NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM (NMSHE)

WILDLIFE WATCH

IN THE INDIAN HIMALAYAN REGION

2014-2015

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

SERIES I

SERIES I

A User Guide for Monitoring Wildlife Species in the Indian Himalayan Region

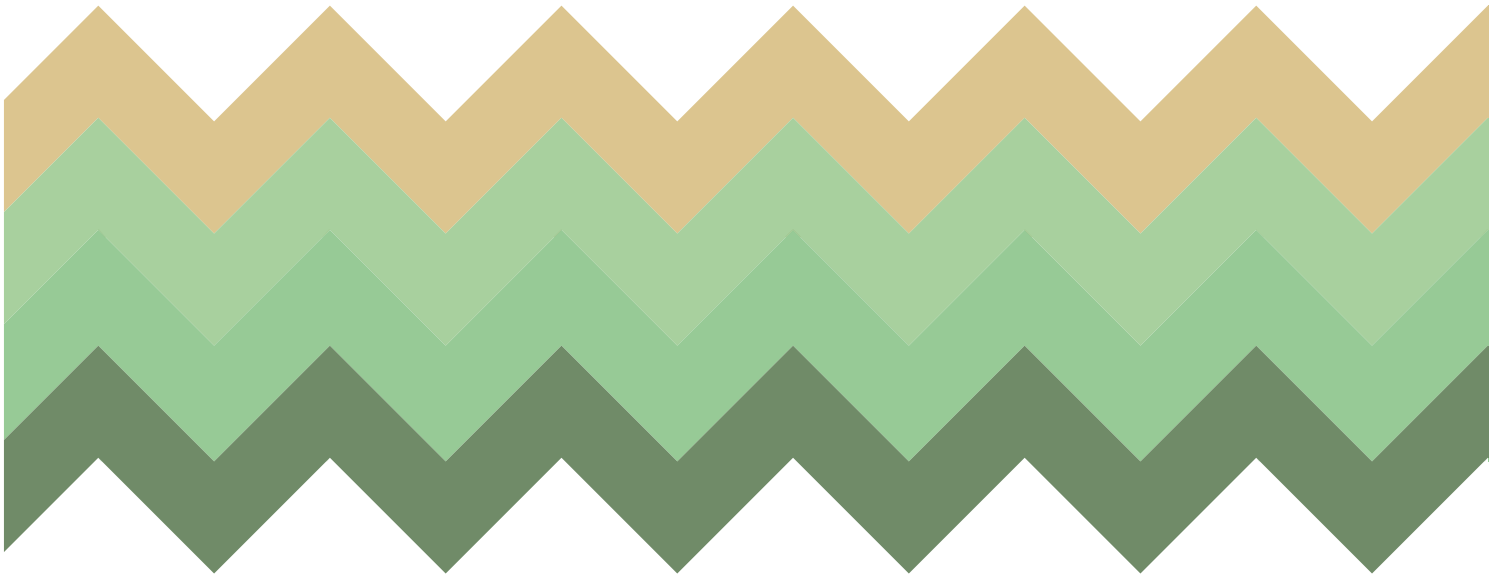
Under the 'National Mission for Sustaining the Himalayan Ecosystem' (NMSHE)
Task Force on Micro flora & fauna, wildlife and animal population
Department of Science and Technology, Government of India

DST Grant Number:
DST/SPLICE/CCP/NMSHE/TF-2/WII/2014[G]
dated 26.08.2014

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

WILDLIFE WATCH

IN THE INDIAN HIMALAYAN REGION



Published by

Wildlife Institute of India
Chandrabani
Dehradun 248001
Uttarakhand, India.
Tel: +91-135-2640111-115
Fax: +91-135-2640117
http://www.wii.gov.in

Design, Layout and printing

Xpressions Print & Graphics Pvt Ltd
Doc. XPS170815381

Citation

Sathyakumar, S. and Mathur, V. B. (Eds.) 2015. Wildlife Watch – Series I. A user guide for monitoring wildlife species in the Indian Himalayan Region. Wildlife Institute of India, Dehradun. 64 pp.

Series I

S. Sathyakumar
& V. B. Mathur
Editors

Illustrations

Tapajit Bhattacharya, Krishnendu Mondal, Sohini Chaudhuri, Naitik G. Patel and Dibyendu Mandal

Contributors

Abhijit Das, G. S. Rawat, J.A. Johnson, Pratap Singh, K. Ramesh, S. Sathyakumar, K. Sivakumar, V.P. Uniyal, Nishikant Gupta, Sujata Upgupta, Tapajit Bhattacharya, A. Arun Kumar, Devendra Kumar, Krishnendu Mondal, Manish Bhardwaj, Naitik G. Patel, Pamela Bhattacharya, Ranjana Pal, Sohini Chaudhuri and Tanvi Gaur

With inputs from

Asha Rajvanshi, Gautam Talukdar, Ruchi Badola, Aashna Sharma, Anshu Shukla, Kamalika Bhattacharya, Neha Aswal, Pooja Kala, Priyanka Kashyap, Shagun Thakur, Shailendra Raut, Shashank Arya and Sonam Priyadarshani

Foreword

Dr. S.S. Negi
डॉ. एस. एस. नेगी

सत्यमेव जयते

Director General of Forest & Spl. Secy.
Government of India
Ministry of Environment,
Forest and Climate Change

वन महानिदेशक एवं विशेष सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय

The Indian Himalayan Region (IHR) that is represented by Biogeographic Zones 1 and 2 encompasses over 395,496 km^2 (12.03% of India's geographical area) and spans across states of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh and West Bengal (northern hill regions). The IHR provides life line to several million people living in the mountains and plains of the Indian subcontinent. India has and continues to experience rapid population growth, urbanization and consequently development needs. India is facing pressures from natural and anthropogenic stressors, and there is a need to balance development and conservation of floral/faunal species and their habitats. The IHR is not untouched by these pressures including the recent threat to wildlife and their habitats due to climate change/climate variability.

Realizing the need for developing science based action plans to address both the existing as well as emerging threats of climate change in the fragile mountain ecosystems of the IHR, the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) has been conceived and launched by the Government of India in 2010. NMSHE is expected to offer practical adaptation strategies based on inputs from various reputed Institutions for the conservation of natural resources, flora, fauna and their habitats in the IHR. The Wildlife Institute of India (WII), an autonomous institution of the Ministry of Environment, Forest & Climate Change (MoEFCC) in the field of wildlife and natural resource conservation has been identified as a Nodal Institute under NMSHE by the Department of Science and Technology (DST), for coordination of the Task Force on Micro flora and fauna, and wildlife and animal population. The goal of Wildlife Institute of India's Task is to develop strategies to mitigate climate change effects on Micro Flora & Fauna, and their habitats in the IHR. One of the expected outputs/outcomes from this project is development of 'Wildlife Watch' Programme for selected indicator/endangered species for regular monitoring by various stakeholders in the IHR.

'Wildlife Watch in the Indian Himalayan Region Series I - A User Guide for Monitoring Wildlife Species in the IHR' is the first in the series of publications that WII has brought to bring out for monitoring of selected indicator/endangered species in the IHR. This user guide will be of immense value in generating awareness and for monitoring of indicator/endangered species in the IHR by biologists, managers, naturalists, amateurs, civil society members, and most importantly the local communities who live in the IHR. Information generated on these species could be sent to WII for inclusion in the database for long-term monitoring.

(S.S. Negi)

इंदिरा पर्यावरण भवन, जोर बाग रोड़, नई दिल्ली–110 003, फोन : 24695278, फैक्स : (011) 24695412
Indira Paryavaran Bhawan, Jor bagh road, New Delhi-110 003, Ph.: 24695278, Fax: (011) 24695412

Preface

The Indian Himalayan Region (IHR) is one of the rich biodiversity regions of the world with over 18,000 plants, 428 mammals, 2,000 birds, 227 herpetofauna, more than 200 fishes, several species of invertebrates and micro-organisms, many of which have global conservation significance. Despite its significant ecological, hydrological and biological values, the fragile mountain ecosystems in the IHR are seriously threatened due to increasing anthropogenic pressures mainly development. In the IHR, wildlife species are threatened due to poaching for meat, illegal wildlife trade, human-wildlife interactions, habitat loss, habitat fragmentation and degradation due to developmental activities and natural resource use by humans. These have led to decline in wildlife populations, reduction in distribution range and in some cases, local extinction of species.

Climate change/climate variability is the recent threat to wildlife and their habitats in the IHR. The effects of climate change are pronounced in places such as the Himalaya where the network of snow-clad mountains, ice-peaks, high intensity drainage and precipitation characterises the bio-social landscape. Evidence suggests that responses of species to impacts of climate change are inter-alia manifested in changes in phenology, earlier onset of spring, migration, changes in behaviour or activity patterns, and lengthening of growing seasons. Therefore, it is very appropriate that scientific investigations are carried out to assess impacts of climate change/climate variability on wildlife species and their habitats in order to formulate and apply directed management strategies for long-term conservation in the IHR.

Under the Government of India's 'National Mission for Sustaining the Himalayan Ecosystem (NMSHE)', the Department of Science and Technology (DST) has identified the Wildlife Institute of India (WII) for coordination of the Task Force on Micro Flora & Fauna, and Wildlife and Animal Populations. The thematic areas identified under the research project are (A) Terrestrial System, (B) Aquatic System, (C) Human Ecology, and (D) Spatial Ecology; and include assessments of (a) animal species/communities diversity, distribution, abundance; (b) wildlife habitats, ecosystems, and ecosystem services; (c) anthropogenic and climate change impacts on wildlife and ecosystems through scenario building and visualization; (d) vulnerability of species/habitats to climate change; and (e) prioritization of species/taxa and sites for monitoring.

In order to sensitize all stakeholders on the importance of monitoring selected endangered or indicator wildlife species in the IHR, this publication 'Wildlife Watch in the Indian Himalayan Region' Series I - A User Guide for Monitoring Wildlife Species in IHR has been conceptualized and developed. The selection of species for 'Wildlife Watch' is based on evaluation and scoring of criteria such as (a) the status (endangered/threatened) based on IUCN and Indian Wildlife (Protection) Act, 1972 (b) functional role (apex predator/ key stone species), (c) values (charismatic, cultural, umbrella/flagship species), (d) detectability in the wild, and (e) sensitivity to climate change or climate variability.

Using the above criteria, we have selected 13 species for Series I; two species each representing mammals, birds, herpetofauna, fishes, invertebrates and three species for flora. We plan to bring out the Wildlife Watch for the next four years with every Series dealing with 12 to 15 species representing the various faunal/floral groups.

For every species, we have presented information on their taxonomic status, local/vernacular names, their physical attributes, elevation range, habitats they occur, some key field identification features, the probable distribution map of the species in the IHR, species photographs, and illustrations of tracks/signs which will come handy for the user, all at one glance. The key references used for compiling the information for the species are presented at the end of the user guide. This user guide can be used by all stakeholders, both amateur as well as trained. For an amateur, creating awareness and reporting of presence only based on visual encounters and signs as part of wildlife monitoring are envisaged. Most of the local community members, pilgrims, tourists, and school/university students would fall in this category. For trained biologists, managers, frontline staff of Forest/Wildlife Departments, field staff of the defence and para-military forces, trained Nature Club members, would fall in the second category from which we envisage reporting more information as per data format provided at the end of this user guide. In order to facilitate easy reporting back to WII, we have provided a mobile number for SMS/Whatsapp or phone call and an email ID as well. Any additional information could be provided in remarks and sent to WII. All the information with source will be stored in a database at WII for future monitoring. This publication will eventually be translated in all major vernacular languages spoken in the IHR and also hosted in our website.

It is hoped that substantial interest would be generated on Wildlife Watch in the IHR through this publication and it would be of great use for Wildlife monitoring by different stakeholders. This user guide has been published with the funds received from DST under the NMSHE project. Mr. Dhritiman Mukherjee, Sh. Subhoranjan Sen, Dr. Ishwari Datt Rai, Mr. S. Chakrabarty, Mr. Misty Dhillon, Dr. B.S. Adhikari and Dr. Rudra Prasad Das are thanked for providing pictures for use in this publication. Dr. Anju Baroth is thanked for her help towards obtaining the Creative Commons License for this document. Assistance provided by Mr. Prudhvi Raj Gunturu is acknowledged.

Editors

CONTENTS

Fish

Invertebrate

Flora

SNOW LEOPARD
Panthera uncia

Vernacular/other names

Him Tendua (Hindi), Tharuva, Barhal he (Pahari), Barfani cheetah (urdu), Shan (Ladakhi), Burhel haye (Bhotia), Sheen-e-sun (Kashmiri)

Taxonomy

***Order**: Carnivora*

***Family**: Felidae*

***Genus**: Panthera*

***Species**: uncia*

Conservation status

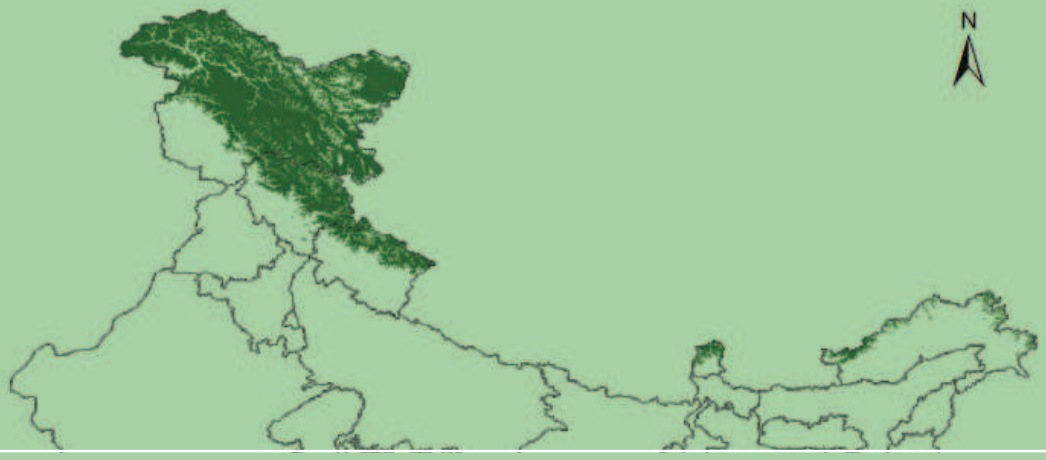
IUCN: *Endangered*

IWPA: *Schedule-I*

CITES: *Appendix-I*

U.S. ESA: *Endangered*

Size



The snow leopard is distributed in the high mountain regions of the Himalaya, Tibetan Plateau and in the mountains of Central Asia. Snow leopard is believed to be well spread along with the geographical ranges of its large prey, i.e., mountain ungulates such as the ibex, Himalayan tahr, blue sheep, and the argali. The upper elevation threshold of most Himalayan mammals is 5,500 m, and snow leopards are observed only occasionally at higher elevations. In Himalaya and Tibetan Plateau, snow leopard can be found at elevations of 3000 m to over 5000 m but as low as 600 m in Russia and Mongolia. They favour steep, rugged terrain well broken by cliffs, ridges, gullies, and rocky outcrops. Mountain ridges, cliff edges, and well defined drainages serve as common travel routes and sites for social marking, including the deposition of scrapes, scats, and scent.

Description

Snow leopard is also known as the 'grey ghost of the mountains' because of their ability to conceal with their surroundings. Coat colour is smoky-grey pelage tinged with yellow and patterned with dark grey, open rosettes and black spots. Snow leopard has adapted to survive in high altitude steep and rugged mountain environment by its well-built chest, an enlarged nasal cavity, large paws, woolly underfur, and a noticeably long tail that helps in balancing while negotiating steep terrain and also used to wrap around the body for added warmth while resting. Usually crepuscular and solitary except when females are raising cubs. Snow leopard has a wide dietary range and is also capable of killing prey up to three times its own weight. In Himalaya, their prey are wild goats and sheep such as ibex, tahr and blue sheep They can feed upon a wide range of hoofed animals such as argali in addition to marmot , pika , hare , and a variety of small rodents and galliformes.

Head to body length: ***180–230 cm***	*Shoulder height:* ***60 cm***	*Weight:* ***40 - 55 kg***	*Tail length:* ***80-105 cm***

Vulnerability to climate change

Climate change may lead to loss of snow leopard habitat in the Himalayan mountain range. The likely upward shift of 'tree line' under warming conditions may lead to competition with common leopard, wild dogs and other carnivores. Snow leopards suffer from conservation challenges such as naturally occurring in low densities, extensive home ranges, dependence upon vulnerable prey populations and high susceptibility to poaching and other anthropogenic threats. Adding to these problems, climate change may act as a catalyst to accelerate population reduction and consequently local extinctions. Climate change integrated conservation for snow leopards demands securing large core areas and maintaining connectivity and also needs climate adaptive approaches that includes monitoring of changes in habitats and human communities.

Monitoring protocol

As an apex predator of the high altitudes of the Himalaya, the snow leopard is an ideal choice for monitoring the health of the high altitude ecosystems in the Himalaya. Monitoring of this elusive and rare big cat is a challenging job as this species prefers specialized habitats such as high altitude environment and steep terrain. Detection of presence can be done through sign survey in alpine and glacial moraines, scree and rocky habitats. Scats, scrapes and pugmarks can indicate the presence of snow leopard in a particular habitat. However, resemblance of some token scats with red fox scat may lead to false detection in many cases, if only sign survey is implied. Continuous observations of prey species group such as blue sheep, ibex and Himalayan tahr groups may also lead to the detection of elusive snow leopard. As snow leopards have distinct pelage patterns for each individual, using double flanking camera traps may lead to the best results for population estimation provided that the number of recaptures are sufficient. Non-invasive, DNA based population estimation from scats is also a good option to estimate the abundance of snow leopard in a particular habitat. Radio-collaring of this large ranging species may also indicate about the habitat use and ranging pattern of this elusive cat.

Reproduction and life cycle

Gestation period:
90- 105 days

Breeding:
January to mid-March

Young per birth:
2 to 3

Weaning:
18- 22 months

Sexual Maturity:
2-3 years

Life Span:
15- 18 years

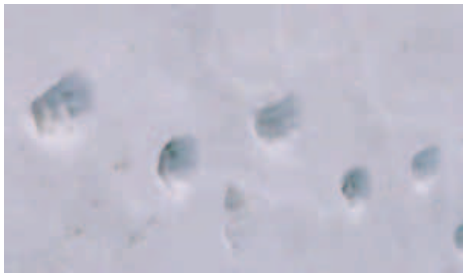
Key threats

- *Poaching for body parts*
- *Retaliatory killings to reduce livestock depredation*
- *Habitat degradation and loss*
- *Prey depletion due to competition with livestock*

Key field identification features

Usually solitary, thick long tail, Tracks are easily distinguishable by the pad shape, size, and scrape marks that are usually made in trails, ridges. Scent marking in overhanging rocks, scats are recognizable by their shape, size, lobes and placement near scrapes. To know more about field identification features see Snow leopard Survey Handbook and Conservation Part II.

Snow leopard pugmark and track



Snow leopard scat

Important web links

https://www.snowleopardnetwork.org

https://www.snowleopardconservancy.org/

https://www.felineconservation.org/FCF-Youth.../Cat.../Snow-Leopard.pdf

https://ebksee.sotite.com/sl-survey-cons-handbook-part-2-pdf-d46985153

MUSK DEER
Moschus spp.

Vernacular/other names

kasturi mrig, kastura, bina, (local names), raos, rons (Kashmiri)

Taxonomy

***Order**: Artiodactyla*

***Family**: Moschidae*

***Genus**: Moschus*

***Species**: leucogaster. chrysogaster, fuscus, cupreus*

Conservation status

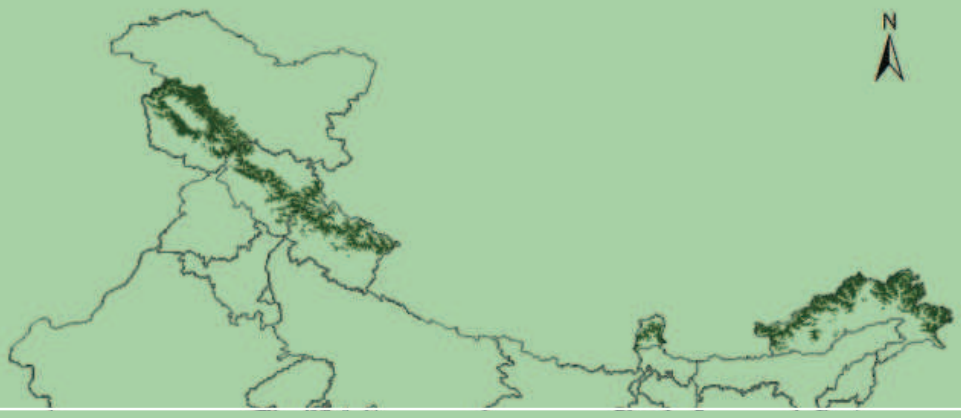
***IUCN:** Vulnerable*

***IWPA:** Schedule I*

***CITES:** Appendix - I*

***U.S. ESA:** Endangered*

Size



Out of six musk deer species in the world, four are found in India. Himalayan musk deer *Moschus leucogaster* is distributed in Himachal Pradesh, Uttarakhand and Sikkim. Alpine Musk deer *Moschus chrysogaster*, is reported to occur in Sikkim and Arunachal Pradesh, and possibly in Uttarakhand. Black Musk deer *Moschus fuscus*, occur in Sikkim, Bhutan and Arunachal Pradesh. *Moschus cupreus* or the Kashmir musk deer is reported to occur only in the Kashmir region of Jammu & Kashmir.

In the Himalaya, they occupy upper temperate and subalpine forests, and alpine scrub and meadows. In India, the musk deer inhabits forested areas between 2500 m and the treeline on the southern side of the Greater Himalaya. The average altitude of the tree line differs in different parts of the Himalaya, ranging from 3200 m to 4300 m above mean sea level.

Description

Musk deer differ from other deer in not having antlers and facial glands. They possess a gall bladder, musk gland and caudal gland, which other deer do not have. Musk deer coat colour ranges from light grey to dark grey - brown. It has have like long ears and the upper canines are significantly developed especially in males. Musk deer are small solitary forest ruminants that are relatively sedentary, meeting their requirements for food and cover within their small home ranges in all seasons.

Head to body length: ***70-100 cm***	*Shoulder height:* ***50 cm***	*Weight:* ***13 - 15 kg***	*Tail length:* ***7-10 cm***

Vulnerability to climate change

Musk deer are habitat specialist species and umbrella species for conservation of old-growth Himalayan temperate and conifer forests and the biodiversity therein. As they are adapted to live in the tree-line and sub-alpine forests, habitat loss or shift due to climate change as well as anthropogenic activities may pose critical threat to the survival of this species. Poaching for musk and habitat degradation/loss due to anthropogenic pressures have already led to local extinctions and low abundance in many parts of its distribution range. Isolated musk deer populations would reduce beyond recovery if the habitat quality is altered, degraded or shifted due to climate change.

Monitoring protocol

Monitoring of musk deer can be carried out in tree-line zone, subalpine and upper temperate forests. Silent drive count can be one of the methods to detect the presence of musk deer and to estimate relative abundance for a certain area and would involve trained man power. Other methods such as trail sampling for evidences and monitoring of active defecation sites would help in estimating indices of abundance and monitoring individuals in the wild respectively. Non-invasive techniques such as camera trapping and genetic analysis from dung would help in estimating absolute abundance of the species.

Reproduction and life cycle

Gestation period:
180-200 days

Breeding:
November - January

Young per birth:
one,
twinning is also common

Weaning:
1-1.5 months

Sexual Maturity:
1.5 years

Life Span:
8-10 years,
17 years in captivity

Key threats

- *Poaching for musk*
- *Habitat degradation and loss*
- *Competition with livestock*

Key field identification features

Solitary, small, shy and cryptic; when flushed easily recognizable from a distance by its bounding gait and short flight distance; non vocal alarm call (sounds like "hiss" made by forcing air through the lips); Tracks are unique with short pointed hooves and well developed lateral hooves. Musk deer hair may be encountered in their habitats, mostly resting sites. Musk deer hair are thick and wavy, with the base white in colour.

Musk Deer pellet groups

Musk Deer hoof and track

Important web links

https://www.iucnredlist.org/details/13895/0
https://www.iucnredlist.org/details/13901/0
https://www.iucnredlist.org/details/136750/0
https://http://animaldiversity.org/accounts/Moschus_fuscus/
http://animaldiversity.org/accounts/Moschus_chrysogaster/

WESTERN TRAGOPAN
Tragopan melanocephalus

Vernacular/other names

Jujurana (Himachali-Kullu, Mandi), Fulgar, Fulgari (Himachali-Chamba), Pyara (Kinnaur), Jyazi (Bushahr) Sonalu, Solalee(Kashmiri), Jewar(Garhwali), Sing monal (Pahari-N.W.Himalaya)

Taxonomy

***Order**: Galliformes*

***Family**: Phasianidae*

***Genus**: Tragopan*

***Species**: melanocephalus*

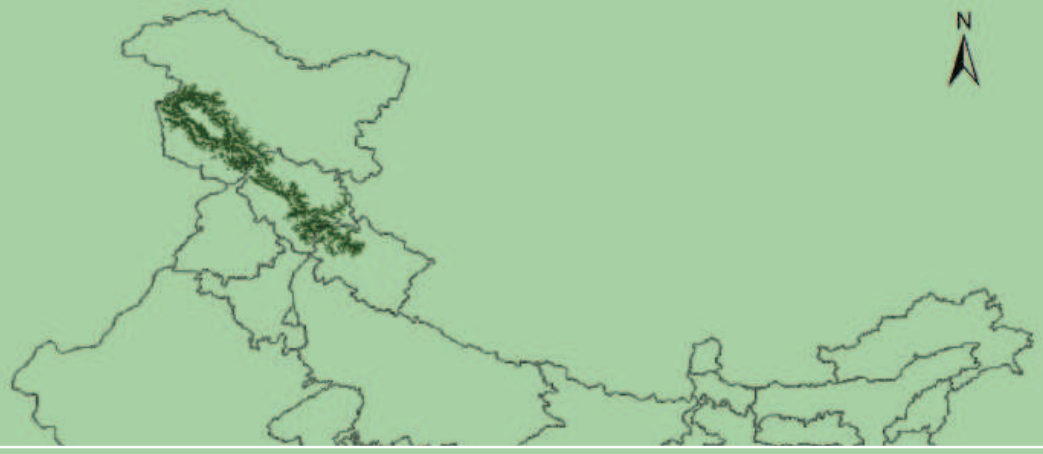
Conservation status

***IUCN:** Vulnerable*

***IWPA:** Schedule I*

***CITES:** Appendix - I*

Size



The western tragopan or western horned tragopan is a medium-sized brightly plumed pheasant found along the Himalayas from Hazara in northern Pakistan to Uttarakhand (up to Mandakini River). This is a rare bird distributed mostly between 2,400 -3,600 m (down to 2,000 m in winter). It inhabits dense undergrowth and montane bamboo clumps in undisturbed temperate and subalpine oak, coniferous, and mixed forests. During breeding season (April-June) they prefer little-disturbed temperate coniferous and deciduous forest with heavy understorey, between 2,400 and 3,600 m. The western tragopan comes down to less snow covered, grassy or shrubby areas between 1,750 and 2,500 m during winter.

Description

The male western tragopan is brilliantly coloured red and black pheasant with white spots. The male is strikingly different from male Satyr Tragopan (which is distributed east from Mount Nanda Devi in Uttarakhand), by having bright orange fore-neck and upper breast, white-spotted black underparts, and deep scarlet hind neck contrasting with intricately patterned black and grey-brown upperparts. It also has red facial skin, bluish throat, and are erected in display. The female is dull grayish-brown in colour, intricately patterned with dark browns, greys and buffs. It has slight rufescent touch to crown and neck and irregular white spotting on underparts. Very similar to female Satyr tragopan, but has dark grey-brown coloration to underparts. When in flight, it could be confused with females of koklas pheasant and Himalayan monal. The former has broad, rounded tail and stockier appearance, darker and more uniform coloration, and lack of white on throat. The latter is heavily streaked on upper and underparts, has white throat and 'horseshoe' patch on rump, and has a loud shrieking flight call.

Body length: ***68-73 cm (Male), 60 (Female)***	*Weight:* ***1,250-2,150 g***	*Altitude range:* ***1,735-3600 m***

Behaviour

Usually found singly or in pairs. It is very shy, extremely wary and skulking, but sometimes forages in forest glades or on open slopes. Generally in early mornings and late evenings they feed on the ground. They roost in well concealed trees. During breeding season, they are territorial. While displaying, males repeatedly expand and contract their horns and colourfully patterned lappets. The call is a nasal, wailing *khuwaah*, repeated in bouts of 7-15 calls, uttered by male and female, usually at dawn and dusk, and is very similar to the wailing of a child or goat. When alarmed, a more abrupt and anxious *waa, waa, waa*.

Vulnerability to climate change

Climate change/variability may lead to species extinction in the future. Galliformes such as western tragopan are mostly sedentary species with high site fidelity and low dispersal ability, and might be vulnerable to the changing climate. Currently, little is known about their possible responses to the future climate. However, upward shift of treeline and thus the upper temperate forest may impact negatively on this habitat specialist species which may not disperse according to the rate of rapid habitat alteration. The cascading effect of climate change and anthropogenic pressure on the upper temperate habitat may adversely impact the survival prospect of western tragopan in its habitat.

Monitoring protocol

As a very shy and elusive species, detecting western tragopan in its habitat is not an easy task. However, amateur bird watchers can always document the presence of the species whenever encountered either directly or from indirect evidences. For monitoring, professionals can do presence/ absence mapping in the upper temperate mixed coniferous forests. Encounter rate can also be used as a measure of relative abundance as number of individual seen per unit effort. The unit effort could be time spent in intensively searching in an area or it could be the distance travelled in an area intensively searching for the bird. During breeding season, the pheasant makes distinct calls, which can be estimated by using call count techniques to calculate the abundance. During breeding season (April-May), males call during early morning hours (predawn period) to attract females and also to challenge rival males in the vicinity. No call heard in an area does not necessarily mean that there are no birds in that area. One can playback a call in an area to get response from individuals in that area. Call count method is good for monitoring populations of calling males in an area over years. Additional information on the group sizes during the breeding seasons will help in understanding the population size in an area. Use of camera traps to detect the presence of this elusive species and relative abundance estimation through photographic capture rate and occupancy estimation can also be used to monitor this species.

Reproduction and life cycle

Breeding:
May-early June

Nest site/type:
nest of sticks, lined with grass, in thick undergrowth

Clutch size:
3- 6

Incubation Period:
28 days

Key threats

- *Poaching*
- *Habitat degradation*
- *Anthropogenic activities during breeding season*

Key field identification features

The nasal call, wailing *khuwaah*, very similar to the wailing of a child or goat repeated in bouts of 7-15 calls, usually at dawn and dusk. Usually found singly or in pairs. It is very shy, extremely wary and skulking, but unmistakably brightly coloured, white-spotted, red and black pheasant. It is distributed westward from Mandakini River in Uttarakhand and there is no overlap with Satyr tragopan distribution range which is eastwards from Mount Nanda Devi.

Important web links
http://www.birdlife.org/datazone/speciesfactsheet.
http://www.birdlife.org/datazone/userfiles

HIMALAYAN SNOWCOCK
Tetraogallus himalayensis

Vernacular/other names

Vernacular/other names: Jer monal (Garhwali), Huinwal (Kumauni), Leep (Himachali- Kullu), Galaond (Himachali-Chamba), Gleund (Himachali-Kangra), Kabak, Gurakakov, Ramchakor (Kashmiri)

Taxonomy

***Order**: Galliformes*

***Family**: Phasianidae*

***Genus**: Tetraogallus*

***Species**: himalayensis*

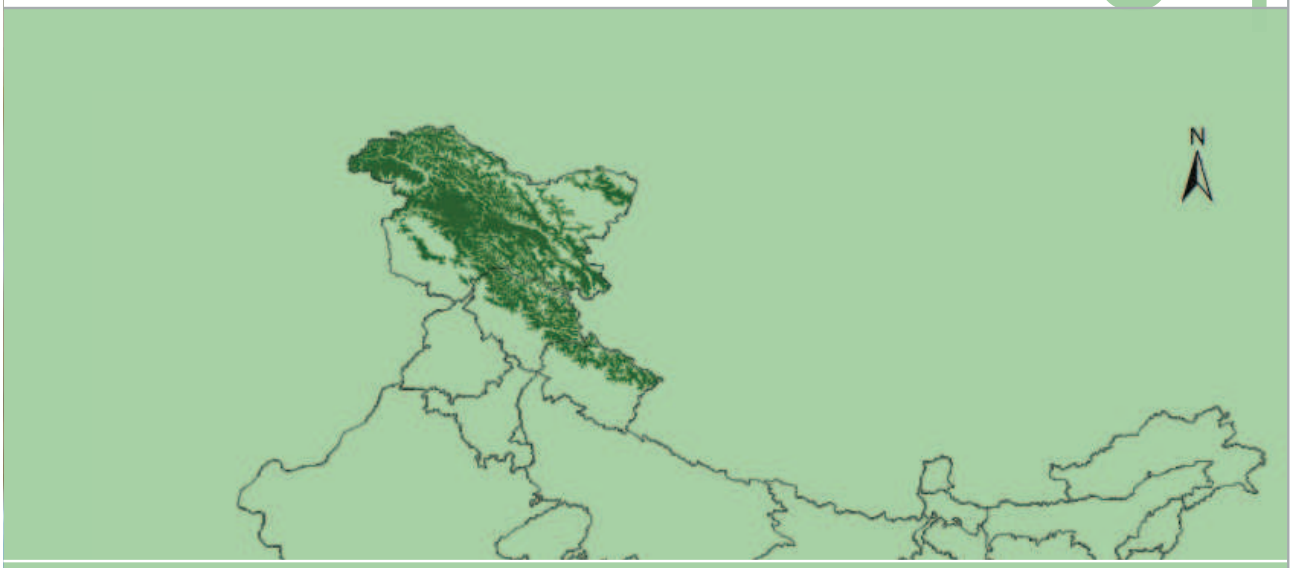
Conservation status

***IUCN:** Least concern*

IWPA: *Schedule IV*

***CITES:** Not listed*

Size



The Himalayan snowcock is distributed across the Himalayan ranges and parts of the adjoining Pamir range of Asia. It can be found in the Himalaya (Jammu & Kashmir, Himachal Pradesh and Uttarakhand) from 4,000 m to 5,500 m (summer) and down to 2,100 m in Western Himalaya. It inhabits alpine meadows and scrub near the snowline, bare stony ridges and steep slopes.

Description

Himalayan snowcock is largely grey, white, chestnut and black streaked and has vermiculated plumage. The white throat, separated by a broken chestnut collar from the dark grey underparts, and white under tail-coverts, are distinguishing characters. There is a strong contrast between pale grey crown/mantle and dark grey back. It lacks white striping on scapulars and coverts which is a striking feature of the Tibetan snowcock. While in flight, Himalayan snowcock shows extensive white in primaries but little or no white in secondaries.

Body length: ***72 cm***	*Weight:* ***: 1,360-3,000 g***	*Altitude range:* ***3,000-5,800 m***

Behaviour

Usually in pairs (breeding season), or parties of 3-5 although coveys of >20 birds are frequently observed. They shoot downhill in the morning to drink and slowly work their way upwards as the day warms up, scratching the ground and digging vigorously with their stout bills. They hardly fly uphill or flap their wings in flight except before alighting. When alarmed, escapes by running uphill like a waddling goose-like gait, its colouration blending to perfection with the barren environment or flying swiftly downhill for a long distance without a single wing beat before settling again. Flicks its heavy tail as it walks, showing the white under-tail coverts. They are noisy birds continually uttering clucking calls as they feed, and shrill cackles of alarm, when flushed as well as on the wing. Call: *cour-lee-whi-whi, chok-chok-chok*.

Vulnerability to climate change

Climate change may compel many species to shift their distribution range in the future. One general pattern is that the galliformes at high elevations such as Himalayan snowcock may face higher range shifts. Another general pattern is that the northward range shift is more than that for other directions. As Himalayan snowcocks is more northerly distributed and more specialized to alpine habitats, they may experience greater decline in future due to habitat loss.

Monitoring protocol

As Himalayan snowcocks inhabit steep rocky areas in high altitude environment, regular monitoring of this species may require substantial efforts through intensive field expeditions in high altitude alpine areas as well as glacial moraine and scree slopes. Trail sampling for the sign survey and direct encounter can generate information about presence of the species. Ridge walking can be one option to generate encounter rate as relative abundance estimates. Scanning of rocky slopes in the form of point count may also help to generate relative abundance of Himalayan snowcock.

Reproduction and life cycle

Breeding:
April-June

Net site/type:
Under stone/rock on leeward side

Clutch size:
3-6

Incubation period:
27-28 days

Key field identification features

They are large, noisy birds found only in the alpine regions. They make continuous clucking calls as they feed, and shrill cackles of alarm, when flushed as well as on the wing.

Key threats

- *Habitat degradation*

Important web links

https://www.iucn.org/dbtw-wpd/edocs/2000-076.pdf
https://www.birdlife.org/datazone/species/factsheet/22678673
https://www.xeno-canto.org/species/ Tetraogallus-himalayensis

BEAUTIFUL STREAM FROG

Amolops formosus

Vernacular/other names

Assam sucker frog, beautiful stream frog, Assam cascade frog, hillstream frog,

Taxonomy

***Order**: Anura*

***Family**: Ranidae*

***Genus**: Amolops*

***Species**: formosus*

Conservation status

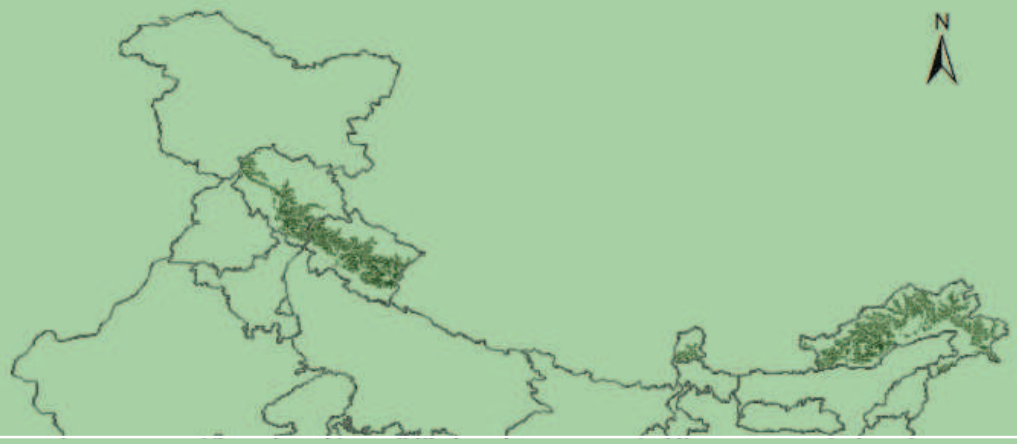
***IUCN:** least concern (LC)*

***CAMP:** not listed*

***IWPA:** not listed*

***CITES:** not listed*

***U.S. ESA:** not listed*



Amolops formosus is found from Himachal Pradesh in the west to Arunachal Pradesh in the east with an altitudinal range of 1500 m to 3000 m. The type locality of the species is Khasi hills, Meghalaya, India. The species is known to inhabit fast flowing torrent streams at 1500 m to 3000 m. It prefers side pools of the torrent streams or the rivulets, the species is known to occur clinging on to rocky boulders in torrent streams. Individuals go into winter sleep during winters (November to March). Breeding of the species takes place during the monsoon from June to September where the eggs are laid in clutches over rocks with overflowing water. The larvae of the species are unique in having a gastrozymous sucker and are known to occur in rheophilous habitat clinging on to the rocks. The species known to be sympatric with *Nanorana vicina*, and in some places with *N. minica* and *Amolops jaunsauri*.

Description

A medium sized frog (~70 mm). Dorsum green with large, dark brown blotches and markings; feeble webbing between fingers and toes about half webbed; toe tips and fingertips having expanded discs. The species is associated with torrential streams. Taxonomic validity of the species is incomplete due to its large distributional range and the population currently distributed in Western Himalaya might most likely be altogether a different species. Larvae of the species are not described.

Threat status

The species is common throughout its range and occur in moderate densities particularly in places where there are torrential streams. Stream pollution, removal of rocks and construction of dams seems to be the major threats to the species. the species population is threatened from introduction of exotic fish species and local consumption.

Vulnerability to climate change

Being physiologically constrained by temperature and humidity coupled with limited vagility, amphibians are candidate organisms for forecasting climate change scenarios. Factors related to climate change known to affect body size, breeding, gaseous exchange and geographical ranges of amphibian species. However, such information is grossly lacking from Indian context. Obligate stream species may be more vulnerable to climate change scenario.

Monitoring protocol

Visual encounter search, relative abundance estimation, stream transect, mark recapture study based on natural marking population monitoring may provide hitherto unknown population trend.

Visual Implant Elastomer tags can be used for population studies on tadpole and froglet.

Reproduction and life cycle

Breeding:
May-September

Eggs:
No pigmented white eggs

Developmental period:
Over wintering
Tadpoles known

Life span:
Not yet known

Key threats

- *Introduction of exotic fish species*
- *Collection for human consumption*

Key field identification features

A medium sized frog with green dorsum having brown patches. Inhabit large rocks along the streams.

Finger and toe tips are dilated to discs. No webbing on fingers, however present between toes.

Dorsolateral side slightly granulated.

Important web links

http://amphibiaweb.org/index.html
http://research.amnh.org/vz/herpetology/amphibia/

MURREE FROG
Nanorana vicina

Vernacular/other names

Paa vicina, murree frog, Himalayan paa frog.

Taxonomy

***Order**: Anura*

***Family**: Dicroglossidae*

***Genus**: Nanorana*

***Species**: vicina*

Conservation status

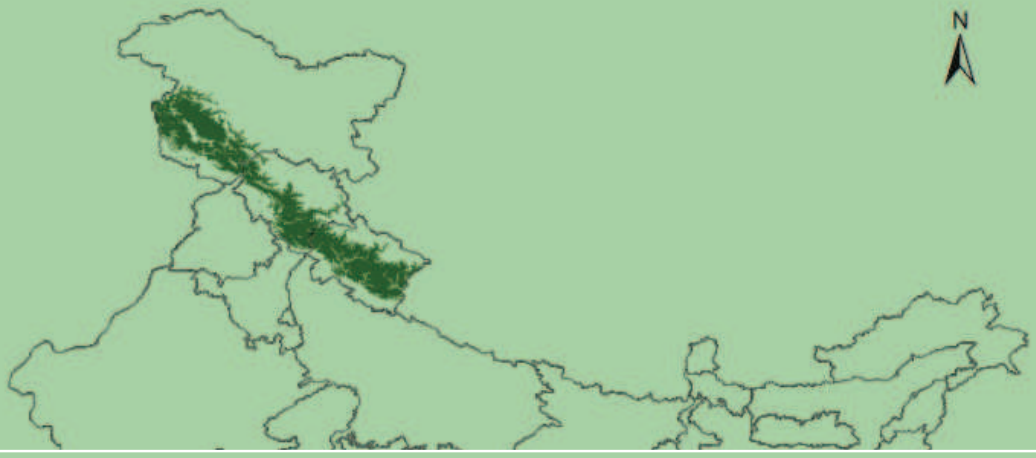
***IUCN:** least concern (LC)*

***CAMP:** not listed*

***IWPA:** not listed*

***CITES:** not listed*

***U.S. ESA:** not listed*



The type locality of the species is Murree, Baluchistan in Pakistan. In India, it occurs in Uttarakhand, Himachal Pradesh and Jammu & Kashmir between 1100 m to 3000 m. Habitat includes broad leaf oak forest and meadow habitats. The species is ubiquitous to forest streams.

Description

Nanorana vicina is a large sized frog (>110 mm) found in the western Himalaya with an altitudinal range of 1500 m to 3300 m. Characteristic features of the frog include rounded finger and toe tips; supra-tympanic fold prominent; dorsally yellow to brown with many dark patches; small tubercles with spiny projections are present around the vent.

Ventral region emaculate and smooth with no spines either on the breast or fingers. Taxonomic validity of the species is yet not fully validated and it may include more than one species given large distribution area. Larval forms of the species have extended developmental periods and are known to over winter during their development. The species is sympatric with *Nanorana minica* much of its distribution range and with *Amolops formosus*. Diet of the species is not yet known.

Vulnerability to climate change

As amphibians are physiologically constrained by temperature and humidity coupled with limited vagility, they are candidate organisms for forecasting climate change scenarios. Factors related to climate change are known to affect body size, breeding, gaseous exchange and geographical ranges of amphibian species. *Nanorana vicina* being a large heavy bodied obligate stream species may show measurable response to climate change.

Monitoring protocol

Visual encounter search, relative abundance estimation, simple stream transect for population monitoring may provide hitherto unknown population trend.

Tadpoles can be sampled/collected by using a simple scoop net and scooping along the bank of the stream. Standard population study protocols of anuran larvae in a lotic aquatic system is not yet known.

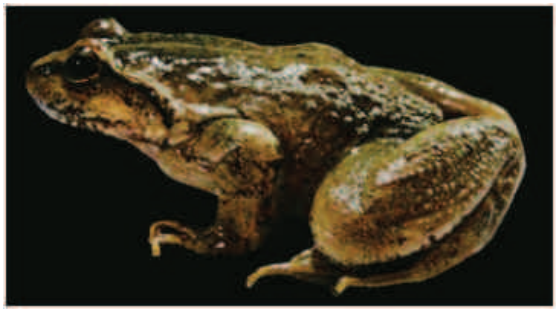
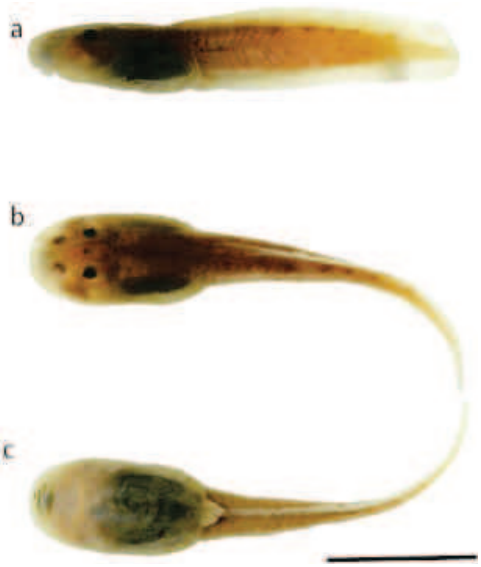


Image source : www.amphibians.org



Nanorana vicina tadpole
(a) Lateral view, (B) Dorsal view, (C) Ventral view

Key threats

- *Introduction of exotic fish species*
- *Dam construction, stream channel modification*

Key field identification features

A large sized brown coloured frog with few black patches on the dorsal side found in hill streams with less water current.

Finger and toe tips are rounded. No webbing on fingers, however present between toes.

Dorsal surface smooth however tuberculated around the vent.

Important web links

http://amphibiaweb.org/index.html
http://research.amnh.org/vz/herpetology/amphibia/

GOLDEN MAHSEER

Tor putitora

Vernacular/other names

putitor

Taxonomy

Class: *Actinopterygii*

Order: *Cypriniformes*

Family: *Cyprinidae*

Genus: *Tor*

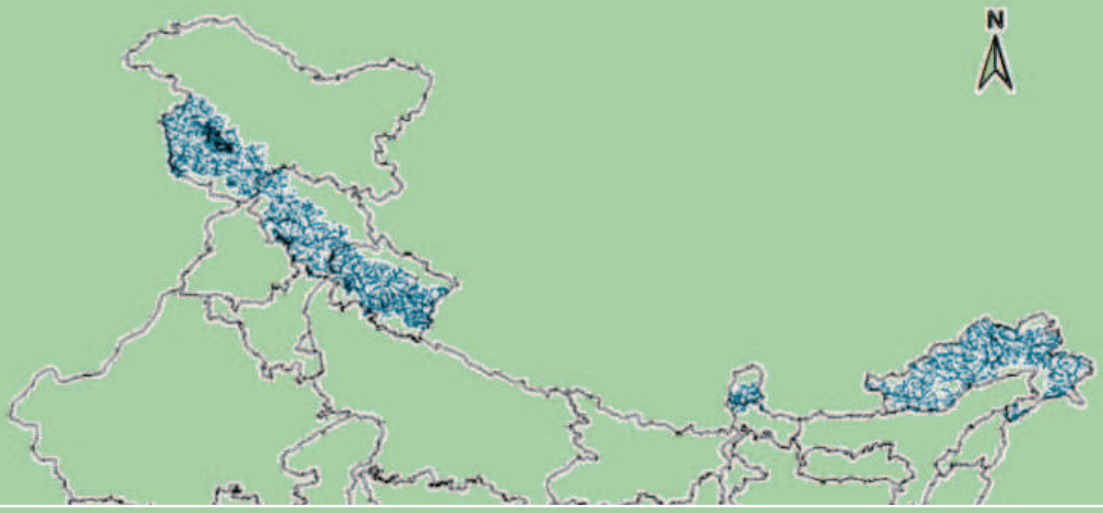
Species: *putitora*

Conservation status

IUCN: *Endangered*

CITES: *not listed*

WLPA (1972): *not listed*



Golden mahseer has been reported from streams and rivers of the Himalayan region and elsewhere in South Asia and Southeast Asia. In India, it has been reported from Assam, Bihar, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Uttarakhand, Uttar Pradesh, and West Bengal. Golden mahseer inhabits streams and rivers of mountain and its adjoining regions. It occurs in rapid streams with rocky bottom, riverine pools and some population also thrive in upland lakes in the Himalaya. It lives in clear water with pH ranges 7.4 – 7.9 and in temperature condition of 13°C to 30°C.

Description

The golden mahseer's native name. mahseer ('maha seer'), refers to its large head. The species has four dorsal spines; eight dorsal soft rays; two anal spines; and five anal soft rays. It can be easily differentiated by large size scales on the body; and head longer than the depth of body. Body flanks are golden orange to yellow, which fades into silvery white on belly. The scales are tinted with numerous black dots along the lateral line; and the fins are yellow in color. Two pairs of short barbles are present along the corner of the mouth. Common length is 183.0 cm TL; maximum recorded length is 275.0 cm TL; and maximum recorded weight is 54.0 kg.

Vulnerability to climate change

In freshwater ecosystem, temperature is an important determinant factor for spatial distribution of the golden mahseer. Fluctuations in the temperature level can strongly affect the fish's growth and reproduction. Further, climate change can affect the golden mahseer population by changing the abiotic filters that prevent the establishment of invasive fish species by allowing such species better breeding environment. Moreover, frequent floods leads to landslides that damage the primary and secondary streams where the golden mahseer breeds.

Monitoring protocol

Commercially important but threatened species of golden mahseer occurs in majority of streams and rivers of Himalaya. Further, this species is highly sensitive to environmental changes that might occur due to climate change. Therefore, monitoring this species would help in monitoring the health of rivers. A day in a month (or once in a season), the total number of golden mahseer that have been caught in the fishing nets (gill net/cast net) of local fishermen should be counted and weighed at any fishing areas. This data, along with other parameters, i.e. date, time, place, length (mm), weight (g), flow (high/low), depth, turbidity (high/medium/low), and fishing method used (gill net/cast net/rod) need to be collected. This data can then be used to estimate the abundance of the fish species by assessing their catch per unit effort (CPUE); and also to estimate the condition factors of fishes. Such an approach will assist in revealing the health and environment conditions of this fish species and the river ecosystem respectively.

Ecological and socio-economic benefits of monitoring the golden mahseer

Golden mahseer could be used as bio-indicators to monitor the naturalness of streams and rivers of the IHR. Any adverse impacts due to climate change on lotic ecosystem of Himalaya are expected to affect the behaviour and populations of this fish species. Therefore, the effects of climate change on the golden mahseer needs to be monitored to develop a better climate change adaptation plan for streams and rivers of the Himalaya. Golden mahseer can also be considered an umbrella species in the lower altitude streams and rivers of the IHR. This species can easily be monitored by the local communities by observing its abundances along with qualities of water that is available in the streams and rivers.

More importantly, this fish species is commercially important hence, monitoring its population, distribution and abundance is vital for the livelihood of local people dependent on it. Also, little is known relating to the migration and spawning behaviour of this species – a vital requirement for the long-term protection and conservation of this threatened species. Monitoring this species could potentially yield vital clues concerning this aspect of these fishes. There are other notable socio-economic benefits of monitoring this fish species.

Very little scientific information is available regarding the golden mahseer. More importantly, there is recognition of the economic benefits for some local communities through catch-and-release angling associated with the golden mahseer.

Key threats

- *Urbanisation and habitat loss*
- *Alien invasive species*
- *Point and non-point sources of pollution*
- *Destructive fishing methods*

Key field identification features

Large scales with yellowish orange tips, fins golden-yellowish in color.

Important web links

www.fishbase.org/
www.calacademy.org/scientists/projects/catalog-of-fishes
www.iucnredlist.org/

COMMON SNOW TROUT
Schizothorax richardsonii

Vernacular/other names

Alwan snow trout

Taxonomy

***Order**: Cypriniformes*

***Family**: Cyprinidae*

***Genus**: Schizothorax*

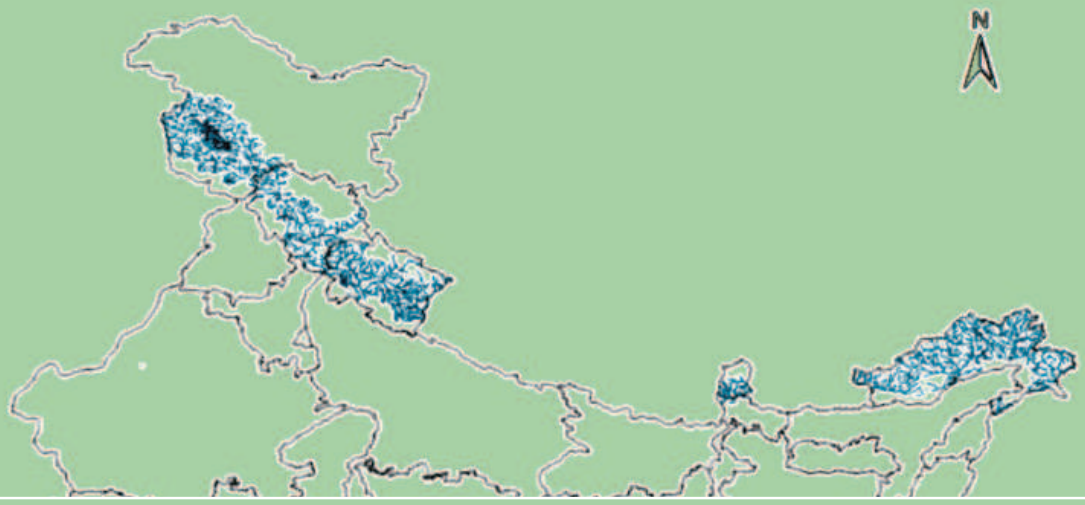
***Species**: richardsonii*

Conservation status

***IUCN:** Vulnerable*

***CITES:** not listed*

***WLPA (1972):** not listed*



In India, the common snow trout is distributed in the water bodies of Arunachal Pradesh, Assam, Bihar, West Bengal, Haryana, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Nagaland, Punjab, Sikkim, Uttarakhand, and Uttar Pradesh.

This species inhabits snow feed streams/rivers; and prefers to live in clear water streams/rivers with bedrocks and boulders substratum, preferably near big submerged stones.

Description

The common snow trout has a cylindrical body. Its head is flattened on the under surface; with a rounded and smooth snout. It has a suctorial mouth on the ventral surface of its head. The scales are very small. Body color in adults is as follows – head and dorsal region of the body are gray, whereas the flanks and belly are silver white. However, in large size specimens, the flanks are golden brown in color. The common length is 40.0 cm TL; common weight is 1.0 kg; and the maximum recorded length is 60.0 cm TL.

Vulnerability to climate change

In freshwater ecosystem, temperature is an important determinant factor for spatial distribution of the common snow trout. Fluctuations in the temperature level can strongly affect the fish's growth and reproduction. Further, climate change can affect the common snow trout population by changing the abiotic filters that prevent the establishment of invasive fish species by allowing such species better breeding environment. Frequent floods are expected in the Himalaya due to climate change that would lead to landsides and disappearance of primary and secondary streams where the common snow trout lives.

Monitoring protocol

Common snow trout occurs majorly in streams and rivers of Himalaya. Further, the species is highly sensitive to environmental changes that might occur due to climate change. Therefore, monitoring this species by citizens would help in monitoring the health of rivers. A day in a month (or once in a season), the total number of common snow trout that have been caught in the fishing nets (gill net/cast net) of local fishermen need to be counted and weighed at any fishing areas. This data, along with other parameters, i.e. date, time, place, length (mm), weight (g), flow (high/low), depth, turbidity (high/medium/low), and fishing method used (gill net/cast net/rod) need to be collected. This data can then be used to estimate the abundance of the fish species by assessing its catch per unit effort (CPUE); and also to estimate the condition factors of fish. Such an approach will assist in revealing the health and environment conditions of the fish species and the river ecosystem respectively.

Ecological and socio-economic benefits of monitoring the common snow trout

The common snow trout could be used as bio-indicators to monitor the naturalness of streams and rivers of the IHR. Any adverse impacts due to climate change on lotic ecosystem of Himalaya are expected to affect the behavior and populations of this fish species. Therefore, the effects of climate change on the common snow trout needs to be monitored to develop a better climate change adaptation plan for streams and rivers of the Himalaya. Cold water fish species such as the common snow trout normally occur in the higher altitude streams and rivers, and their distribution is largely determined by water flow, temperature and low turbidity. Therefore, this species could be used to monitor the changes in the water flow and temperature of streams and rivers in the higher altitudes of the IHR.

More importantly, this species of fish is commercially important hence, monitoring its population, distribution and abundance is vital for the livelihood of local people dependent of it. Also, little is known relating to the migration and spawning behavior of this species – a vital requirement for the long-term protection and conservation of this threatened species. Monitoring the species could potentially yield vital clues concerning this aspect of the species. There are other notable socio-economic benefits of monitoring this fish species.

Key threats

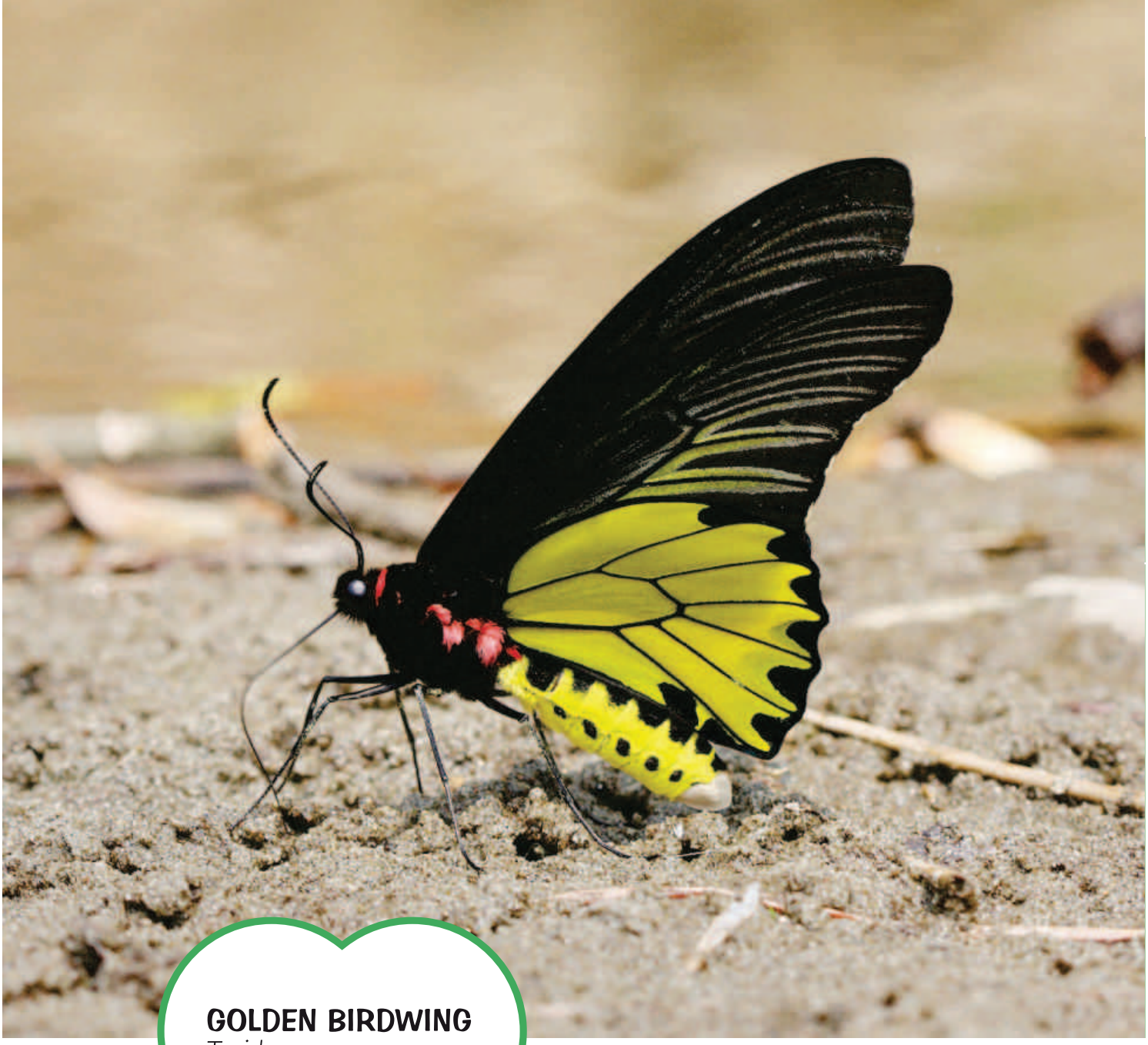
- *Urbanisation and habitat loss*
- *Alien invasive species*
- *Point and non-point sources of pollution*
- *Destructive fishing methods*

Key field identification features

Silver colored fish with minute scales.

Important web links

http://www.fishbase.org/
http://www.calacademy.org/scientists/projects/catalog-of-fishes
http://www.iucnredlist.org/



GOLDEN BIRDWING
Troides aeacus

Vernacular/other names

Golden birdwing (English)

Taxonomy

Order: *Lepidoptera*

Family: *Papilionidae*

Genus: *Troides*

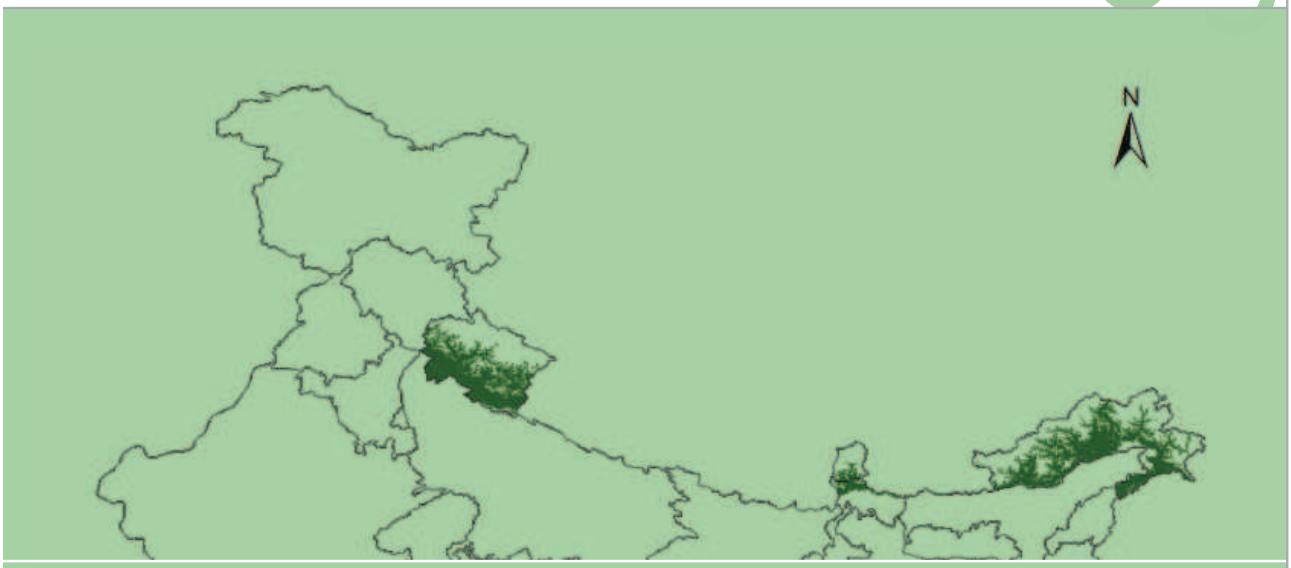
Species: *aeacus*

Conservation status

IUCN: *not listed*

CITES: *Appendix II*

WLPA (1972): *not listed*



Most common from May to June in the warmer forested foot hills of the Himalaya, where it is seen sailing slowly around flowering trees and shrubs. Birdwings inhabit warm moist forests and adults are usually glimpsed along the forest periphery. May be observed in the open patches of the forest, sailing 4-5 m above ground, but often comes down to feed on flower. They feed upon and are important pollinators of nectar-bearing flowers such as *Aesculus indica* and *Lantana*.

This species is found in IHR from Uttarakhand to Arunachal Pradesh, in the altitudinal range from 300m to 1700m.

Description

Birdwings are swallowtail butterflies of family Papilionidae, belonging to the genera Trogonoptera, Troides, and Ornithoptera. They are named for their exceptional large size, angular wings, and birdlike flight. Birdwings are the largest butterflies in world. Due to their large size and brightly colours, they are very popular among collectors, that's why all birdwings are now listed by CITES.

Wingspan: 115-188 mm

Male

Upper hind wing golden with small areas of black dusting around cone shaped black marginal markings in spaces 2, 3 and 4 on the inner edges; sometimes a black discal spot placed behind vein 2. Space 7 all yellow up to marginal spot. Males are strong and fast flyers, fly high above ground and can fly far above canopy. They are easily disturbed.

Female

Upper forewing black-brown with very broad grey vein stripes extending well into cell. White-grey inside margin in half of cell, or often the entire cell white-grey. Upper hind wing with a row of large wedge-shaped black discal spots, black dusting between the spots and deeply incised black marginal border in spaces 2, 3 and 4; base of space 1b black. Under forewing with vein stripes more white and prominent. Upper side of abdomen ringed with yellow.

Larval food plant

Aristolochia spp.

Life cycle

After mating, females immediately begin to seek appropriate host plants; climbing vines of the Aristolochia. The female lays her spherical eggs under the tips of the vine's leaves, one egg per leaf. The caterpillars are voracious eaters but move very little. The feeding caterpillars incorporate and concentrate the poisonous aristolochic acid (known to be carcinogenic). Birdwing caterpillars possess a retractable organ behind their heads known as osmeterium. Shaped like the forked tongue of a snake, the osmeterium excretes a stinking terpene-based compound and is deployed when the caterpillar is provoked. Adult may live up to 1- 8 months.

Vulnerability to climate change

Butterflies being ectothermic organism their population dynamics may respond to temperature change more directly and more rapidly. With warmer temperature butterflies emerge earlier in the year and their active flight season occur earlier which may lead to frost death or death due to starvation caused by food scarcity due to unavailability of food plant.

Key threats

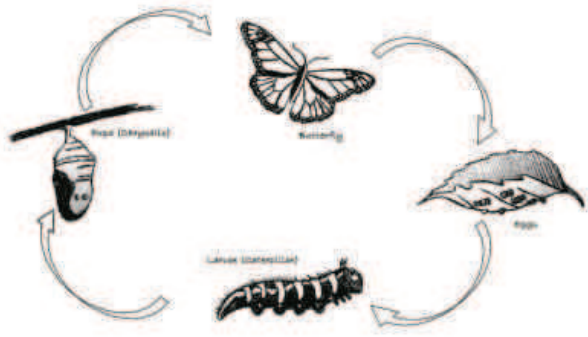
- *Habitat degradation and habitat loss*
- *Collection from the wild for illegal trade and personal collection*

Key field identification features

Head, thorax and abdomen are mainly black, with small red patches on thorax and yellow underside of abdomen. Forewings are black with veins bordered as whitish and hind wings are bright yellow. Caterpillars are pale brown, with long thorn like protrusions.

Monitoring protocol

This is a large butterfly and can easily be located, most common from May to June in the warmer moist forested foot hills of the Himalaya up to 1700 m, where it is seen sailing slowly around flowering trees and shrubs. Observed in the open patches of the forest, sailing 4-5 m above ground, but often comes down to feed on flowers. Species can be monitored through transect counts and opportunistic observations. GPS coordinates may be recorded with photographs and sent.



Important web links

https://lepidoptera.pro/taxonomy/15253
https://ifoundbutterflies.org/sp/1133/Troides-aeacus
https://en.butterflycorner.net/Troides-aeacus-Golden-Birdwing.983.0.html

HIMALAYAN RELICT DRAGONFLY

Epiophlebia laidlawi

Taxonomy

Order: *Odonata*

Family: *Epiophlebiidae*

Genus: *Epiophlebia*

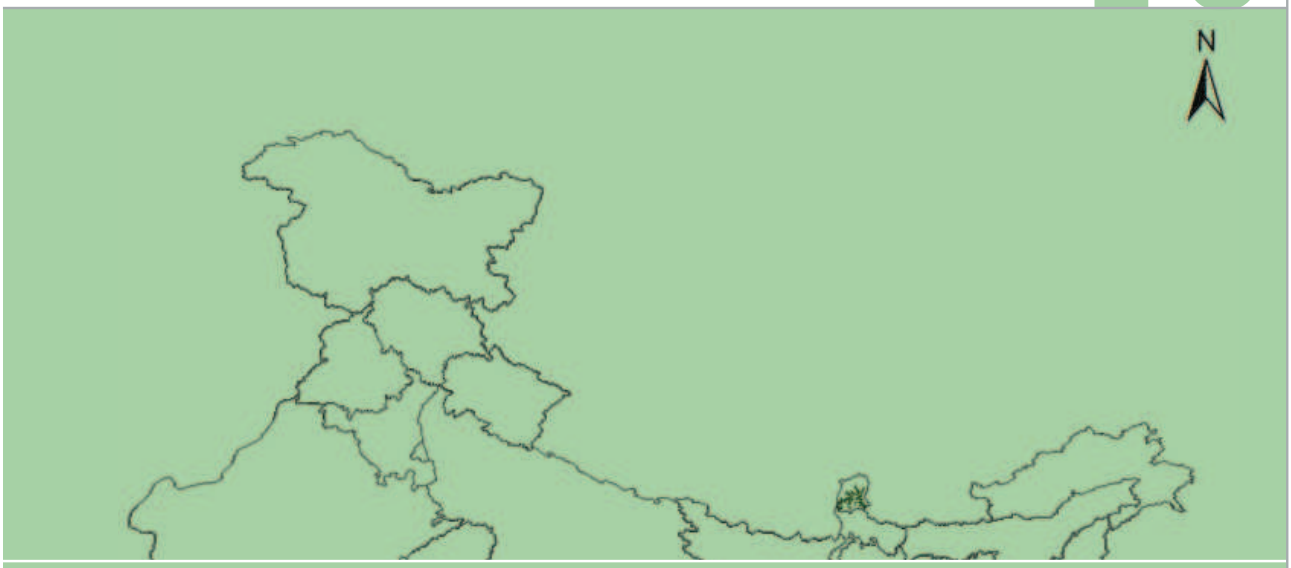
Species: *laidlawi*

Conservation status

IUCN: *Near Threatened*

IWPA: *Not listed*

CITES: *Not listed*



Himalayan Relict Dragonfly is distributed in Sikkim and northern part of West Bengal in IHR. The Himalayan relict dragonfly breeds in streams that can be found at elevations between 1,800 and 3,500 m and may also breed in waterfalls around 2,000 m elevations.

Description

It is considered as intermediate between the dragonflies and the damselflies, mainly because of the appearance, This is now known to be in error however; in reality, the genus Epiophlebia shares a more recent ancestor with dragonflies and became separated from these in and around of the uplifting Himalayas. They are relict species of a once widespread group.

The adult flight is slow and rather uncoordinated. The hind wings being very similar in size and shape to the forewings and held back over the body at rest as in the damselflies. The discoidal cell in the forewing is uncrossed and foursided. In hindwing, the crossvein is long making the cell distally wide. The arculus is situated between the primary antenodals.

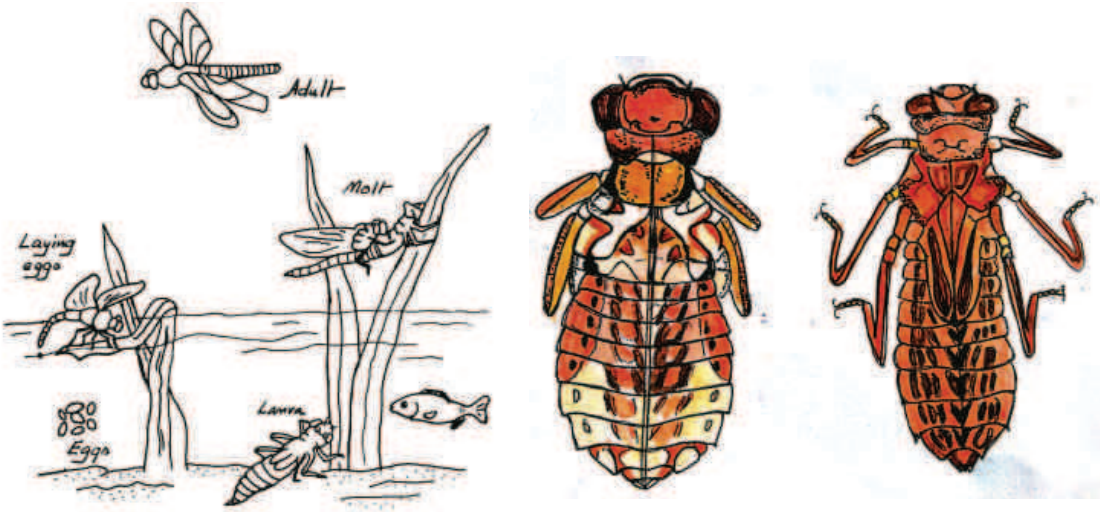
After breeding, females lay their eggs on plant stems located near the edge of streams. The eggs are laid from bottom to top in a regular zig-zag pattern preferably on bryophytes. The larvae may grow from five to nine years, which is supposed to be the longest period for any odonate. It is observed that larvae stridulate when disturbed. The larvae appear like those of the Anisoptera but are unable to use the anisopteran jet-propulsion mode of escape, but walk.

Vulnerability to climate change

During warming phase after last ice-age, its range contracted, resulting in disjunct distribution. The current trend to increasing global temperature will further reduce acceptable habitats and threaten the existence of this last representative of an ancient group of odonata. This species is also suffering from habitat loss caused by pollution, as well as siltation caused by erosion in the streams.

Monitoring protocol

At edges of stream in forested area. This species has not been sighted during last few attempts. It is difficult to locate adults but larvae can be seen in streams and rivers. More information is needed about ecology of species for any conservation planning.



Key threats

- *Habitat loss due to water pollution*
- *Siltation caused by erosion in the streams*

Key field identification features

The discoidal cell in forewing is uncrossed and foursided and in hindwing crossvein is long making the cell distally wide. The adult flight is slow and uncoordinated, larvae around 2 cm length, stout built and brownish in color.

Larvae stout, elongate with a slight petiolation at the base of the wing pad; antennae with five segments; body covered with tubercles, but lacking bristles, body firm.

Important web links

https://en.wikipedia.org/wiki/epiophlebia_laidlawi
https://iucnredlist.org/details/7896/0
https://216.92.149.63/zootaxa/2009/f/zo2216p036f.pdf

HIMALAYAN BIRCH
Betula utilis

Synonyms:

Betula albosinensis var. septentrionalis C.K.Schneider

Betula bhojpattra Lindley

Betula bhojpattra var. latifolia Regel

Betula utilis var. pratii Burkill

Vernacular/other names

Bhojpatra (Hindi), Bhurja (Sanskrit)

Taxonomy

***Order**: Fagales*

***Family**: Betulaceae*

***Genus**: Betula*

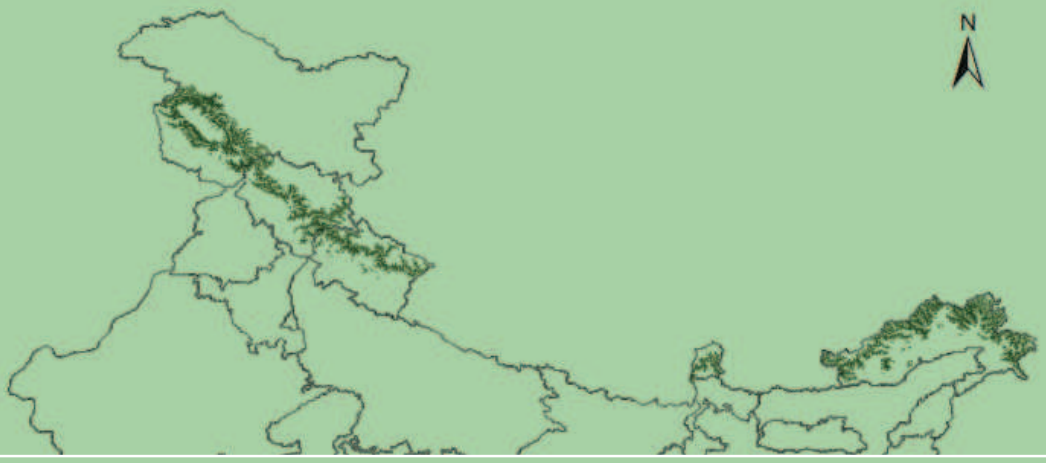
***Species**: utilis*

Conservation status

***IUCN:** Least Concern*

***CITES:** Not listed*

***WPA (1972):** Not listed*



Birch *(Betula utilis)* is a medium sized deciduous tree found approximately between 3000 – 4000 m and often forms 'treeline' i.e., upper limit of trees in the Himalayan region. It is often associated with high altitude fir *(Abies spectabilis)*, brown oak *(Quercus semecarpifolia)*, and species of Rhododendrons especially *R. campanulatum* and *R. barbatum*. It frequently grows among scattered conifers, with undergrowth of shrubs that typically include krummholtz forming Rhododendrons, Willows and hill bamboos. The tree depends on moisture from snowmelt, rather than from monsoon rains. Bent growth is their characteristic feature during deep winter snow in the Himalaya.

Description

A characteristic high altitude tree attaining a height of up to 15m, bark white or dark red-brown, exfoliating in thin flakes. Branches are reddish-brown, smooth and branchlets are brown with dense resinous glandule and pubescent. Petiole 0.8-2 cm; leaf blade ovate, ovate-elliptic, or oblong, 4-9 × 2.5-6 cm, abaxially densely resinous punctate and pubescent, bearded in axils of lateral veins, adaxially densely villous when young, base rounded or subcordate, margin irregularly and doubly mucronate serrate, apex acuminate or caudate-acuminate; lateral veins 8-14 on each side of mid-vein. Female inflorescence 1, or 2 or 3 in a raceme, pendulous, cylindrical, 3-5 cm × 7-12 mm; peduncle 0.5-1.5 cm; bracts 5-8 mm, pubescent, ciliate, 3-lobed, middle lobe lanceolate, lateral lobes ovate, ca. 1/3 of the length of middle lobe. Nutlet obovate, 2-3 × 1.5-2 mm, with membranous wings ca. as wide as nutlet.

Use and trade

The species is a valuable timber tree of commercial importance, mainly used for fuel. The wood is often hard and dense but brittle, while the heartwood has a silky luster and pinkish or light reddish brown in color. The wood is used for various building purposes, bridges and for fodder. In the past, the outer papery bark (popularly known as *Bhojpatra*) was a substitute for paper, mainly for the inscription of religious texts. Today this 'paper' continues to have many uses, such as for packaging, roof construction, umbrella covers, bandage, cigarette paper, and for various religious ceremonies. The species is regarded as a sacred tree in the Himalayan region and have high medicinal properties. The bark has carminative and antiseptic properties and an infusion of it is given for hysteria. Part of the bark is applied to cuts, wounds and burns, and water boiled with bark is taken in cases of jaundice and used as drops to relieve ear ache. A paste of the resin is applied to boils and used as contraceptive by people in the Kumaon region of Uttarakhand, India and west of Nepal. Besides it's religious and commercial significance, *Betula utilis* forms critical habitat for a large number of Himalayan fauna such as musk deer, pheasants (e.g., monal, western tragopan, satyr tragopan) and a number of smaller birds especially altitudinal migrants.

Vulnerability to climate change

Betula utilis usually grows in north-facing slopes in the sub-alpine areas, which receive heavy snow. Deficit in snow- fall and extreme weather events such as hailstorm during early summer or increased temperature could affect its phenology, flowering, seed production and regeneration. Patch mortality due to fungal and other diseases have been observed in several pockets of Himalaya which are induced due to climate change. It is hypothesized that with the changing climate the natural habitats in the sub-alpine areas would become increasing stressful for the cold adapted species such as *Betula utilis* making them vulnerable to local extinction.

Monitoring protocol

Permanent plots (20x20 m) may be laid within 3300 – 4000 m in observed areas. Phenology, regeneration and population structure of birch, other associated plants and direct and indirect evidences of faunal species may be monitored.

Reproduction and life cycle

- *Flowering:* ***June to July,***
- *Fruiting:* ***July to August***

Key threats

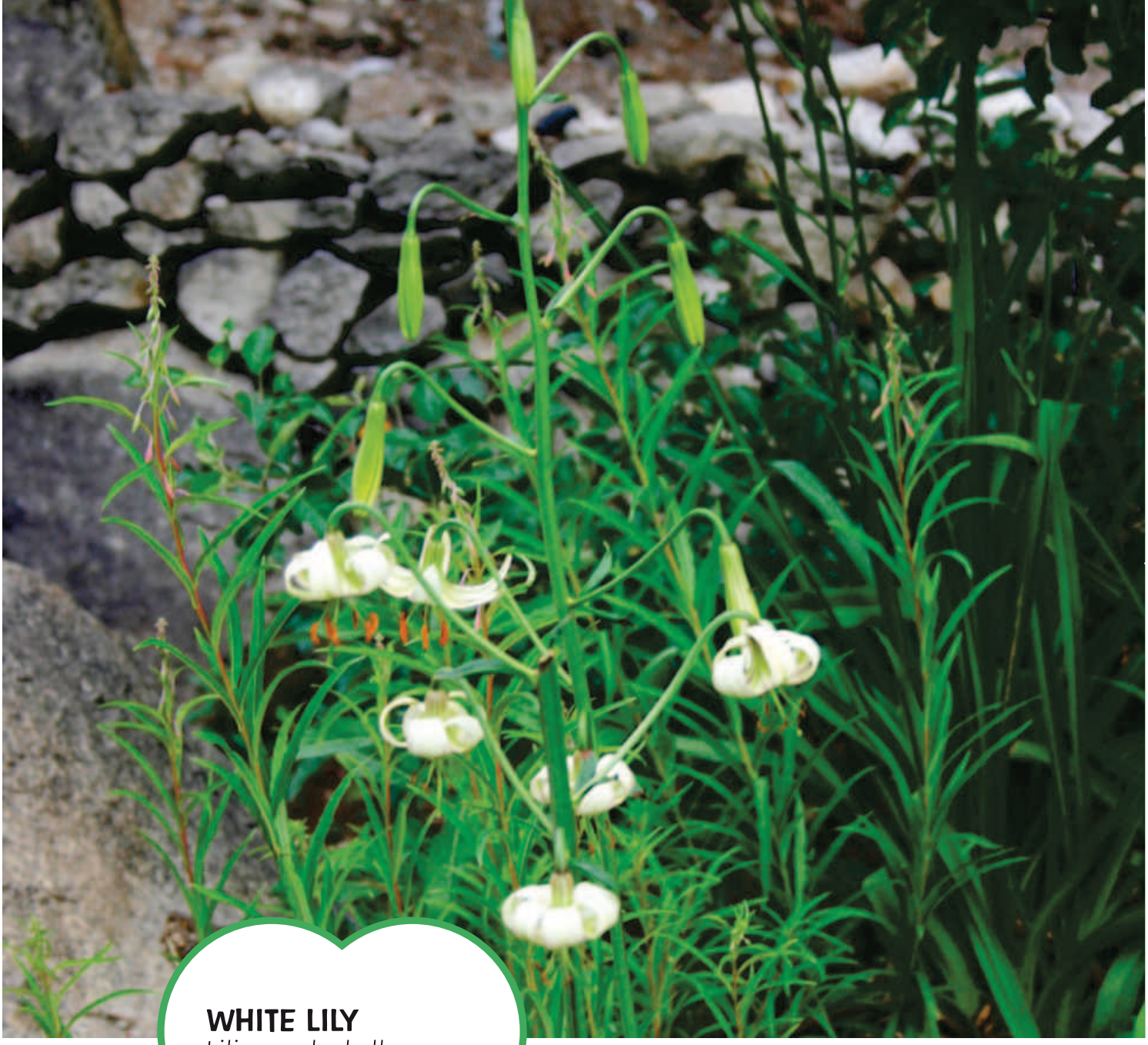
- *Loss of habitat*
- *Over exploitation for fuel wood and timber*

Key field identification features

- Bark dark reddish brown
- Paper like bark

Important web links

https:/ en.wikipedia.org/wiki/Betula_utilis
https:/ www.iucnredlist.org/details/194535/0



WHITE LILY
Lilium polyphyllum

Vernacular/other names

White Himalayan Lily,
Many-leaved lily,
Kalihari (Hindi),
Kakoli (Sanskrit)

Taxonomy

***Order**: Liliales*

***Family**: Liliaceae*

***Genus**: Lilium*

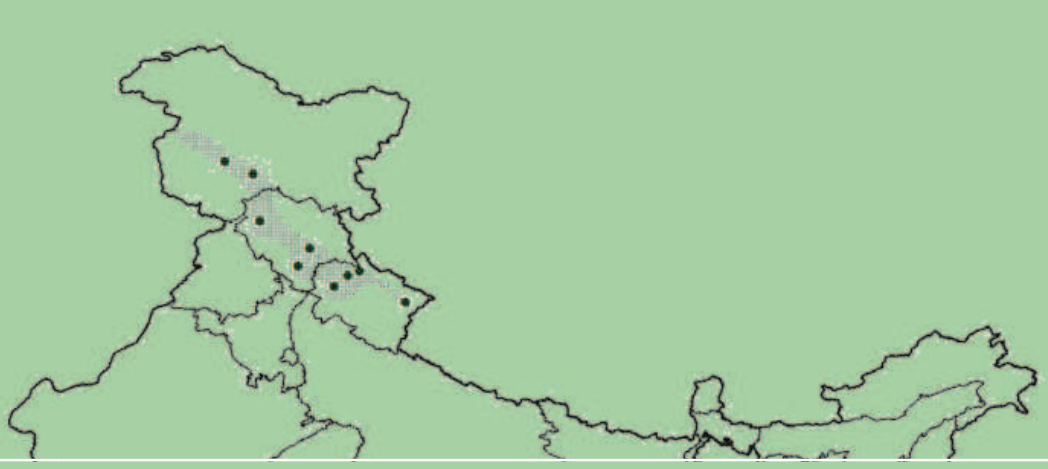
***Species**: polyphyllum*

Conservation status

***IUCN:** Critically Endangered*

***CITES:** Not listed*

***WPA (1972):** Not listed*



White Lily is restricted to its native habitat in the Himalayan region. It is found between Afghanistan and Uttarakhand State in India. In the IHR, the species has very small population, and reported only from a few places namely Dhauladhar and Shimla in Himachal Pradesh, Chatru and Doda in Jammu & Kashmir and Dhanaulti, Gangotri and Bhangeli in Uttarakhand. It grows commonly in humus-rich forest floors between 2100 and 3000 m.

Description

Plants are bulbous herbs and grow up to 1 m height. Leaves are narrow, alternate, linear or oblong-lanceolate, 8–12 cm × 0.5–1 cm, sessile and flashy. Flowers are white with purple dots, pendulous, 2 inch in diameter, fragrant, anther are large yellow to orange and capsules three-angled with winged seeds. Bulb is with dark brown scarious coats. Flowering occurs during June–July (rainy season) and fruiting during September–October (autumn season).

Use and trade

Bulbs have soothing, astringent and anti-inflammatory properties. They are used in traditional and modern medicines and used as refrigerant, galactogogue, expectorant, aphrodisiac, diuretic, antipyretic and tonic in cough, bronchitis, vitiated conditions, seminal weakness, strangury, burning sensation, hyperdipsia, intermittent fever, hematemesis, rheumatalgia and general disability. Bulbs are also used in revitalising night cream and Chywanaprasha. The bulbs and roots are traded under the trade name *Kakoli/Ksheerkakoli* in the local and national markets.

Threats

Loss of habitat and unregulated collection are two of the major threats to this species. Habitat loss continues due to construction of roads, agricultural invasions and human settlements.

Over-exploitation for trade and habitat degradation due to heavy grazing coupled with climate change and proliferation of invasive species has led to considerable depletion of its natural populations. This has resulted in the listing of this species as Threatened in the Red Data Book of Indian Plants and subsequently as Critically Endangered by the IUCN which necessitated a study of the population biology to suggest in-situ and ex-situ conservation measures.

Vulnerability to climate change

The species has been heavily exploited for its medicinal value in the past. No quantitative studies are available on its vulnerability to climate change. However, considering its narrow altitudinal range and habitat specificity in Gangotri area, its intricate relationships with the pollinators and dispersal agents, it would be prudent to establish its vulnerability to climate change.

Monitoring protocol

Population structure, phenology, seed setting and dispersal pattern could be monitored within the permanent plots in observed areas.

Reproduction and life cycle

- *Flowering:* ***June to July***
- *Fruiting:* ***September to October***

Key threats

- *Habitat loss*
- *Unregulated collection*

Important web links
http://www.iucnredlist.org/details/50126623/0

CHILGOZA PINE
Pinus gerardiana

Synonyms:

Pinus aucklandii Lodd. ex Gordon

Pinus chilghoza Knight

Pinus gerardii J. Forbes

Pinus neosa Gouan ex W. H. Baxter

Vernacular/other names

Himalayan nut pine, Gerrard's Pine.

Taxonomy

***Order**: Pinales*

***Family**: Pinaceae*

***Genus**: Pinus*

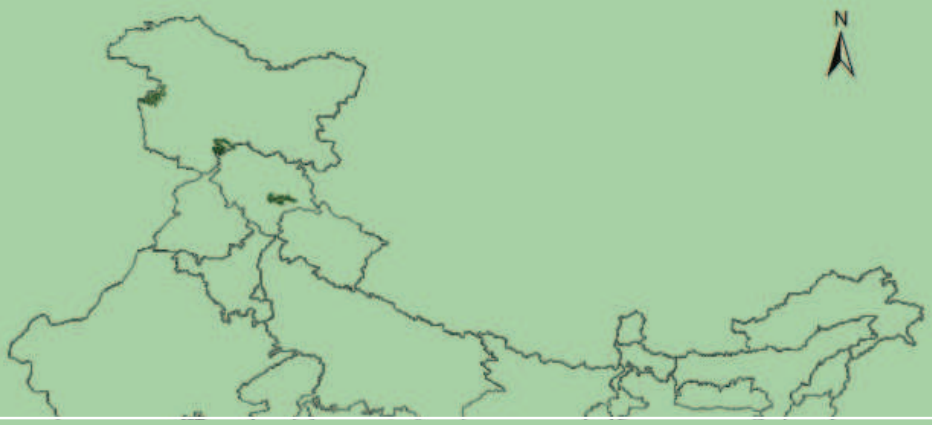
***Species**: gerardiana*

Conservation status

***IUCN:** Near Threatened*

***CITES:** Not listed*

***WPA (1972):** Not listed*



Pinus gerardiana is found in a few inner rain shadow zones of north-west Himalaya approximately between 2000 m to 3,350 m above sea level. In India it occurs mainly in Kinnaur and Pangi districts of Himachal Pradesh, Kishtwar and Gurej regions of Jammu and Kashmir. It forms scattered woodland along open hill slopes and at times occurs in association with blue pine (*Pinus wallichiana*) and deodar (*Cedrus deodara*). This species prefers dry and sunny slopes having more or less open vegetation. Evidence suggests that the pine seeds are dispersed by birds. However, detailed studies on the dispersal patterns are lacking.

Description

The trees are middle sized about 10-25 m tall with long and erect branches that are not whorled. They usually have deep and wide-open crowns but in dense forests the crowns have narrow and shallow in appearance. The bark is grey, smooth and thin, which peels off in large flakes. Branchlets are smooth and olive-green. Bark has characteristic light greyish-green patches which are especially seen after it is peeled off. Leaves are stiff, needle-like, 2-4 inch long in fascicles of 3, back rounded but glossy green outer surface. Additionally, leaves have blue-green stomatal lines on the inner face and deciduous sheaths, which falls in the first year. The cones are ovoid- oblong, 6 – 9 inch long, 4 – 5 inch in diameter, glaucous when mature. The pine nuts (seeds) are irregularly cylindric with thin shell and short rudimentary wing. Seeds are 17–23 mm long and 5–7 mm broad.

Cones appear during May-June and female cones ripen in the autumn of the second year.

Uses and trade

The major economic use of this pine is for its well-known edible, carbohydrate and protein rich seeds (pine nuts, *neoza* in Hindi). The seeds are usually harvested in autumn and onset of winter. Local and market names for the seed are "*chilgoza*", "*neja*" (singular) or "*neje*" (plural). In Kinnaur district of Himachal Pradesh it serves as one of the most important and expensive cash crop for the local people costing approximately ₹ 1800-2400 ($20–$53) per kilogram. Some villages of this district have own rights for seed harvest and export to markets of northern India. Sufficient cones are however are left on the trees after harvest to ensure natural regeneration. Fire wood collection is only practiced on trees that do not produce enough cones. In some areas private companies own harvesting rights where no cones are left for regeneration. Light construction work is locally performed with the wood. Despite such importance of this species horticulture cultivation of this species is quite rare.

Vulnerability to climate change

Pinus gerardiana usually grows in cold deserts of northwestern Himalaya, which receive heavy snow. Deficit in snow- fall and extreme weather events such as hailstorm during early summer or increased temperature could affect its phenology, seed production and regeneration. It is hypothesized that with the changing climate the natural habitats in the sub-alpine areas would become increasing stressful for the cold adapted species such as *P. gerardiana* leading to either upward migration or vulnerable to local extinction.

Monitoring protocol

Permanent plots (20x20 m) may be laid within 1600 - 3350 m in observed areas. Phenology, regeneration and population structure of chilgoza, other associated plants and direct and indirect evidences of faunal species may be monitored.

Reproduction and life cycle

Cones appear during May-June and female cones ripen in the autumn of the second year.

Key threats

- Degradation of habitat
- Lack of regeneration
- Destructive method of harvesting
- Over exploitation for pine nuts and fuel wood

Key field identification features

- *Bark grey, smooth and thin*
- *Flaky bark*

Important web links

http://www.iucnredlist.org/details/34189/0

LIST OF KEY REFERENCES

Snow leopard (*Panthera uncia*)

Jackson, R., Mallon, D., McCarthy, T., Chundawat, R. A. and Habib, B. 2008. *Panthera uncia*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>.

Jackson, R. and Hunter, D. O. 1996. "Snow Leopard Survey and Conservation Handbook Part I, II and III". Snow Leopard Survey and Conservation Handbook. Seattle, Washington, and Fort Collins Science Center, Colorado, US: International Snow Leopard Trust and U.S. Geological Survey.

Musk Deer (*Moschus* spp.)

Sathyakumar, S. 2007. Musk deer. In: The Encyclopedia of Mammals. 3rd Edition (Ed: Mcdonald. D.W.) Oxford University Press.

Sathyakumar, S. 2002. Species of the greater Himalaya. (IN) Sathyakumar, S. and Bhatnagar, Y. V. 2002. Mountain Ungulates ENVIS Bulletin: Wildlife and Protected Areas. Wildlife Institute of India, Dehradun. Vol. 1 No. 1. Page no. 1 - 6.

Timmins, R. J. and Duckworth, J. W. 2015. *Moschus cupreus*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>

Wang, Y. and Harris, R. B. 2008. *Moschus chrysogaster*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>

Wang, Y. and Harris, R. B. 2008. *Moschus fuscus*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>.

Timmins, R. J. and Duckworth, J. W. 2015. *Moschus leucogaster*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>.

Western Tragopan (*Tragopan melanocephalus*)

BirdLife International. 2013. *Tragopan melanocephalus*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>.

Ali, S. and Ripley, S. D. 1987. Compact handbook of the birds of India and Pakistan, (2nd edition). Bombay: Oxford Univ. Press.

Himalayan Snowcock (*Tetraogallus himalayensis*)

Ali, S. and Ripley, S. D. 1987. Compact handbook of the birds of India and Pakistan, (2nd edition). Bombay: Oxford Univ. Press.

BirdLife International. 2012. *Tetraogallus himalayensis*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>.

Beautiful Stream Frog (*Amolops formosus*)

Bordoloi, S. Ohler, A., Ahmed, F. and Shrestha, T. K. 2004. *Amolops formosus*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>

Murree frog (*Nanorana vicina*)

Ohler, A. and Dutta, S. 2004. *Nanorana vicina*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>.

Heyer, W. R., Donnelly, M. A., McDiarmid, R. W., Hayek, L. C., and Foster, M. S. 1994. Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Smithsonian Institution Press, Washington, DC, 364 pp.

Golden Mahseer (*Tor putitora*)

Gupta, N., Sivakumar, K., Mathur, V. B. and Chadwick, M. A. 2014. The “tiger of Indian rivers”: stakeholders' perspective on the golden mahseer as a flagship fish species Area 46(4):389-397

Jha, B. R. and Rayamajhi, A. 2010. *Tor putitora*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>.

Nautiyal, P. 2014. Review of the Art and Science of Indian Mahseer (Game Fish) from Nineteenth to Twentieth Century: Road to Extinction or Conservation? Proceedings of the National Academy of Sciences, India Section B: Biological Sciences, 84(2): 215-236.

Common Snow trout (*Schizothorax richardsonii*)

Vishwanath, W. 2010. *Schizothorax richardsonii*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>.

Golden Birdwing (*Troides aeacus*)

Collins, N. M. and Morris, M. G. 1985. Threatened Swallowtail Butterflies of the World. IUCN. ISBN

Li, X. S., Luo, Y. P., Zhang, Y. L., Schweiger, O., Settele, J. and Yang, Q. S. 2010. On the conservation biology of a Chinese population of the birdwing *Troides aeacus* (Lepidoptera: Papilionidae). Journal of Insect Conservation 14: 257–268.

Haribal, M. 1992. The Butterflies of Sikkim Himalaya and their Natural History, Sikkim. Nature Conservation Foundation, Gangtok, Sikkim, 217pp.

Wynter-Blyth, M. A. 1957. Butterflies of the Indian Region. Bombay Natural History Society, Bombay, 523pp.

Kehimkar, I. 2008. The Book of Indian Butterflies. Bombay Natural History Society and Oxford University Press, 497pp.

Himalayan Relict Dragonfly (*Epiophlebia laidlawi*)

Tillyard, R. J. 1921. On an Anisozygopterous Larva from the Himalayas (Order Odonata). Records of the Indian Museum 22 (2): 93–107.

Fraser, F. C. 1934. Fauna of British India. Odonata. Volume 2. Taylor and Francis. p. 151.

Fraser, F. C. 1935. "A missing link". The Journal of the Darjeeling Natural History Society 10 (2): 56–59.

Silby, J. 2001. Dragonflies of the world. The Natural History Museum. London.

Himalayan Birch (*Betula utilis*)

Hooker, J. D. 1872-1897. The flora of British India (Vol. V), London.

Pusalkar, P. K. and Singh, D. K. 2012. Flora of Gangotri National Park, Western Himalaya, India. Botanical Survey of India, India.

White Lilly (*Lilium polyphyllum*)

Dhyani, A. 2009. *Lilium polyphyllum* – rarest of rare lilies. Lilies and related plants. – R. Horticult. Soc. Lond. 85 – 91.

Hooker, J. D. 1872-1897. The flora of British India (Vol. VI), London.

Nayar, M. P. and Sastry, A. R. K. 1987. Red Data Books of Indian Plants. Botanical Survey of India, Kolkata.

Rana, M. S. and Samant, S. S. 2011. Population biology of *Lilium polyphyllum* D. Don ex Royle-A Critically endangered medicinal plant in a protected area of Northwestern Himalaya. Journal for Nature Conservation 19: 137-142.

Pusalkar, P. K. and Singh, D. K. 2012. Flora of Gangotri National Park, Western Himalaya, India. Botanical Survey of India, India.

Chilgoza Pine (*Pinus gerardiana*)

Hooker, J. D. 1872-1897. The flora of British India (Vol. 5), London.

Wildlife Watch
in the Indian Himalayan region

Wildlife watch survey (record sheet)

1. Species Name _____

2. Scientific Name (if known) _____

3. Number of Individual/s _____

4. Sex Male _____ Female _____Unknown _____

5. Observation type: _____

   O- Observed; F - Tracks/pugmarks; H-Hair/feather/skin; R- road kill; K- Kill;
   B- Bone/teeth; S- scat/pellet; V- Vocalizatiion

6. Location/ Nearest Landmark _____

7. Altitude (approx.) _____

8. GPS Coordinates (if possible) _____

9. Any other Information _____

_____

_____

_____

9. Your Name _____

10. Your contact Number _____

11. Your email ID _____

Please send the details of your record to wlw.nmshe@wii.gov.in or message/Whatsapp in +91 9410915297

Photo credits:

Snow Leopard:
Page No. 10 - WII Camera trap
Page No. 12 - Tapajit Bhattacharya
Page No. 13 - Tapajit Bhattacharya

Musk Deer:
Page No. 14 – S. Sathyakumar
Page No. 16 – S. Sathyakumar
Page No. 17 - Tapajit Bhattacharya

Western Tragopan:
Page No. 18 – K. Ramesh
Page No. 21 – Dhritiman Mukherjee

Himalayan Snowcock:
Page No. 22 – Subharanjan Sen
Page No. 24 - Tapajit Bhattacharya
Page No. 25 - Tapajit Bhattacharya

Beautiful Stream Frog:
Page No. 26 – Abhijit Das
Page No. 28 – Naitik Patel
Page No. 29 – Naitik Patel

Murree Frog:
Page No. 30 - Abhijit Das
Page No. 32 – Abhijit Das
Page No. 33 - Naitik G. Patel

Golden Mahseer:
Page No. 34 - Sandeep Chakrabarti
Page No. 37 - Sandeep Chakrabarti

Common Snow Trout:
Page No. 38: J.A. Johnson
Page No. 41a: J.A. Johnson
Page No. 41b: NIshikant Gupta

Golden Birdwing:
Page No. 42 - Rudra Prasad Das
Page No. 44 - Naitik G. Patel
Page No. 45 - Naitik G. Patel

Relict Dragonfly:
Page No. 46 - Tapajit Bhattacharya
Page No. 49- Tapajit Bhattacharya

Himalayan Birch:
Page No. 50 – Manish Bhardwaj
Page No. 53a – Ishwari Datt Rai
Page No. 53b - Manish Bhardwaj

White Lily:
Page No. 54 – G.S. Rawat
Page No. 57a – G.S. Rawat
Page No. 57b – Ishwari Datt Rai

Chilgoza Pine:
Page No. 58 - Vaneet Jishtu
Page No. 60 - Vaneet Jishtu
Page No. 61a - Vaneet Jishtu
Page No. 61b - Vaneet Jishtu

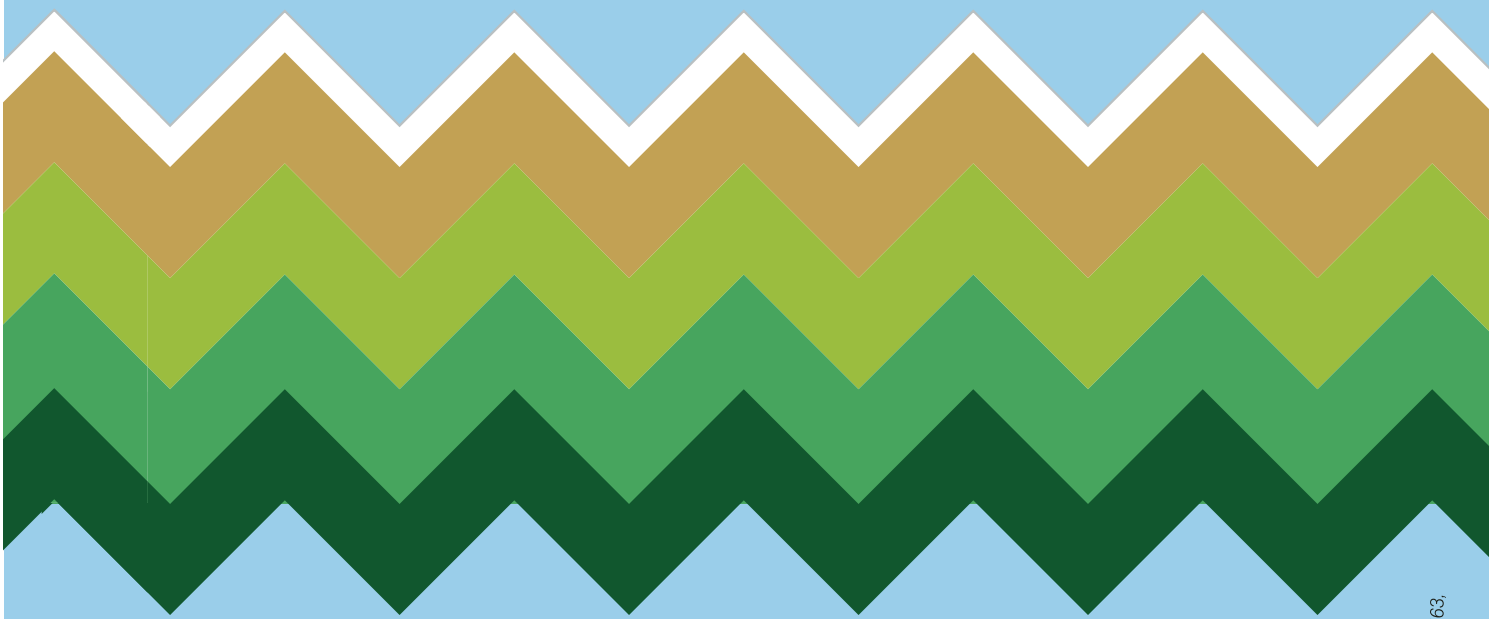
Logo designed by Krishnendu Mondal

Illustrations:

Snow leopard pugmark : Page No. 13 – Krishnendu Mondal
Musk deer hoof mark: Page No. 17 - Tapajit Bhattacharya
Murree Frog: Page No. 32 – Sohini Chaudhuri
Golden Birdwing life-cycle: Page No. 45 - Krishnendu Mondal
Relict Dragonfly: Page No. 46 - Sohini Chaudhuri
Relict Dragonfly lifecycle: Page No. 48 - Krishnendu Mondal
Relict Dragonfly larvae: Page No. 48 - Sohini Chaudhuri
White Lily: Page No. 57 - Krishnendu Mondal

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

P.O. Box # 18, Chandrabani
Dehradun - 248 001 (Uttarakhand)
t. (0135) 2640111-115; **f.** 0135-2640117
w. www.wii.gov.in; **e.** wii@wii.gov.in



*For more information, please contact: **m.** + 91 9410915297, **e**: wlw.nmshe@wii.gov.in*

Xpressions: 9219552563,
Doc. XPS170815381