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An updated checklist of Mammals of Uttarakhand, India

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Abstract

Uttarakhand state is an important part of Himalaya global biodiversity hotspot and rich in mammalian diversity. In the present study an attempt has been made to document the diversity of mammals along with information regarding occurrence of species in different altitudinal zones of Uttarakhand ranging from alpine trans-Himalaya to temperate Gangetic plains. Present study is based on the published literature and field surveys undertaken by authors in different parts of the state during last eighteen years (2004 to 2021). Analysis of data revealed the occurrence of 109 species of mammals belonging to 27 families and 09 orders. Of this, one species was listed as Critically Endangered, followed by 09species as Endangered, 08 species as Vulnerable and 13 species as Near Threatened in IUCN categories. Order Carnivore was represented as the most dominant group having 07 families and 33 species followed by Chiroptera with 06 families and 25 species. Habitat degradation and habitat fragmentation due to anthropogenic activities, poaching, forest fire, invasive species intervention, harvesting of fuel-wood, timber, foliage and medicinal plants were possible threats and reasons for decreasing mammalian population of the state.

Keywords: Conservation, Diversity, Mammals, Uttarakhand, Western Himalaya

Introduction

Uttarakhand state (28˚43'-31˚27' N and 77˚ 34'-81˚02' E) lies in the lap of Western-Himalaya as part of Northern India. The entire state has a complex hill system with varying altitudinal ranging from 190m in foothills and gradually increasing up to 6,000m in Trans Himalaya. During the last one decade, several new species of vertebrates and invertebrates have been discovered from the state (Editor-Director, 2008; 2010). The total geographic area of state is 53,483 km², which consist 86% of mountains while the remains as plain. The state contributes 45.74% forest cover of the total geographical area. In the northern parts of state, Greater Himalaya ranges covered with the high Himalayan peaks and glaciers, while the lower foothills are densely forested. The two magnificent glaciers Gangotri and Yamunotri give rise to two major rivers of India *i.e.,* Ganga and Yamuna. The state has major four types of forest including alpine meadows (Bugyals) in the extreme north which covered with small grasses and scrubs, temperate forests in the Higher Himalaya covered with Chir, Pine, Burans and Oak plants, tropical deciduous forests in the Lesser Himalayas, and subtropical in the Shivalik Range and in parts of the Tarai covered with mixed vegetation such as, Sal, Shisham, Khair, Bamboo, Mango and Jamun plants. Uttarakhand state's ecosystem is home to many faunal and floral components. Due to variability of forests and ecosystem components the state also supports endemism of different species of both flora and fauna. The state holds 12% area under protected areas, for conservation and development of biodiversity resources which includes one world heritage site (*i.e.*, Nanda Devi), six national parks, seven wildlife sanctuaries, four conservation and one biosphere reserve. Endangered species like the Snow Leopard *Panthera uncia*, Tiger *P. tigris*, Himalayan Musk Deer *Moschus leucogaster*, Alpine Musk Deer *M. chrysogaster,* Asian Elephant *Elephas maximus*, Indian Pangolin *Manis crassicaudata*, and Wild Dog *Cuon alpinus* find suitable habitats in these forests cover of Uttarakhand (Rahmani *et al*., 2016).

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Mammals are members of vertebrate group which have most advance evolutionary characteristics among all the fauna. A total of 5,416 species of mammals with 1229 genera, 153 families and 29 orders are known from globe (Wilson and Reeder, 2005). Order Rodentia have maximum number of mammalian species more than 2,277 in the world with 33 families and 481 genera. The smaller mammals are in more numbers as compare to large sized mammalian species, there are 428 species of mammals in India, with 191 genera and 48 families and 14 orders, which is almost 8% diversity of world's mammalian species (Sharma *et al.,* 2013). Studies on the taxonomy of mammals were carried out by many authors in India such as, Fauna of British India - Mammalia (Pocock 1939, 1941), Book of Indian animals (Prater, 1971), Checklist of Indian and Palearctic mammals (Ellerman and Morrison-Scott 1951), Indo-malayan region mammals (Corbet and Hill, 1992), Checklist of mammals of India (Alfred *et al.,* 2002), South Asian mammals (Srinivasalu and Srinivasalu, 2012), Mammals of South Asia (Johnsingh and Manjrekar, 2013, 2015) and Indian mammals (Menon, 2014).

The Uttarakhand state supports23% of total mammalian species of India. However, the information on mammalian fauna of Uttarakhand is scarce and scattered in published and unpublished sources. Previous work on mammals in India was done by Blanford (1888-91), Jerdon (1867), Pocock (1939,1941), Ellerman and Morrison-Scott (1951), Ellerman (1961), Prater (1971), Tak and Lamba (1981), Saharia (1982), Tak and Lamba (1984), Wilson and Reeder (1993), Alfred *et al.* (2002), Menon (2003), Islam and Rahmani (2004), Wilson and Reeder (2005), Ramakrishna and Alfred (2007) Sharma *et al.* (2013). Review of literature revealed that studies on mammals of Uttarakhand are limited. The various researchers have worked on exploration on the distribution and abundance of mammalian species in the state. Mammalian fauna of Uttarakhand has been documented by Dang (1964,1968), De and Spillett (1966), Green (1980, 1985), Green and Singh (1981), Fox *et al.* (1986), Lamba (1977, 1987), Osmaston and Sale (1989), Satyakumar (1990, 1993), Sinha (1995a, 1995b), Tak (1997), Sati (2002, 2004), Sati and Sinha (2003, 2004), Khati (2004) and Sati and Tak (2005, 2008, 2010).

Material and Methods

Present review is based on the published literature on the occurrence of mammals in Uttarakhand state and surveys by first two authors during last eighteen years to observe the distribution of different species of class-Mammalia in the state of Uttarakhand and further contribution was given by third author by surveys and sightings during last three years (Table 1). Most of the localities were covered by first author, during past five years such as Auli, Gorson Bugyal, Chopta, Surkanda Devi forest area, Kedarnath Wildlife Sanctuary, Chila Range of Rajaji National Park, Asan Barrage and Jhilmil Jheel, and the second author also participated in some field surveys. Some areas namely Sonanadi Wildlife Sanctuary, Chila Range of Rajaji National Park, Valley of Flowers National Park and Jhilmil Jheel were explored extensively. Different localities and habitats were covered (Figure 1). In case of inadequate sightings, we tried to identify the taxa up to genus or family level. Observations were made every day during 6.00 am to 4.00 pm (with few exceptions), with the help of prismatic field binoculars (8x40) and identification of species was carried out with the help of a field guide and book of Indian mammals written by Menon (2003) and Alfred *et al.* (2002; 2006). All the sightings are based on direct observations and indirect evidences such as pugmarks, dung/pallets, carcass, hairs and skins. The presence of some mammals is inferred on the basis of interview with forest officials, guides and villagers residing around surveyed locality.

The classification of mammals is reorganized several times since Carl Linnaeus initially defined the class (Simpson, 1945). It keeps on changing time to time and none of the arrangement is universally accepted. Vaughan *et al.* (2013) provided a simplified arrangement based on the compendiums by McKenna and Bell (1997) and Wilson and Reader (2005). Recently, some molecular studies revealed new relationships among mammal families (Springer *et al.* 2004, 2007; Romiguier, *et al.* 2013). However, these lineages are contentious, and yet to be established. Keeping these uncertainties in view, in the present study we adopted the framework as given by Vaughan *et al.* (2013) with minor changes such as family Platanistidae is kept under order Artiodactyla as per recent studies (Thewissen *et al.*, 2007) and family Soricidae kept under order Eulipotyphla (Douady *et al.*, 2002). The local status of mammals has been assessed on the basis of their local distribution in the state and categorized as Abundant, Rare, Locally Common, Uncommon, Occasional, and Data deficient (those exact status is not known in the state).

Table 1. Showing the areas covered during the surveys

Sl. No.	Area surveyed	Dates from-to-	Localities surveyed
1	Rajaji National Park and adjacent localities, including Bheemgoda Barrage area	22.04.2004 to 23.04.2004, 29.05.2004 to 31.05.2004, 12.06.2004 to 13.06.2004, 25.02.2016, 26.02.2016, 23.02.2018, 08.01.2019, 09.01.2019, 14.01.2019, 06.04.2019 & 07.01.2019	Chilla Range (29°57′51.42″ N; 78°11′59.60″ E) Motichoor Range (30°01′45.26″ N; 78°10′02.62″ E) Ranipur Range (29°58′10.53″ N; 78°07′29.45″ E) Mohand (30°08′39.99″ N; 77°56′10.28″ E)
2	Jhilmil Jheel Conservation Reserve	23.02.2018 & 02.07.2019	Main Wetland area (29°47′39.18″ N; 78°12′31.18″ E)
3	Asan Barrage and adjacent localities	10.01.2016, 07.03.2017, 21.04.2017, 17.08.2017, 24.11.2017 & 15.12.2017	Main Reservoir and adjoining forest patches (30°26′15.02″ N; 77°39′56.17″ E)
4	Sonanadi Wildlife Sanctuary	18.02.2016 to 20.02.2016 & 31.05.2016 to 04.06.2016	Lohachor (29°35′09.54″ N; 79°00′31.41″ E) Rathuadhap (29°39′37.70″ N; 78°52′43.44″ E) Kakridhang (30°35′26.13″ N; 79°43′45.26″ E) Halduparao (29°37′57.91″ N; 78°44′28.37″ E) Khansur Chauki (29°43′30.05″ N;78°42′43.13″ E) Mota Sal Bith (Tannu) (29°34′55.8″ N; 78°40′98.1″ E) Hathnikund (29°37′37.9″ N; 78°37′58.2″ E) Mandalti Sot (29°39′28.3″ N; 78°43′67.03″ E) Kakridhang (29°37′9.13″ N; 78°44′52.93″ E) Kandikhal (29°38′29.2″ N; 78°42′52.25″ E) Plan Nadi plains (29°39′04.47″ N; 78°44′32.23″ E)
5	Valley of Flowers National Park	29.09.2015 to 05.10.2015 & 12.08.2016 to 20.08.2016	(30°43′36.05″ N; 79°35′41.58″ E) (30°43′13.65″ N; 79°35′24.94″ E) (30°42′27.14″ N; 79°35′46.20″ E)
6	Chopta and Adjacent Area	10.04.2021 to 14.04.2021	Chopta (30°21′07.32″ N; 79°02′16.63″ E) Tungnath (30°29′21.26″ N; 79°12′53.12″ E)
7	Auli and Gorson Bugyal	15.09.2007 to 18.09.2007 & 02.04.2018 to 08.04.2018	Joshimuth (30°32′59.92″ N; 79°33′39.66″ E) Bugyal (30°31′46.78″ N; 79°33′47.41″ E)
8	Govind National Park and adjoining localities	15.04.2003 to 20.04.2003	Sankri Range (31°07′06.19″ N; 78°20′30.95″ E) Osla (30°08′26.49″ N; 78°26′59.13″ E)

9	Mana village, Badrinath area and adjacent localities	19.09.2007 to 21.09.2007	Mana village (30°46′26.17″ N; 79°29′45.94″ E) Badrinath (30°44′43.32″ N; 79°29′48.05″ E)
10	Dehradun and Adjacent areas	19.05.2019 to 23.05.2019	FRI (30°20′45.87″ N; 77°59′49.36″ E) Mussoorie hills (30°28′17.97″ N; 78°02′27.30″ E) Ponda Village (30°22′08.18″ N; 77°58′56.46″ E) WII (30°17′01.28″ N; 77°58′26.03″ E) Maldevta (30°20′45.30″ N; 78°07′44.96″ E)
11	Surkanda Devi Forest areas	15.03.2018, 22.05.2018 to 24.05.2018& 15.03.2018	(30°47′54.62″ N; 78°08′41.08″ E)

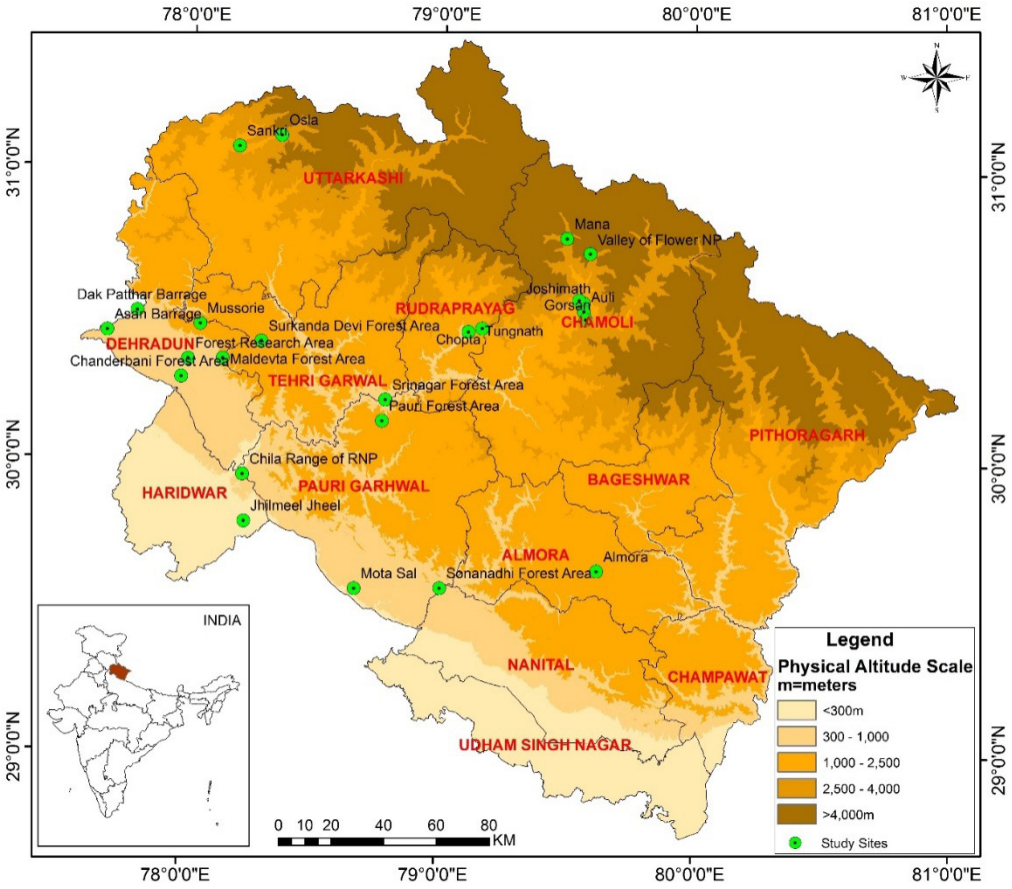

Figure 1. Map of the Uttarakhand is showing the surveyed localities and altitudinal ranges.

Results and Discussion

Based on direct sightings, published records and indirect evidences, total 109 species belonging to 27 families and 09 orders have been enlisted from the state (Table 2). Information on species distribution in each altitudinal zone (Figure 1 and 2), IUCN conservation status (Figure 3) and abundance (Figure 4) has been summarized in Table 2. Wroughton's Wood Mouse *Apodemus wardi* (Wroughton, 1908) was reported by Sati and Tak (2010) from Uttarakhand. However, it was treated as sub-species of Miller's Wood Mouse *Apodemus rusiges* by Menon (2014), which was later on synonymized with Ward's Field Mouse *Apodemus pallipes* (Barrett-Hamilton, 1900) by Molur (2016). The distribution of this species in Uttarakhand is ambiguous, so we excluded it from the present checklist. Occurrence of Indian Long-eared Hedgehog *Hemiechinus collaris* in Uttarakhand, was reported by Sati and Tak (2010). However, the distribution of this species is confined to mostly Gujarat and Rajasthan states of India, and North-West Frontier Province of Pakistan. Since it is the species of arid habitat, so the presence of this species in Uttarakhand is debatable. Keeping this in view, we excluded the species from the present list of mammals of Uttarakhand. The details of recorded species along with their conservation status and distribution ranges are summarized in Table 2.

Distribution of Mammals in

Table 2. Mammalian checklist of Uttarakhand (systematic arrangement adopted from Vaughan *et al.* 2013)

Sl. No.	Taxa	Conservation status (IUCN/ WPA)	Distribution areas based on altitude (1,2,3,4,5)	Remarks on abundance of the species
Order PROBOSCIDEA Family ELEPHANTIDAE				
1	Asian Elephant *Elephas maximus* Linneaus, 1758	EN/I	4,5	Common
Order PRIMATES Family CERCOPITHECIDAE				
2	Rhesus Macaque *Macaca mulatta* (Zimmermann, 1780)	LC/II	2,3,4,5	Abundant
3	Western Assamese Macaque *Macaca assamensis pelops* McClelland, 1840	NT/II	1,2,3	Rare
4	Tarai Gray Langur *Semnopithecus hector* Pocock, 1928	NT/Unlisted	4,5	Locally Common
5	Nepal Gray Langur *Semnopithecus schistaceus* Hodgon, 1840	LC/Unlisted	1,2,3	Locally Common
Order RODENTIA Family HYSTRICIDAE				
6	Indian Crested Porcupine *Hystrix indica* Kerr, 1792	LC/IV	2,3,4	Common
Family SCIURIDAE				
7	Himalayan Marmot *Marmota himalayana* (Hodgson, 1841)	LC/II	1,2,3	Locally Common
8	Red Gaint Flying Squirrel *Petaurista petaurista* (Pallas, 1766)	LC/II	3,4,5	Common
9	Western Woolly Flying Squirrel *Eupetaurus cinereus* Thomas, 1888	EN/II	1	Rare
10	Kashmir Flying Squirrel *Eoglaucomys fimbriatus* (Gray, 1837)	LC/Unlisted	2,3,4	Rare
11	Northern Palm Squirrel *Funambulus pennantii* Wroughton, 1905	LC/IV	2,3,4,5	Very Common

Family MURIDAE				
12	Royle's Mountain Vole *Alticola roylei* (Gray, 1842)	NT	2,3	Locally Common
13	Indian Gerbil *Tatera indica* (Hardwicke, 1807)	LC/Unlisted	3,4,5	Locally Common
14	Indian Long-Tailed Tree Mouse *Vandeleuria oleracea* (Bennett, 1832)	LC/V	2,3,4,5	Uncommon
15	Miller's Wood Mouse *Apodemus rusiges* Miller, 1913	LC/V	2,3, 4	Locally Common
16	House Mouse *Mus musculus* Linnaeus, 1758	LC/V	1,2,3,4,5	Abundant
17	Little Indian Field Mouse *Mus booduga* (Gray, 1837)	LC/V	3,4,5	Common
18	Soft-Furred Field Rat *Millardia meltada* (Gray, 1837)	LC/V	3,4,5	Common
19	Indian Bush Rat *Golunda ellioti* Gray, 1837	LC/V	5	Uncommon
20	Chestnut White-bellied Rat *Niviventer fulvescens* (Gray, 1847)	LC/V	1,2,3,4	Uncommon
21	Greater Bandicoot Rat *Bandicota indica* (Bechstein, 1800)	LC/V	2,3,4,5	Very Common
22	Lesser Bandicoot Rat *Bandicota bengalensis* Gray, 1835	LC/V	1,2,3.4.5	Very Common
23	Short-tailed Bandicoot Rat *Nesokia indica* (Gary, 1830)	LC/V	2,3,4	Common
24	House Rat *Rattus rattus* Linnaeus, 1758	LC/V	2,3,4,5	Abundant
Order LAGOMORPHA Family LEPORIDAE				
25	Indian Hare *Lepus nigricollis* Cuvier, 1823	LC/IV	3,4,5	Locally Common
26	Woolly Hare *Lepus oiostolus* Hodgson, 1840	LC/Unlisted	1,2	Uncommon
Family OCHOTONIDAE				
27	Royle's Pika *Ochotona roylei* Ogilby, 1839	LC/IV	2,3	Locally Common
28	Large-Eared Pika *Ochotona macrotis* (Gunther, 1875)	LC/Unlisted	1,2	Locally Common
29	Plateau Pika *Ochotona curzoniae* (Hodgson, 1858)	LC/Unlisted	1	Occasional
30	Nubra Pika *Ochotona nubrica* Thomas, 1922	LC/Unlisted	1	Uncommon
Order EULIPOTYPHLA Family SORICIDAE				
31	Asian Grey Shrew *Crocidura attenuate* Milne-Edwards, 1872	LC/Unlisted	2,3,4	Locally Common
32	House Shrew *Suncus marinus* (Linnaeus, 1766)	LC/Unlisted	1,2,3,4,5	Common
33	Etruscan Shrew *Suncus etruscus* (Savi, 1822)	LC/Unlisted	1,2,3,4,5	Occasional
34	Himalayan Shrew *Soriculus nigrescens* (Gray, 1842)	LC/Unlisted	1,2	Occasional
Order CHIROPTERA Family PTEROPODIDAE				
35	Indian Flying Fox *Pteropus giganteus* Brunnich, 1782	LC/V	3,4	Abundant

36	Fulvous Fruit Bat *Rousettus leschenaultia* (Desmarest, 1820)	LC/V	3,4,5	Common
37	Greater Short-Nosed Fruit Bat *Cynopterus sphinx* (Vahl, 1797)	LC/V	2,3	Very Common
38	Lesser Dawn Bat *Eonycteris spelaea* (Dobson, 1871)	LC/V	3,4	Occasional
39	Blanford's Fruit Bat *Sphaerias blanfordi* (Thomas, 1891)	LC/V	3,4,5	Rare
Family MEGADERMATIDAE				
40	Greater False Vampire Bat *Lyroderma lyra* Geoffroy, 1810	LC/Unlisted	4,5	Common
Family RHINOLOPHIDAE				
41	Greater Horseshoe Bat *Rhinolophus ferrumequinum* (Schreber, 1774)	LC/Unlisted	3,4,5	Locally Common
42	Rufous Horseshoe Bat *Rhinolophus rauxii* Temminck, 1835	LC/Unlisted	2,3,4	Very Common
43	Blyth Horseshoe Bat *Rhinolophus lepidus* Blyth, 1844	LC/Unlisted	3,4,5	Locally Common
44	Big-Eared Horseshoe Bat *Rhinolophus macrotis* Blyth, 1844	LC/Unlisted	2,3	Rare
45	Pearson's Horseshoe Bat *Rhinolophus pearsonii* Horsfield, 1851	LC/Unlisted	3,4	Occasional
Family HIPPOSIDERIDAE				
46	Schneider's Leaf-nosed Bat *Hipposideros speoris* (Schneider, 1800)	LC/Unlisted	2	Locally Common
47	Great Himalayan Leaf-nosed Bat *Hipposideros armiger* (Hodgson, 1835)	LC/Unlisted	3,4,5	Locally Common
Family VESPERTILIONIDAE				
48	Hodgson's Bat *Myotis formosus* (Hodgson, 1835)	NT/Unlisted	3,4	Rare
49	Nepalese Whiskered Bat *Myotis muricola* (Gray, 1846)	LC/Unlisted	2,4	Common
50	Kashmir Cave Bat *Myotis longipes* Dobson, 1873	Data Deficient	2,3,4	Unknown
51	Indian Pipistrelle *Pipistrellus coromandra* Gray, 1838	LC/Unlisted	4	Common
52	Least Pipistrelle *Pipistrellus tenuis* (Temminck, 1840)	LC/Unlisted	5	Common
53	Java Pipitrelle *Pipistrellus javanicus* Gray, 1838	LC/Unlisted	2,3,4,5	Locally Common
54	Serotine Bat *Eptesicus serotinus* (Schreber, 1774)	LC/Unlisted	3,4	Uncommon
55	Sombre Bat *Eptesicus tatei* Ellerman & Morrison-Scott, 1951	Data Deficient	1,2	Unknown
56	Greater Asiatic Yellow Bat *Scotophilus heathii* Horsfield, 1831	LC/Unlisted	3,4,5	Common
57	Common Noctula *Nyctalus noctule* (Schreber, 1774)	LC/Unlisted	3	Occasional

58	Peter's Tube Nosed Bat *Harpiola grisea* (Peters, 1872)	Data Deficient	3	Unknown
Family MINIOPTERIDAE				
59	Schreiber's Long-Fingered Bat *Miniopterus schreibersii* (Kuhl, 1817)	VU/Unlisted	3,4,5	Rare
Order PHOLIDOTA Family MANIDAE				
60	Indian Pangolin *Manis crassicaudata* Geoffroy, 1803	EN/I	4,5	Uncommon
Order CARNIVORA Family FELIDAE				
61	Tiger *Panthera tigris* (Linnaeus, 1758)	EN/I	3,4,5	Uncommon
62	Common Leopard *Panthera pardus* (Linnaeus, 1758)	VU/I	2,3,4,5	Occasional
63	Snow Leopard *Panthera uncia* (Schreber, 1775)	VU/I	1	Uncommon
64	Eurasian Lynx *Lynx lynx* (Linnaeus, 1758)	LC/I	1,2	Rare
65	Pallas's Cat *Otocolobus manul*, (Pallas, 1776)	LC/I	1	Rare
66	Jungle Cat *Felis chaus* Schreber, 1777	LC/II	2,3,4,5	Locally Common
67	Leopard Cat *Prionailurus bengalensis* (Kerr, 1792)	LC/I	1,2,3,4,5	Uncommon
Family VIVERRIDAE				
68	Himalayan Palm Civet *Paguma larvata* (Smith, 1827)	LC/II	1,2,3	Locally Common
69	Common Palm Civet *Paradoxurus hermaphroditus* Pallas, 1777	LC/II	1,2,3,4,5	Uncommon
70	Small Indian Civet *Viverricula indica* Geoffroy-Saint-Hilaire, 1803	LC/II	1,2,3,4,5	Uncommon
Family HERPESTIDAE				
71	Indian Grey Mongoose *Urva edwardsii* (Geoffroy Saint-Hilaire, 1818)	LC/II	1,2,3,4,5	Locally Common
72	Small Indian Mongoose *Urva auropunctata* (Hodgson, 1836)	LC/II	2,3,4,5	Locally Common
Family HYAENIDAE				
73	Stripped Hyena *Hyaena hyaena* (Linnaeus, 1758)	NT/III	1,2,3,4,5	Uncommon
Family CANIDAE				
74	Grey Wolf *Canis lupus* Linnaeus, 1758	LC/I	1,2	Uncommon
75	Himalayan Wolf *Canis lupus chanco* Gray, 1863	LC/I	1	Uncommon
76	Golden Jackel *Canis aureus* Linnaeus, 1758	LC/II	3,4,5	Locally Common
77	Wild Dog *Cuon alpinus* (Pallas, 1811)	EN/II	1,2	Locally Uncommon
78	Indian Fox *Vulpes bengalensis* (Shaw, 1800)	LC/II	3,4,5	Occasional
79	Tibetan Sand Fox *Vulpes ferrilata* Hodgson, 1842	LC/I	1	Rare
80	Red Fox *Vulpes vulpes* (Linnaeus, 1758)	LC/II	1,2	Occasional
Family URSIDAE				
81	Asiatic Black Bear *Ursus thibetanus* Cuvier, 1823	VU/II	1,2,3	Uncommon
82	Sloth Bear *Melursus ursinus* (Shaw, 1791)	VU/I	3,4,5	Locally Common

83	Himalayan Brown Bear *Ursus arctos isabellinus* Horsfield, 1826	CR/I	1,2,3	Rare
Family MUSTELIDAE				
84	Honey Badger *Mellivora capensis* (Schreber, 1776)	LC/I	3,4	Uncommon
85	Stone Marten *Martes foina* (Erxleben, 1777)	LC/II	1,2,3	Uncommon
86	Yellow-Throated Marten *Martes flavigula* (Bodaert, 1785)	LC/II	2,3,4,5	Locally Common
87	Eurasian Otter *Lutra lutra* (Linnaeus, 1758)	NT/II	1,2	Uncommon
88	Asian Small-Clawed Otter *Aonyx cinereus* (Illiger, 1815)	VU/I	4,5	Uncommon
89	Smooth-Coated Otter *Lutrogale perspicillata* (Geoffroy Saint Hilaire, 1826)	VU/II	2,3,4	Locally Common
90	Mountain Weasel *Mustela altaica* Pallas, 1811	NT/II	1,2,3	Occasional
91	Himalayan Stoat or Ermine *Mustela erminea* Linnaeus, 1758	LC/I	1,2,3	Uncommon
92	Siberian Weasel *Mustela sibirica* Pallas, 1773	LC/II	1,2,3,4	Uncommon
93	Yellow-Bellied Weasel *Mustela kathiah* Hodgson, 1835	LC/II	1	Rare
Order ARTIODACTYLA Family MOSCHIDAE				
94	Himalayan Musk Deer *Moschus leucogaster* Hodgson, 1839	EN/ Unlisted	1,2,3	Locally Common
95	Alpine Musk Deer *Moschus chrysogaster* Hodgson, 1839	EN/ Unlisted	1,2,3	Uncommon
Family CERVIDAE				
96	Indian Muntjac *Muntiacus muntjak* (Zimmermann, 1780)	LC/III	3,4,5	Locally Common
97	Sambar *Rusaunicolor* (Kerr, 1792)	VU/III	2,3,4,5	Common
98	Swamp Deer *Rucervus duvaucelli* (Cuvier, 1823)	VU/I	5	Locally Common
99	Spotted Deer *Axix axis* (Erxleben, 1777)	LC/III	4,5	Abundant
100	Hog Deer *Axis porcinus* (Zimmermann, 1780)	EN/I	4,5	Locally Common
Family BOVIDAE				
101	Blue Bull *Boselaphus tragocamelus* (Pallas, 1766)	LC/III	3,4,5	Abundant
102	Black Buck *Antilope cervicapra* (Linnaeus, 1758)	NT/I	5	Uncommon
103	Greater Blue Sheep *Pseudois nayaur* (Hodgson, 1833)	LC/I	1,2,3	Locally Common
104	Himalayan Tahr *Hemitragus jemlahicus* (Smith, 1826)	NT/I	1,2,3	Uncommon
105	Argali *Ovis ammon* (Linnaeus, 1758)	NT/I	1	Rare
106	Himalayan Brown Goral *Nemorhaedus goral* (Hardwicke, 1825)	NT/III	1,2,3	Locally Common
107	Himalayan Serow *Capricornis thar* (Hodgson, 1831)	NT/I	1,2,3,4	Occasional

Family SUIDAE				
108	Indian Wild Pig *Sus scrofa* Linnaeus, 1758	LC/III	2,3,4,5	Common
Family PLATANISTIDAE				
109	Ganges River Dolphin *Platanista gangetica* (Lebeck, 1801)	EN/I	5	Locally Common

Abbreviation: IUCN Category: LC-Least Concern; NT-Near Threatened; EN-Endangered; VU-Vulnerable; WPA-Wildlife Protection Act: Schedule I, II, III, IV and V; Distribution Areas: 1-Trans Himalaya (>4000m asl); 2-Higher Himalaya (4000-2500m asl); 3-Lower Himalaya (2500-1000m asl); 4-Shivalik Ranges (1000-300m asl); 5-Gangetic Plains (<300m asl).

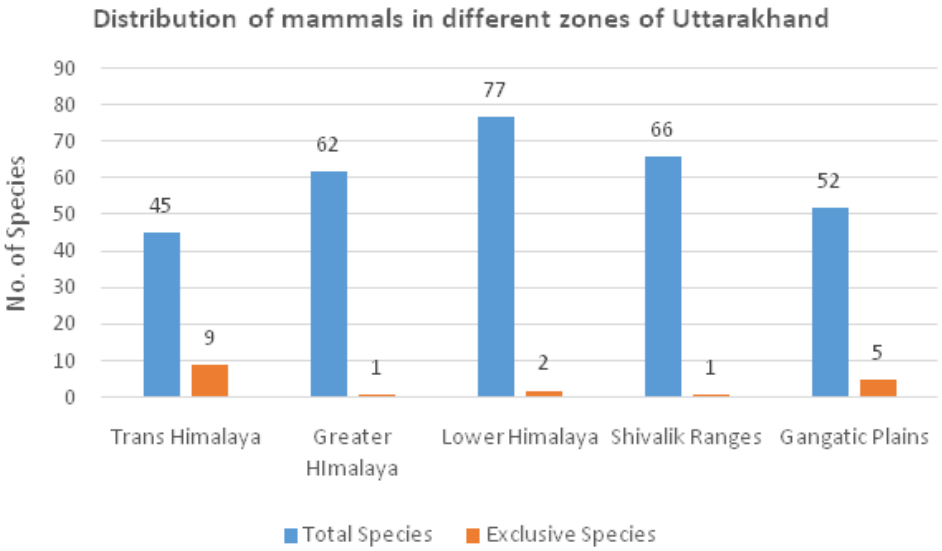

Figure 2. Distribution of Mammalian species in Uttarakhand based on altitudinal zones.

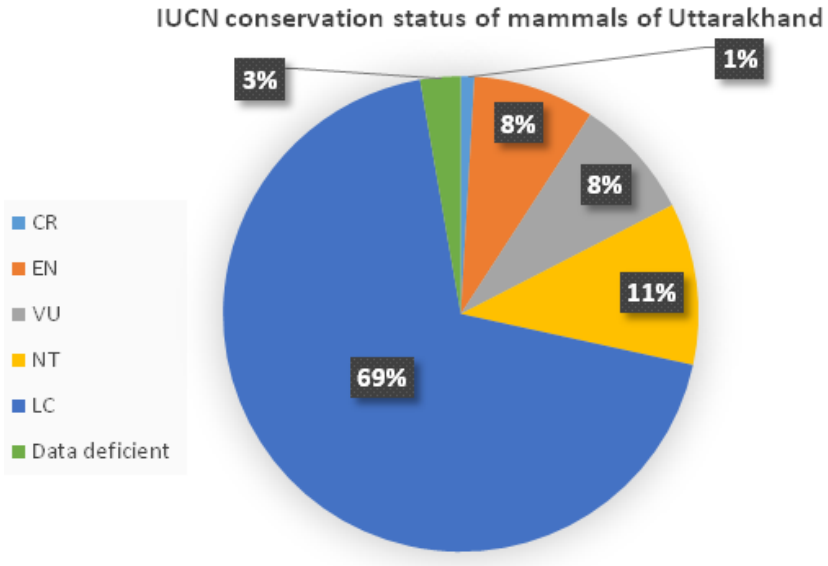

Figure 3. Number of threatened species in different categories of IUCN.

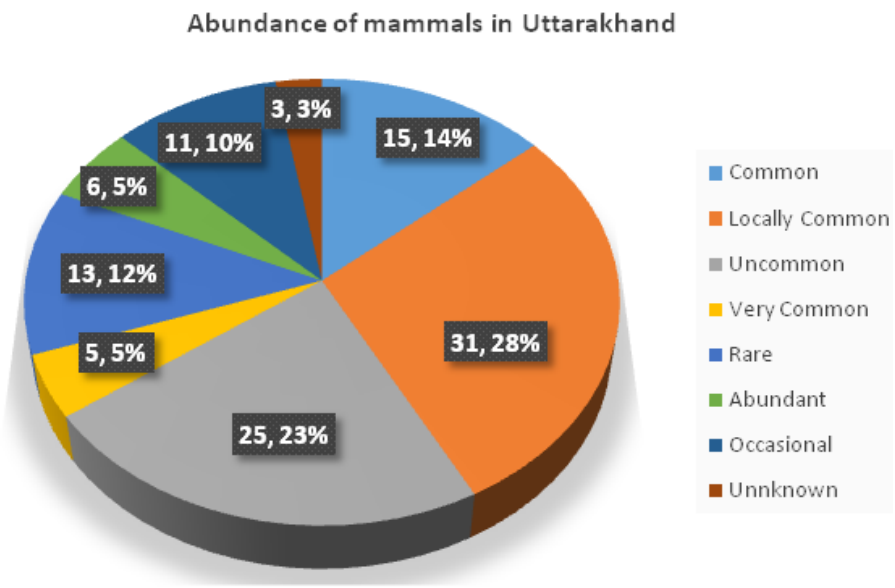

Figure 4. Different categories of abundance of mammals in Uttarakhand.

Uttarakhand

Uttarakhand state represents a complete slice of the cross-section of the Himalaya ranging from the Trans-Himalaya to the Gangetic plains. The state has been divided into five geographical regions/zones based on its altitudinal gradient and physiography of landscape, as these geographical regions are distinguishable from each other in terms of occurrence of flora as well as fauna.

Trans-Himalaya: Uttarakhand, northerly region constitutes the Trans Himalaya ranging from northeastern Greater Himalaya and extends up to Indo-China border towards the North. The elevation ranges between 4000 to 5700 m, though there are some isolated higher ridges which exceed the height of 6000 m in North and North-West. Trans Himalaya comes under '1C' *i.e.*, Trans Himalaya (Cold arid regions of Eastern HP and UK) as per new Trans-Himalayan Biogeographic Province, the landscape is relatively dry and dominated by glaciers. The lower elevated vegetated region constitutes short growing season and mostly dominated by alpine dry scrub and mixed herbaceous formations. The temperature and primary productivity are low in these regions creating a desert like condition and this area is also referred to as 'high-altitude cold desert' by Kumar *et al.* (2017). The region is home for some of the threatened and elusive species like Snow Leopard *Panthera uncia*, Tibetan Argali *Ovis ammon*, Tibetan Sand Fox *Vulpes ferrilata*, Himalayan Wolf *Canis lupus chanco,* Yellow-Bellied Weasel *Mustela kathiah,* Plateau Pika *Ochotona curzoniae,* Nubra Pika *O. nubrica,* Western Woolly Flying Squirrel *Eupetaurus cinereus* (Pal *et al.* 2018), Pallas's Cat *Otocolobus manul* (Pal *et al.*, 2019) and Asiatic Wild Dog or Dhole *Cuon alpines* (Pal *et al.*, 2018).

Higher Himalaya: This zone lies south to the Trans-Himalayan zone and ranges from 2500-4000m elevation, including some peaks above 4000m asl. This range is characterized by many famous peaks of state such as Nanda Devi (7817m), Nilkhanth (7273m), Kamet (7756m), Trishul (7120m), Kedarnath (6968m), Nandakot (6861m) and Bandarpunch (6320m). This zone act as the storage of glacier and snow as well as serves as an origin of many rivers of northern India, (Editor-Director, 2010). The zone comes under '2B' *i.e.*, Western Himalaya as per new Trans-Himalayan Biogeographic Province and consist of vegetation described as *Caragana-Artemisia-Lonicera* formation, alpine steppe, scrub and stony deserts (Kumar *et al.*, 2017). Mammals found in this zone are Common Leopard *Panthera pardus,* Asiatic Black Bear *Ursus thibetanus*, Sloth Bear *Melursus ursinus*, Woolly Hare *Lepus oiostolus*, Blue sheep *Pseudois nayaur*, Himalayan Tahr *Hemitragus jemlahicus*, Schneider's Leaf-nosed Bat

Hipposideros speoris, Nepalese Whiskered Bat *Myotis muricola* and rare Western Assamese Macaque *Macaca assamensis pelops* (Menon, 2014).

Lower Himalaya: This zone lies south to the Higher Himalaya and north to the Shiwalik Range. It extends in between 1000 to 2500m elevation and comprises of a series of ridges with river valleys. As per new Trans-Himalayan Biogeographic Province this zone comes under '2B' *i.e.,* Western Himalaya. Several South flowing rivers, *viz*. Yamuna, Alaknanda, Bhagirathi, Ramganga, Pindar, Koshi and Kali emanate from the snow frame higher reaches constitute the main topographical feature of this zone. This zone consists of comparatively narrow and rugged valleys having much forested and less cultivated vegetation. Common Noctula *Nyctalus noctula* and Peter's Tube Nosed Bat *Harpiola griseai* are exclusively found in this zone, along with some other elusive and threatened mammals such as Smooth-Coated Otter *Lutrogale perspicillata,* Mountain Weasel *Mustela altaica,* Himalayan Stoat or Ermine *Mustela erminea* Indian, Crested Porcupine *Hystrix indica* (Figure 5), Red Gaint Flying Squirrel *Petaurista petaurista* and Honey Badger *Mellivora capensis.*

Shivalik Range: These ranges generally form more or less a continuous and outermost belt of Himalaya in Uttarakhand. The average elevation is in between 300-1000 m and seldom rises over 1200 m. These ranges are thickly forested with sporadic pockets of agriculture. In the South, the Shiwaliks are flanked by foothills and Terai areas also known as Gangatic Plains. Mammalian species commonly and uncommonly found in this zone are Indian Pangolin *Manis crassicaudata,* Asian Elephant *Elephas maximus,* Sambar *Rusaunicolor*, Tiger *Panthera tigris*, and Asian Small-Clawed Otter *Aonyx cinereus* and Indian Pipistrelle *Pipistrellus coromandra.*

Gangatic Plains: This zone consists of depositional layer of River bodies and encompass large urban areas. The North of this plain are bounded by Himalayas which feed numerous rivers which contributes as the source of a fertile alluvium deposition. Moving from West to East the annual rainfall increases. The Plain are flat and treeless which make it suitable for agricultural purposes by using irrigation channel pattern. The main rotational crops grown in this zone on are wheat, rice, maize and sugarcane. Mammals found in this zone are Black Buck *Antilope cervicapra*, Swamp Deer *Rucervus duvaucelli,* Ganges River Dolphin *Platanista gangetica*, Least Pipistrelle *Pipistrellus tenuis* and Indian Bush Rat *Golunda ellioti*.

Conservation Threats

Mammalian diversity is one of the most important attributes of Indian biodiversity. Himalayan northern region, constituting 6.4 % of the total geographical area and include some of the highest peaks in the world which make India one of the richest areas in terms of habitats and species. The rocky-steep slopes, unconsolidated soils and frequent rainfall make these habitats extremely fragile. The grassy meadows and moist alpine deciduous forests offer manifold niche for endangered bovids such as Himalayan Tahr *Hemitragus jemlahicus*, Bharal *Pseudois nayaur* and Himalayan Serow *Capricornis thar*. Mammals are facing a variety of threats nowadays in terms of anthropogenic activities, constructions, illegal poaching, forest fire and alien species invasion.

Habitat fragmentation and corridor discontinuity: These two threats continuing the mammals by obstructing natural diurnal activities. Due to this, mammals usually unable to move frequently inside a specific habitat, they don't migrate to another habitat easily. The expansion of human settlements, industrialization, national highways, agriculture lands and increasing traffic, railway tracks also lead to corridor disruption. Larger mammals having large home range are relatively more prone to disappear as a consequence of fragmentation and degradation of habitat (Haleem *et al*. 2014).

Illegal poaching: Hunting of mammals is well known form day immemorial; some of the ungulates are game animals such as, Himalayan Musk Deer *Moschus leucogaster*. These poor animals are hunt for passion, business, skin, byproducts and food etc. In remote area these practices are still continuing till now, which leads to the drastic decline in the population of such species.

Forest fire: The forest area of Uttarakhand consists of shrubs and lower plants which in hot summer season dries off and work as a fuel for the fire, because of which the forest of the state is more prone to forest fire. During the last decade, this threat is increasing more and more because of global warming.

Anthropogenic pressure: Villagers of remote areas and villager living near the forest area, still depend on the forest resources for their livelihood, primarily include the

Figure 5. Some species of mammals from the study area. **(A).** Himalayan Gray Langur *Semnopithecus schistaceus*, **(B).** Himalayan Tahr *Hemitragus jemlahicus,* **(C).** Golden Jackel *Canis aureus,* **(D).** Yellow-Throated Marten *Martes flavigula,* **(E).** Indian Muntjac *Muntiacus muntjak* and **(F)** Indian Crested Porcupine *Hystrix indica.*

collection of fuel wood, fodder, medicinal herbal plants and pasture for their domestic animals grazing, leaving very limited space for home ranges and foraging for the wild animals.

Alien Invasive Species: A number of invasive species have been reported to cause loss of biodiversity including species extinction, and drastic changes in ecosystem function**.** A total of 163 floral taxa belonging to 105 genera and 46 families have been reported as invasive alien species from Uttarakhand (Chandra Sekar *et al*. 2012). The alien and invasive species like *Lantana camara, Parthenium hysterophorus, Cannabis sativa* (Indian hemp) and *Ipomoea carnea*, becoming dominated over other species of plants and grasses, and affecting the regeneration of other plants, which reduces the suitability of the habitat in case of ungulates.

Climate change and diseases: The climate change is affecting the growth and breeding season of mammals as well as the health of newly born individual. The increase in human population and pollution is also a leading threat for declining the habitats of mammals and ofcourse global warming (carbon emission) also attributes to this problem. Other health issues like eye infection in Blue Sheep in Gangotri National Park was noticed in 2018 by the researchers also a major threat for the affected species.

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