

## Review article

# Perspectives of Higher Vertebrates in Arunachal Himalaya Biodiversity Hot spot: A Review

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**Abstract:** Arunachal Pradesh is in the easternmost and the largest among the North Eastern region of India covering an area of 83,743 sq.km. It is situated between 26°30' - 29°30' N and 91°30' - 97°30' E. The state lies between transition Zone of Indo-Chinese, Indo-Malayan and part of Indo-Burmese region and due to its strategic bio-geographic location, it depicts the phenomenon of edge effects or law of interspersed where ecotones or edges are comparatively richer in wildlife than participating regions. It is perhaps the richest biodiversity state with wide altitudinal variations, high rainfall, varied soil structure and different climatic regimes from temperate to alpine. Owing to its unique biodiversity, it has already gained the status of Mega - Biodiversity Hotspot in the world. The state has the highest protected area network in India. An area of 10,079.14 sq.km constituting 12 per cent of the total geographical area of the state has been brought under PAN. State has 11 Wildlife Sanctuaries and 2 National Parks. It is the only state in India where three goat antelopes *Naemorhedus goral*, *Naemorhedus sumatraensis* and *Budorcas taxicolor* are found and it also has the pride of harbouring four big cats: Tiger, Leopard, Clouded Leopard and Snow Leopard. The 3 bear species, Asiatic black bear, Sloth bear and Sun bear recorded from North-east are all found in Arunachal Pradesh. The recent entrant to higher vertebrates, white cheeked macaque *Macaca leucogenys* and Himalayan forest thrush *Zoothera salimalii* has been recorded from this state. Due to its unique location, vast areas, thin human populations and being second largest forest cover in India, one can still hope to find new species unknown to rest of the world.

**Key words:** Arunachal Pradesh, biodiversity Hot spot, eastern Himalaya, endemic species, higher vertebrates

## Introduction

Arunachal Pradesh was formerly known as North East Frontier Agency (NEFA) is the eastern most state of India. It lies between 26°28' N to 29°31' N Latitudes and 91°30' E to 97°30' E longitudes. It has been identified as one of the ecological "Hot-Spot" area in the world (Myers *et al.*, 2000). It has a total area of 83,743 square kilometers. Arunachal Pradesh is a beautiful picturesque state with abundance of natural resources and varied landscapes and manifold vegetations.

It has international boundary with China on north (1080km), Myanmar to the East (440km) and Bhutan to the

west (160km). It shares its inter-states boundary with Nagaland and Assam in the east and south-east and Assam in the south. Arunachal Pradesh being a part of Himalaya-East Biogeography Zone (Rodgers *et al.*, 2000) stands at the junction of three biogeographic realms, the Afro-tropical, Indo-Malayan and Indo-Chinese (Takhtajan, 1969.). The rich species diversity of flora and fauna of Northeast India including Arunachal Pradesh is largely attributable to the diverse geographical area, varied topography, climatic conditions and soil variability. Immigration of plant and animals has been observed owing

to the fact that the state Arunachal Pradesh falls in transitional zone of these three biogeographic realms (Rao, 1994). Biological elements from all the above regions find representation in the flora and fauna of the state.

As per 2011 census, there are twenty (20) districts in Arunachal Pradesh with twenty nine (29) numbers of towns, 3863 numbers of villages and total population of 13,83,727 persons. Arunachal Pradesh is an agriculture based state about 68% of the total working population is engaged in agriculture and other related activities. They practice shifting cultivation on the hill slopes; the practice is rooted in their traditional way. The principal Agriculture and horticulture produce are rice, maize, potato, apple, orange, pineapple, pear, cardamom, rubber and tea.

Forest is the primary source of natural wealth of the state. Forest covers 61.45% of total area of territory, spreading over 51,539.99 sq.km (FSI 2000; Kalita and Haridasan, 2001). The landscape and forests vary with changing altitude providing conditions for diverse vegetation range from wet-tropical through sub-tropical and tropical mountain to temperate and sub-alpine giving way to alpine above 4,200 meter above mean sea level (Saha, 1981). The altitudinal variations ranges from 100 m above msl in the foothill region, the area passes through a series of hills, ranges of mountains and rises up to the height of about 7500 m above msl. The annual rainfall varies from 100 mm to 6000 mm spread over 8-9 months. This well distributed precipitation with high humidity rising up to 90% is conducive to the luxuriant growth of forests (Borang & Thapliyal, 1993).

The forests of Arunachal Pradesh are classified into six (6) major types (Kaul & Haridasan, 1987): (i). Alpine (above 3500m), (ii). Temperate (1800-3500 m), (iii). Sub-tropical pine (1000-1800m), (iv). Sub-tropical broad leaved (900-1900m), (v). Tropical wet evergreen (upto 900 m), (vi). Tropical semi-evergreen (upto 600 m) above msl.

The forests of the state are legally classified and notified as reserve forests, protected forests, Anchal and village forest reserves, National parks and Wildlife sanctuaries under the relevant provisions of Assam Forest Regulation 1891, Anchal and Village Forest Reserve Act 1975/1981 and Wildlife

Protection Act 1972. Unsurveyed forests where status of rights and ownership is unsettled are classified as unclassed state forests. The Forest Survey of India in their 2001 assessment has estimated the Forest area is 68,045 Sq.km in the State, which constitutes 81.25% of total geographical area. However, the recorded forest cover as per report of Department of Environment and Forest, Government of Arunachal Pradesh in the year 2000-01 is as: (i). Reserved Forests (9722.69 sq.km), (ii). Protected Forests (694.3 sq.km), (iii). Anchal Reserved Forests (329.38 sq.km), (iv). Village Reserved Forests (300.24 sq.km), (v). National parks (2468.24 sq.km), (vi). Wildlife Park (7059.75 sq.km), (viii). Unclassed State Forests (30965.39 sq.km), in total 51539.99 sq.km.

Arunachal Pradesh- largest state of North East India has eleven Wildlife Sanctuary, two National Parks, two Tiger Reserve and in the recent notification i.e., at the approval of the Government of India's Vide F. No. 15-3 (1) 2015-NTCA Dated the 18<sup>th</sup> December 2015, the Governor of Arunachal Pradesh has declared Kamlang Wildlife Sanctuary as "Kamlang Tiger Reserve", and from the date of its Notification there are now three (3) Tiger Reserve (Gazetteers of A.P, 2016).

The climatic conditions of the state range from tropical to alpine, depending on topography and altitude. Five major climatic zones has been recognized: Zone-I: Humid hypothermic (foothill), Zone-II: Per-Humid hypothermic (foothill), Zone-III: Thermic per humid (mid-hills and valleys), Zone-IV: Thermic humid (mid hills and valleys), Zone-V: Alpine and high hills.

In view of the peculiar mountainous character, the distribution of rainfall is not uniform all over the state. There is wide range of variation from 1081 mm to 6484 mm of rainfall over the state. Rainfall decreases gradually from east to west and also south to north of Arunachal Pradesh.

### **Biodiversity Hotspots**

Myers (1988) developed the concept of Hotspots and he identified 10 Hotspots. Myers *et al.* for the first time in the year 2000, demarcated 25 global Hotspots in the world that

were areas of high biological diversity and exceptional concentration of endemic plants but were under severe anthropogenic threat. Subsequently, it was revised and the total number of Hotspots increased to 34 (Mittermeir *et al.*, 2004). The Hotspots were further revised and Forest of East Australia is the 35<sup>th</sup> Biodiversity Hotspot identified (Williams *et al.*, 2011).

The categorization of India by McNeely *et al.*, (1990) as one of the twelve mega-diversity countries in the world have been surfaced for its placement on the world's conservation map.

India biodiversity is unique for four of the 35 global hotspots: (1) the Western Ghats, (2) the Himalayas (3) the North East India covering south of Brahmaputra along with (4) the Andaman and Nicobar Islands including Sundarban hotspots located within the country (Bawa, 2006).

### Eastern Himalayan Hotspot and biodiversity

Myers (1988) defined the eastern Himalaya hotspot covering the Indian states. The eastern Himalayas are located on the confluence Zone of the Indo-Malayan, Afro-tropical and Indo-Chinese bio-geographical realms (Takhtajan, 1969; Roy and Behera, 2005). This region falls between the 82° 70' - 100° 31' E Longitudes and between 21° 95' - 29° 45' N Latitudes covering total area of 524190 sq.km. It extends from the Koshi valley in Central Nepal to Northwest Yunan in China and includes Bhutan, North East India, the Darjeeling hills of West Bengal, southeast Tibet in China and northern Myanmar.

This is the richest bio-geographical province of Himalayan Zone. This zone is considered as one of the two mega biodiversity hotspot of India. World Wildlife Fund (WWF) has identified the entire eastern Himalaya as a prior Global 200 Eco-region (Olson *et al.*, 1998). In year 2000 the eastern Himalaya biodiversity hotspot was brought within a wider Indo-Burma hotspot covering central Nepal, the whole of northeast India, the Andaman and Nicobar Islands, Hainan Island in southern China, Myanmar, Thailand, and on to Indo-China, then south to the Kra in the Malaysian peninsula (Myers *et al.*, 2000). This hotspot with an area of 2, 20, 60,000 sq.km is the second largest to the Mediterranean basin. The

Indo-Burma hotspot alone has 7000 endemic plants and possesses 1.9% of the Global endemic vertebrates (Myers *et al.*, 2000)

### Arunachal Pradesh: A biodiversity Hotspot

Arunachal Pradesh which lies between 26°28' - 29°30' N and 91°30' - 97°30' E is a province of eastern Himalaya range of India which is one of the 35<sup>th</sup> biodiversity hotspots of the world (Myers *et al.*, 2000; Mittermeier *et al.*, 2004 and Williams *et al.*, 2011). It covers 2.5% geographical area of the country; 15.76% of the Indian Himalayan region and 43.26% of the hotspot (Dollo *et al.*, 2009)

#### a. Total area coverage

Arunachal Pradesh covers 83,743 sq.km land area, which forms nearly 33% area of north east region and 2.55% area of country (Sundriyal, 2001). The predominant soil groups are sandy loam, red and yellow alluvial (Jha, 1985).

#### b. Forest coverage

The geographical area of Arunachal Pradesh is mostly hilly and mountainous, covered with highly varied and dense vegetation, crisscrossed by six major rivers and their tributaries (Kaul and Haridasan, 1987; FSI, 2000 and Kalita and Haridasan, 2001). The state has a range of vegetation types, varying from low-altitude dense tropical-subtropical rain-forest, to temperate broad-leaved forest, higher-mid altitude Himalayan coniferous forest and high Himalayan scrub and meadows (Proctor *et al.*, 1998; Benniamin, 2010). It is known for its rich biodiversity, as it harbours more than 33% of the Indian total flora with unique taxa and large number of genetic resources making it a "cradle of speciation". The state has nearly 73% of total land area under evergreen forest with almost all the districts are having good forest cover. Nearly 5% land is under jhum cultivation while another 4% is under settled agriculture (Sundriyal, 2001)

#### c. Different altitude coverage

Arunachal Pradesh has a wide altitudinal variation in its physiographical structure ranging from 100m to 7000m msl.

It can be divided into four distinct regions; 1) The greater Himalayas with snow-capped mountains rising up to 7000m msl, 2) The lower Himalayas ranging up to 3500m msl, 3) The sub-Himalayan belt including Siwalik Hills up to 1700m msl, 4) The plains which are eastern continuity of Assam plains.

#### d. Different climatic region coverage

The state is characterized by high annual rainfall 2000mm to 4000mm and high humidity (Hedge, 2000). The climate varies from hot and humid in the Siwalik range and progressively cold as one move northwards to higher altitudes. The main rainy season lasts from June to September and is associated with the south-west monsoon.

#### Distribution of higher vertebrates in eastern Himalayan biodiversity Hotspot

Aristotle made the first attempt to bring some sort of system into classification of animal life. The next big step was taken by Linnaeus, a Swedish naturalist of eighteenth century whose system with some modifications is being used universally even today. All backbone animal life in the world was divided into two classes--(1) Warm blooded, (2) The cold-blooded.

The former group includes those who blood keeps a constant temperature and is little affected by the temperature of the surrounding air. The latter group takes on the temperature of their surroundings. They are hot when their environment is hot and cold when their environment is cold. The warm blooded animals are further subdivided into – (1) Mammals (2) Birds.

Mammals are covered with hair, bear live young and suckle them, and birds are feathered, winged, lay eggs and as a rule incubate them with the heat of the bodies. They are the only feathered creature in the world.

North-east India with two Endemic Bird Areas, the Eastern Himalaya (EBA 130) with global distribution of 22 restricted range species and the Assam Plains (EBA 131) with 3 restricted range species signifies the importance of the habitats that ranges in this region (ICBP, 1992; Rahmani and Choudhury, 2012 and Mazumdar *et.al.*, 2014). The richness

of the region's avifauna largely reflects the diversity of habitats associated with a wide altitudinal range.

#### Avifaunal work in India

Birds study in India as we know it today was implicitly insubstantial before the advent of the Britishers. The premier attempt to record the avian fauna was done by a Madras based surgeon Edward Buckley who documented and described 22 birds seen around the East India Company's Fort St. George. Birds illustrations improved tremendously when John Gould produced, in 1832 "A century of birds from the Himalayan mountains" and from 1850, the marvelous six volume "Birds of Asia". The first serious attempt to illustrate the birds of the region was done by Brian Hodgson, T.C Jerdon and Edward Blyth, often called the founders of the Indian ornithology (Grewal *et al.*, 2002). The Indian ornithology proper may be said to date only from the publication of Jerdon's "Birds of India", published in 1862-84, it was based on work of all three men, assisted by a steadfast groups of field workers. Jerdon's Birds of India introduced refreshing elements of novelty. Besides describing the superficial structure and plumage of various species, it also furnished short accounts of their general habitats, of interest of the layman. Jerdon spent further many years of his service (an army surgeon) in various part of the country and collected and studied birds persistently and his "fifty illustrations from Indian birds" brought further seriousness in the study of Indian birds.

Second significant advance in the ornithological knowledge on Indian birds materialized with the advent of distinguished man, Allan Octavious Hume. He is widely known as the founder of Indian national congress, but is also called the "pope of Indian ornithology" (Grewal *et al.*, 2002). For many years he dominated the field. He encouraged many naturalist spread over the country and guided in collecting skins and keeping field records. He identified and described many of the specimens collected and as such he published twelve volumes of bird's observation between 1873 and 1888. These volumes are collectively known as "stray feathers" and are of eminence help for any serious work on Indian ornithology

and act as valuable reference works even today. After the stray feather has refrained from publication, notes and regional papers on Indian birds had begun to appear in “the Ibis” which is published by the British ornithological union and increasingly in the then newly started “journal of the Bombay natural history society (JBNHS)” and these became the prime repositories of ornithological information of this region.

A year after the last stray feathers was published, a further boost for Indian birds and habitats appeared with the first volume of “Fauna of British India: Birds” by Eugene W. Oates and W.T Blandford in the year 1889. Three more volumes were published in the following nine years. These were the most significant attributing works on Indian ornithology for atleast twenty years. They included detailed observations from parts of the Indian regions not covered by the earlier endeavour.

Between 1921 and 1930 another expert “amateur” E.C Stuart Baker, an officer of Indian police who had spent his service in Assam did a major works of collecting and studying birds and their nesting habits intensively. He documented 86 families, 598 genera and 1672 species and subspecies. Some of Bakers classic early works appeared first in the journal of the Bombay natural history society, including “game birds of India, Burma and Ceylon”. But Baker’s most manifested works are the eight volumes of the second edition of the “Fauna of British India”, published between 1922 and 1931, and the “Nidification of birds of the Indian empire”, which was published between 1932 and 1935.

The 20<sup>th</sup> century saw a new era of enthusiastic and dedicated ornithologists in India. A landmark book “The Book of Indian Birds” was authored by Salim Ali in 1941. Second edition, 1942 and currently in its thirteenth edition, 2002. In 1948, Sidney Dillon Ripley discovered new species of bird, Mishmi Wren Babbler *Spelaornis badeigularis*. In 1951, Biswas added new species Blossom-headed Parakeet *Psittacula roseate* to the existing bird lists.

In 1968, Salim Ali and Sidney Dillon Ripley co-authored “Handbook of the birds of India and Pakistan” published by the Bombay natural history society and the tenth and last in

1974. The handbook, listing 2060 birds, remains the standard and most exhaustive work on Indian birds.

In 1980, modern birds guide of India by Martin woodcock’s “Collins Hand guide to the birds of the Indian sub-continent” was published.

In 1983, the earlier handbook of birds of India and Pakistan by of Salim Ali and Dillon Ripley was published as a compact edition listing 78 families, 20 orders and 1232 species and sub-species.

In 1992, a new species of birds, Sillem’s mountain finch *Leucosticte sillemi* was discovered by C.S Roselaar and in 1996; P.C.Rasmussen further added new species Nicobar Scops Owl *Otus alius* to the birds checklists (Rasmussen, 1998).

In 1993, the first photographic guide to the birds of India by Bikram Grewal was published, and the third edition in 2000. In 2002, Bikram Grewal, Bill Harvey and Otto Pfisher published a photographic guide to the Birds of India and the Indian sub-continent. In 2016, a fine book on a pictorial field guide to the birds of India, Pakistan, Nepal, Bhutan, Sri Lanka and Bangladesh was authored by Bikram Grewal, Sumit Sen, Sarwandeep Singh, Nikhil Devasar and Garima Bhatia.

Inskipp *et al.*, 1996 in their book, An Annotated Checklist of the Birds of Oriental Region listed 1295 species and subspecies from the subcontinent.

Other significant book to be published are “Birds of the Indian subcontinent”, 1998 and “The pocket guide to the birds of the Indian subcontinent”, 1999 by Richard Grimmett, Carol Inskipp, Tim Inskipp and “A field guide to the birds of the Indian subcontinent”, 2000 by Krys Kazmierczak and B. Van Perlo’s.

Though ornithology in India is 300 years old but definite checklist of how many birds are present was compiled in 2016, putting the number of species across the country at 1,263. Taxonomically, the birds population in India is divided into 23 orders, 107 families and 498 genera. Among birds family Muscicapidae are the most diverse with 97 species. Of all the birds known to occur within the geographical boundaries of India, 61 species are endemic and another 134 species are near- endemic, meaning these are restricted to India with

small populations found in the neighboring countries. (Praveen *et al.*, 2016).

### Avifaunal work in Arunachal Pradesh

Avifaunal work was started in Northeast Frontier Agency (NEFA) now Arunachal Pradesh after the advent of British-India. Prior to that there is no enough record on works of avian fauna. The first spur for expedition came with the establishment of British-India Government in the Brahmaputra Valley; the then Northeast Frontier Agency was part of Assam. The earliest publications on avian fauna referring to North-East Frontier was by Jerdon (1870) who first worked on birds in Mishmi Hills while identifying *Lapoporus sclateri* (Sclateri's or Mishmi Monal Pheasant).

During 19th century some of the noteworthy works were done in 1875, 1876a, 1876b, 1876c, 1878 in Dafla hills, 1877 in Mishmi hills, Sadiya and Brahmakund and similar works were also done in Naga Hills incorporating Tirap and Changlang which is situated in the eastern part of Arunachal Pradesh by Godwin-Austen. Works were further done in 1887 and 1895 in Dafla Hills by Cran and Ogilvie-Grant respectively.

In 20<sup>th</sup> century advance studies on avian fauna were carried forward mainly in Mishmi Hills and Abor Hills and including few works in Dafla Hills by Coltart (1902); Baily (1913, 1915) in Mishmi Hills and Abor Hills; Baker (1913a, 1913b, 1914a, 1914b) in Abor Hills and Mishmi Hills; Stevens (1914) in upper Assam including the hills and plain of central parts of Arunachal Pradesh; Parsons (1935, 1939a, 1939b) in Sadiya Frontier Tract including Mishmi Hills; Lightfoot (1940) in Aka Hills; Ludlow and Kinnear (1937, 1944) in Mishmi Hills; Whistler (1941) in Margherita and Lakhimpur district of Assam covering Subansiri district, the then Dafla Hills; Ripley (1948, 1952) in Mishmi Hills and Abor Hills; Ali and Ripley (1948) in Mishmi Hills and Abor Hills; Betts (1954, 1956) in Subansiri area; Ripley (1980); Nair (1981); Saha (1981, 1985); Chatterjee and Chandramani (1987); Chatterjee (1989); Choudhury (1990a, 1990b, 1992, 1993, 1996, 1998); Pandya (1990); Singh (1991a, 1991b, 1991c, 1993, 1994, 1995, 1999); Ripley *et al.*, (1991); Katti *et al.*, (1992); Sen, (1993); Kaul and

Ahmed (1992, 1993); Alstom (1994); Kaul (1994); Athreya (1996); Crosby (1996); Athreya *et al.*, (1997); Flemming (1997); Kumar, R and Singh, P (1997, 1999); Datta *et al.*, (1998); Singh *et al.*, (1999); Sen and Mukhopadhyay (1999).

In current century, extensive work to document the status of Avian fauna of Arunachal Pradesh are done by eminent workers like, Choudhury 2002, 2003a, 2003b, 2005, 2006); Datta ( 2000, 2001, 2002); Kumar (2000); Singh, *et al.*, (2000); IBN-ICBP (2001) Pawar and Birand (2001); Ghose and Ringu (2002) Newton (2002); Kumar *et al.*, (2003); Borang (2004a, 2004b); Mishra *et al.*, (2004); Mishra and Datta (2007); Kumar (2007, 2008, 2013); Greeshma (2011).

The studies on birds of Arunachal Pradesh started with the advent of British-India to Northeastern part of India but definitive check-list of available avian fauna started last decade with Singh in 1994 listing 519 species. In the year 2006, Choudhury listed 738 species found in the state and Borang further added to existing check-list, increasing the number of documented species to 768. Recently in 2013, Borang in his study checklist and status of birds in Arunachal Pradesh documented 776 species belonging to 324 genera, 65 families (Borang, 2013).

### Reported work on Mammals in different district of Arunachal Pradesh

There is no sufficient record of Mammalian work in Arunachal Pradesh before the advent of British- India to the North east Region (NER). In late 18<sup>th</sup> century, works on mammals started by Zimmerman while studying *Yacaca mulatta* but referring to it as *Cercopithecus mulatta* in North Kamrup, Assam including the Dafla Hills and neighbouring countries Nepal and Bhutan.

In 19<sup>th</sup> century few works on mammalian fauna were done by some prominent workers. McClelland (1839-1840) prepared the list of Mammalia and birds collected in Assam, Mishmi and Naga hills. Blyth (1843-1863) while preparing the catalogue of the Mammalia in the Museum of Asiatic Society studied the mammalian species available in Meghalaya and Naga hills which included the present valleys in Longding and Tirap.

In 20<sup>th</sup> century many workers expedited hills and Valleys of Arunachal Pradesh and reports on wildlife from this north east region increased tremendously, Anandale (1911-1912) prepared Zoological results of Abor expeditions. Wroughton (1916a, 1916b, 1921) worked on Langurs, Squirrels and other mammalian species in Northern Assam including Dafla Hills and Dibang Valleys. Thomas from 1908 to 1922 worked on various aspects of mammalian fauna from NER. In 1908 he worked on squirrels, 1914a reported a new *soriculus* from Mishmi Hills, 1914 b reported on small mammals collected from Tibet and Mishmi Hills and in 1921-1922 scientific results on mammalian survey from Mishmi Hills were reported. Hinton (1918-1926) worked in different districts of Arunachal Pradesh. In 1918 he worked in western part of the state and in 1919 in the Eastern part. Study on mammalian fauna in North Assam including Dafla Hills were done by him in 1923. Hinton and Lindsay (1926a, 1926b) worked in Assam and Mishmi Hills. Pocock (1931) studied pig-tailed macaque in Naga Hills including Tirap district and from 1939-41 worked on various species and reported his work as fauna of British India and Mills (1923) studied the pattern of animal distribution in Naga Hills including eastern part of Arunachal Pradesh.

After Independence many keen interested researchers have come up and several significant works has been done. Kurup (1965 - 1968) worked on mammals of Assam and adjoining areas of Arunachal Pradesh. Agarwal (1980) studied on Murids. Khajuria, Chaturvedi and Ghosal (1977) in collaboration prepared the catalogue of mammaliana and Mandal (1981) reported on the occurrence of *Mus boodunga boodunga* in Arunachal Pradesh. Saha (1981) reported a new genus and a new species of flying squirrel, in 1984 reported the occurrence of the Tail-less fruit Bat *Megaerops ecaudatus* in Arunachal Pradesh and in 1985 worked on the fauna of Namdapha National Park. Gosh (1987) also worked on faunal resources of proposed Namdapha Biosphere Reserve. Mehta (1987) reported on the status of wildlife in Arunachal Pradesh, Chatterjee (1989) surveyed for Snow Leopard and associated animals in Mouling National park, Thapliyal (1991) reported

Arunachal Pradesh as a unique abode of wildlife and Singh (1991a, 1991b) in the same year made preliminary survey in Tawang district and Pakhui Wildlife Sanctuary, East kameng district and in 1995, he reported the occurrence of Bharal *Pseudois nayaur* (Hodgson) in Thingbu circle of Tawang district, Arunachal Pradesh.

Borang *et al.*, 1993 studied natural distribution and ecological status of non-human primates in Arunachal Pradesh and Borang (1995) reported ecological status of Capped Langur *Presbytes pileatus*. Mukherjee (1994) studied on Red Panda in Eagle nest Wildlife Sanctuary, Athreya and Johnsingh (1995) surveyed for Clouded Leopard *Neofelis nebulosa* in North east India and Dey (1995) reported Arunachal Pradesh as the confirmed new site for Clouded Leopard. Choudhury (1995a, 1995b, 1997a, 1997b, 1997c) studied on Primates of Namdapha National Park, status of Wild Elephants in Dibang Valley, and on small carnivores, Mustelids, Viverids, Herpestids and Ailurids and prepared Checklist of the Mammals of Assam which is tremendously useful for reference for study of mammals of North East India. Athreya *et al.*, (1997), carried out the faunal survey of Namdapha Tiger Reserves. Datta & Goyal (1997) studied on the arboreal mammals of the state and Datta (1998a, 1998b, 1999) reported on Pangolin sightings in western Arunachal Pradesh and evidences of Clouded Leopard in Pakhui Wildlife Sanctuary. Sinha (1998) studied on Bats of North east Hills and Oli *et al.*, (1999) prepared inventory of Mammalian fauna in Dehang-Debang Biosphere Reserve, Arunachal Pradesh.

In the current century, mammalian fauna from higher altitude which were not covered by early workers were also studied and in 2006 Arunachal macaque *Macaca munzala*, a species new to science and the Chinese goral *Nemorhaedus caudatus*, a new addition to the ungulate fauna of the Indian subcontinent and 33 more mammals were reported while studying at high altitude mammals of the western part of Arunachal Pradesh, (Mishra *et al.*, 2006).

In the year 2010 and 2013, a study on endangered Wild dog *Cuon alpinus* were conducted in the Western part of the state (Gopi *et al.*, 2010; Selvan *et al.*, 2013).

### Status of endangered species of higher vertebrates in Arunachal Pradesh

Studies conducted by Zoological survey of India (ZSI) have recorded 96,000 species of animals from India. Among these, International union for conservation of nature (IUCN) has assessed 18 species of amphibians, 14 varieties of fish, 13 birds and 10 mammals as critically endangered and 310 species as endangered, including 69 fish, 38 mammals and 32 amphibians.

Arunachal Pradesh has the distinction of having rare and endangered species of birds like Ward's trogon (*Harpactes wardi*), Mishmi Wren (*Spelaeornis badeigularis*), Wren Babbler (*Spelaeornis troglodytoides*) and Bogun Liocichla (*Liocichla bugunorum*) some of them which are nowhere reported in India.

In case of mammals, our country has 43 mammals endemic to Indian trans boundary, 15 restricted to Western Ghats, 17 from Peninsular India, 4 in Himalaya, 9 are in Island and 2 from North-East India (Das *et al.*, 2016). The highly endangered Hispid Hare (*caprologus hispidus*) has been reported from Daying Ering Memorial Wildlife Sanctuary, Arunachal Pradesh.

### Conservation status in Arunachal Pradesh

Arunachal Pradesh is the only region in the world known to harbour all three species of Goral; the Chinese goral *Nemorhaedus caudatus*, the Red goral *Nemorhaedus baileyi* and Himalayan goral *Nemorhaedus goral*. It is also home of Large herbivores; Serow *Naemorhaedus sumatraensis* and Takin *Budorcas taxicolor* (Mishra *et al.*, 2006). Considering the high diversity in flora and fauna, the Government of Arunachal Pradesh has taken up conservation network action plan. An area of 10,079.14 sq. km constituting 12% of the total geographical area of the state has been brought under Protected Area Network (PAN) representing diverse ecosystems and wildlife habitats. Incidentally, the state has the highest coverage of PAN in India against the 4% of National figure (Borang *et al.*, 2013). Outside this network, there is a large area, which is rich in faunal wealth, mostly unexplored and worth considering for faunal studies (Islam

and Rahmani, 2004). It has 11 Wildlife Sanctuary and 2 National Parks.

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