldenstadt, *Circus macrourus* Gmelin, *Mycteria leucocephala* Pennant). Further, of the total species recorded from Punjab Shivaliks two species have been found to be under App. I of CITES (*Falco jugger* Gray, *Falco peregrinus* Tunstall) and 156 species under Wild Life Protection Act.

Only 19 mammalian species could be recorded from the area which include four globally threatened species as per IUCN (*Semnopithecus entellus* (Dufresne), *Macaca mulatta* (Zimmermann), *Lutra lutra* (Linn.) and *Manis crassicaudata* Gray), three species

belonging to Sch. I, three species under Sch. II, four species under Sch. III, six species under Sch. IV and two species under Sch. V of Indian Wildlife Protection Act.

The list of globally threatened vertebrate fauna of Punjab Shivaliks is as below:

Table 1: Globally Threatened Vertebrate Fauna of Punjab Shivaliks

S.No.	Common Name	Zoological Name	IUCN
Reptiles			
1	Brown River Turtle	<i>Kachuga smithi</i> (Gray)	LR/nt
2	Indian Rock Python	<i>Python molurus</i> (Linnaeus)	LR/nt
Birds			
1	Oriental Darter	<i>Anhinga melanogaster</i> (Pennant)	LR/nt
2	Ferruginous Pochard	<i>Aythya nyroca</i> (Guldenstadt)	LR/nt
3	Pallied Harrier	<i>Circus macrourus</i> (Gmelin)	LR/nt
4	Painted Stork	<i>Mycteria leucocephala</i> (Pennant)	LR/nt
Mammals			
1	Common Langur	<i>Semnopithecus entellus</i> (Dufresne)	LR/nt
2	Common Otter	<i>Lutra lutra</i> (Linn.)	Vu
3	Indian Pangolin	<i>Manis crassicaudata</i> (Gray)	LR/nt
4	Rhesus Monkey	<i>Macaca mulatta</i> (Zimmermann)	LR/nt

Vu: Vulnerable, **LR/nt:** Lower risk near threatened, **LRlc:** Lower risk least concern

The project highlights that the Shivalik area is quite rich in biodiversity. Based on the diversity of species of plants and animals collected from the region, the following areas have been identified as biodiversity rich pockets in the Punjab Shivaliks:

- Guru Gobind Singh Nature Reserve, Anandpur Sahib (Ropar)
- Sadavarat Forest Ropar & Ropar Wetland (Ropar)
- Kahanpur Khuhi Forest (Ropar)
- Dholbaha-Kukanet Forest (Hoshiarpur)
- Nara Forest (Hoshiarpur)
- Chohal Forest (Hoshiarpur)
- Takhni-Rehmapur Wildlife Sanctuary (Hoshiarpur)
- Talwara Forest (Hoshiarpur)
- Manguwal Forest (Hoshiarpur)
- Dhar & Dunera Forest (Gurdaspur)

A view of some of the important localities is presented in Plates 1.1 & 1.2.

However, certain areas in the region show poor diversity due to erosion and land degradation. These are (Plate 1.3):

- Certain areas of Jaijjon (Hoshiarpur)
- Rel Majra (Nawanshahr)
- Certain areas of Ropar Shivaliks (near Mirzapur and Ropar city)
- Certain areas in Talwara block (Hoshiarpur)

Conservation measures need to be taken up in these areas.

The study, though exhaustive, is by no means all-inclusive. Data needs to be generated on those taxa, which could not be covered, as well as, on phytosociology and detailed ecological distribution of important elements of flora and fauna. However, it can serve as a useful baseline document.