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Editorial

Pakistan Wildlife Foundation was established in June 2010 as a non-profit, conservation organization by a small group of likeminded conservationists, nature lovers and wildlife ecologists with the mission to enhance awareness among the masses in the country regarding biodiversity and environment and to change their attitudes towards positive, sensible and responsible actions for nature. The foundation was incorporated with Securities and Exchange Commission of Pakistan (SECP) in October, 2010 under the Corporate Universal Identification No. 0073723.

Pakistan Wildlife Foundation aims to provide a platform for the nature lovers, university students, young scientists and researchers to communicate globally with biodiversity experts through publishing their wildlife related research. For the purpose, Pakistan Wildlife Foundation launched *Pakistan Journal of Wildlife* which is a quarterly and peer-reviewed research journal published both in electronic and print versions. The journal publishes research on wildlife biology, wildlife ecology, wildlife diseases, wildlife conservation and management, sustainable use of wildlife resources and the interactions of these matters with social, economic and political issues.

The journal was launched in 2010; it could however, not be published due to some unavoidable reasons. Back issues of the journal are now being published both in electronic and print versions. Publishing a research or review article or a short communication in *Pakistan Journal of Wildlife* is free of cost and hence, a support to the young scientists and researchers. This is also an initiative to publicize any wildlife related research that remained unpublished due to shortage of financial resources.

Pakistan Wildlife Foundation welcomes the teachers, researchers and especially the young scientists to publish their research in *Pakistan Journal of Wildlife*. Details about the submission procedure for research articles are available in the journal under Instruction to contributors / authors and also at; www.pakwildlife.org. The articles can be submitted through E-mail at; editor@pakwildlife.org or info@pakwildlife.org.

A separate section; *Letters to Editor* is allocated in the journal for readers' / researchers' feedback in the form of comments, suggestions and recommendations. The Editorial Board can be accessed / approached through E-mail at; editor@pakwildlife.org or info@pakwildlife.org.

Historical and Current Distribution of Smooth-coated otter (*Lutrogale perspicillata sindica*) in Sindh, Pakistan

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Abstract: The study was conducted from October 2008 to September 2010 to record the historical and current distribution of smooth-coated otter (*Lutrogale perspicillata sindica*) in Sindh province of Pakistan. Surveys were conducted jointly by professional staff from Sindh Wildlife Department and WWF-Pakistan. An extensive literature review was carried out to explore the historic distribution of the species in Sindh. For recording the current distribution, different direct and indirect methods including direct observation, observing tracks, holts, spraints and feeding remains were applied. Local people were interviewed using a pre-tested questionnaire. Around 5000 km were traversed covering 36 different sites in 12 districts of Sindh and the existence of smooth-coated otter was confirmed at 25 sites in 11 districts. Both the historical and current distribution of the species was plotted on maps using GIS tools. The results showed that the species existed in isolated populations and in fragmented habitats in its type locality where it was once distributed evenly and all along the Indus River and irrigation system.

Key words: Sindh otter, Indus River, Sukkur barrage, Indus eco-region, Pakistan Wildlife Foundation.

INTRODUCTION

Two otter species exist in Pakistan: the smooth-coated otter (*Lutrogale perspicillata*) and the Eurasian otter (*Lutra lutra*). The Eurasian otter occurs in the northern mountainous region while the smooth-coated otter occurs in Khyber Pakhtunkhwa, Punjab and Sindh Provinces of Pakistan (Roberts 1997; Khan *et al*. 2009). Reports of hunters also show the existence of the smooth-coated otter in Balochistan province (pers. comm.; Mr. Faiz Mohammad, a local conservationist). The sub-species found along the Indus river has been referred as the "Sindh otter" (*Lutrogale perspicillata sindica*) by Pocock (1940).

The wildlife conservation movement started in Pakistan during the early 1970s following the release of a report on the World Wildlife Fund (WWF) expedition to Pakistan (1967) and based on that a report of the Wildlife Enquiry Committee (1971) under the Ministry of Agriculture and Works, Government of Pakistan (Khan and Bhaagat, 2010). But since then only a few practical efforts have been made by wildlife biologists and ecologists to study or update the existing knowledge about mammals especially otters in the country. According to the Wildlife Enquiry Committee Report (1971), the smooth-coated otter was categorized as "Endangered" in the country. In 1997, Roberts described 188 mammalian species and provided their conservation status in Pakistan, which listed the smooth-coated otter as being "Rare". However, according to a more recent assessment (Sheikh and Molur, 2005) the species has been assessed as "Near Threatened" in Pakistan. The species is also protected under Provincial Wildlife Legislation being included in the 3rd Schedule which means it cannot be hunted under any circumstances except for the scientific studies. Even in the presence of such wildlife laws, the species has been hunted ruthlessly because of lax enforcement of legislation and the demand for its fur. This has resulted in a considerable decrease in its population. In addition, habitat degradation, water pollution, human-otter conflicts, misconceptions of its use in medicinal recipes and above all the lack of awareness about the importance and ecological role of the species have also contributed to its decline and put the species at risk (Khan *et al*. 2009).

The smooth-coated otter is widely distributed in South and South East Asia, including Pakistan, India, Nepal, Bhutan, Bangladesh, South West China, Myanmar, Thailand, Vietnam, Malaysia, Sumatra, Java and Borneo (Mason and Macdonald, 1986; Corbet and Hill 1992).

Isolated populations of the species also exist in Iraq (Pocock, 1941). Hooshang *et al.* (1997) and Mirzaei *et al.* (2010) have reported the species to be extinct in Iran; present only in the Hawr-al-Azim wetland, Khuzestan, located near the borders with Iraq. Blanford (1888)

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reported that the species was prominent in the Indus valley in Sindh. Murray (1884) observed 20-30 tamed otters tethered by fishermen on the River Indus, while some were basking or playing on the sand. Pocock (1939) described the species to be extant in Pakistan extending from Bahawalpur southwards to Sindh; in the lower Indus valley and Eastern Nara swamp. Sindh otter has been regarded as a distinct race being different from the Indian form, having a smaller size (Pocock, 1939).

The present study was designed to document both historical as well as current distribution of the species in Sindh Province. The study was conducted jointly by Sindh Wildlife Department (SWD), Government of Sindh and WWF Pakistan, Islamabad (WWF-P) from October 2008 to September 2010.

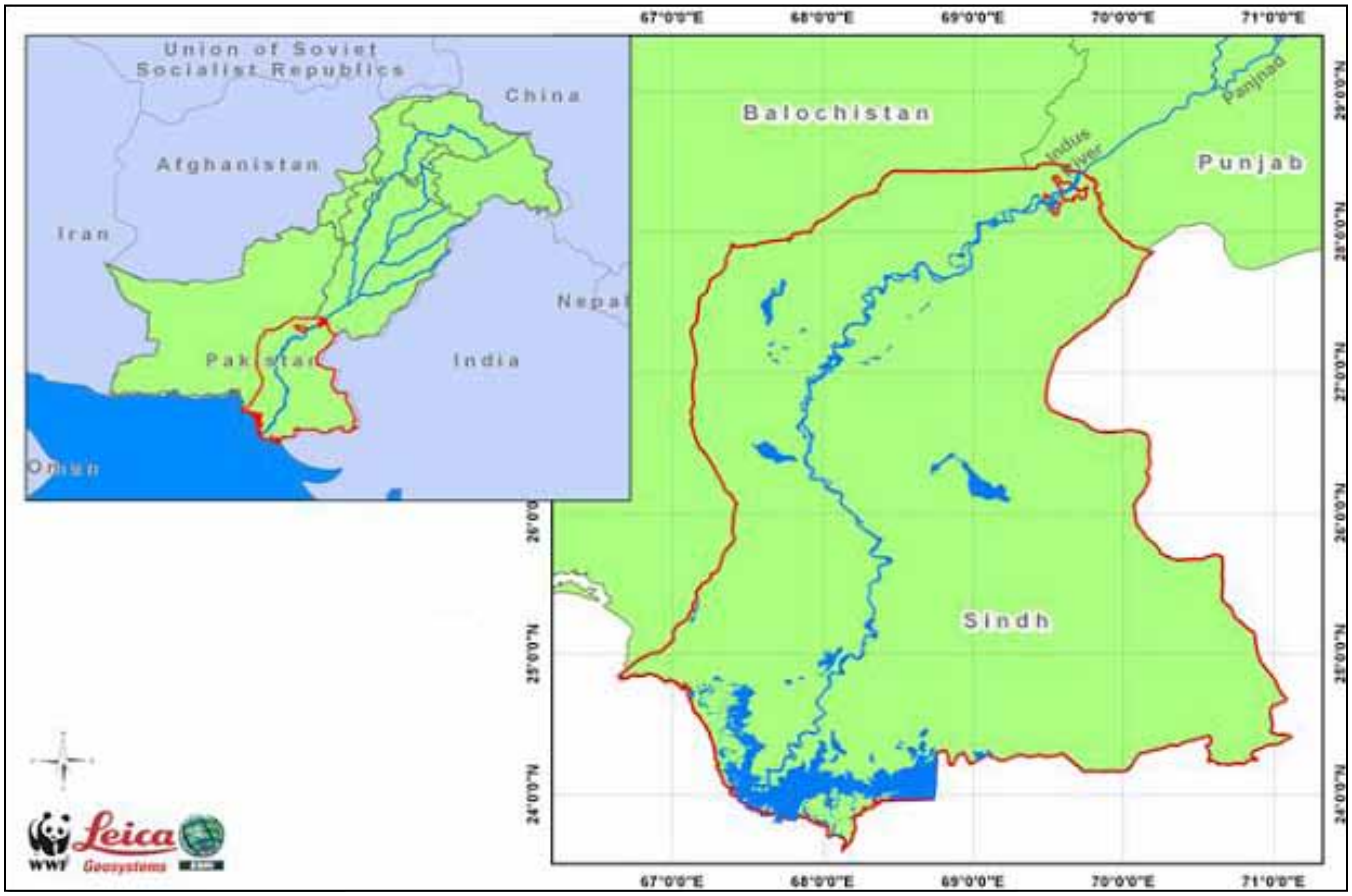

Fig. 1: Map of the study area; Sindh Province of Pakistan

Pakistan came into being in 1947 and since then only a few workers have dealt with the otters. Ellerman and Scot (1951), Ellerman (1961) and Prater (1965) confirmed the occurrence of this species in Pakistan. Siddiqui (1969), Ahmad and Ghalib (1975) and Roberts (1997) have also described Smooth-coated otters in their published material while discussing the mammalian fauna of Sindh province. Roberts (1997) reported the species to occur in the areas of Keti Bunder, Sindh coast, Sundari Lake and in the East Nara swamps, about 25 km upstream of Sukkur Barrage. He considered its distribution range beyond the lower Indus as indefinite. Gachal and Slater (2004) and Gachal *et al.* (2007) reported the distribution of the species from Sukkur to Guddu Barrage. Khan and Husnain (2008) reported the species around Keti Shah riverine forest in Sukkur district.

MATERIALS AND METHODS

Study Area

Sindh province of Pakistan includes 23 districts and is located in South Eastern part of Pakistan between 23° and 28° N latitudes and 66° and 71° E longitudes covering an area of 140,914 km² (about 18% of the country's total land area, Government of Pakistan 1998). It is bordered to the North West by Balochistan Province, to the North East by Punjab Province, to the Southern side by the Arabian Sea and towards the East by Rajasthan and Gujrat states of India (Fig. 1)

The study area represents four geophysical parts with Khirthar mountain range on its West, a central

plain bifurcated by the Indus river, a desert belt to the East and the Indus delta to the South. The Indus River is regarded as the lifeline and backbone of the economy for the Province as it provides the irrigation and drinking water to the Province (Akbar, 2008). The network of canals, in Sindh, off take from three barrages viz., Guddu, Sukkur and Kotri on the Indus River. A large number of freshwater lakes and ponds of varying sizes are formed due to seepage of water along different canals and annual inundation of river water during monsoon that provide suitable habitats for smooth-coated otter (Khan *et al*. 2009). Four types of distinct ecosystems exist in the study area *i.e.*, tropical thorn forests, riverine wetlands, deserts and coastal ecosystems (Akbar, 2008).

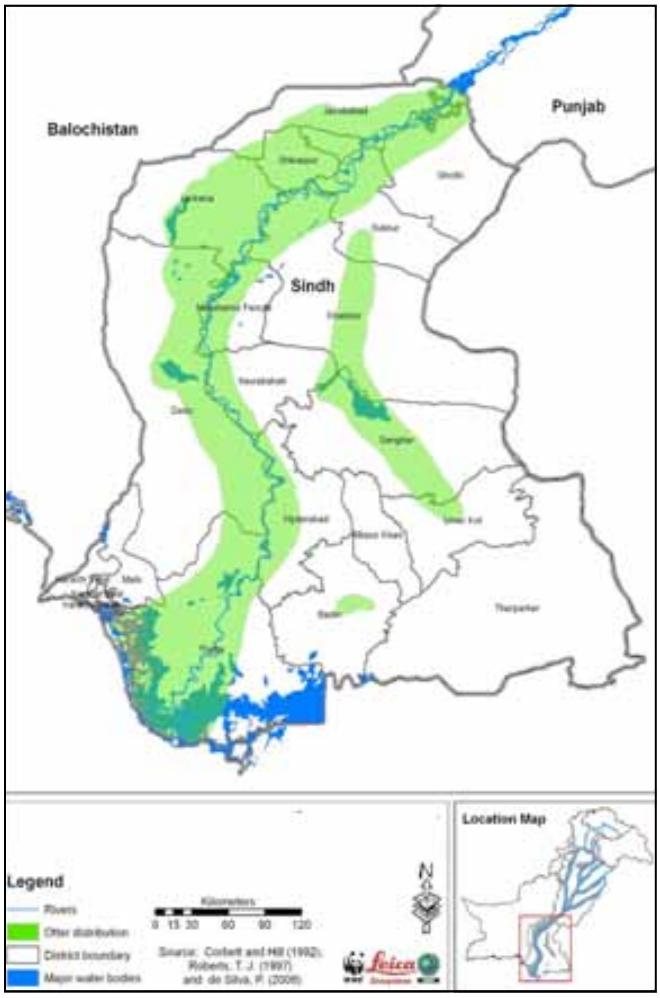

Fig. 2: Historical distribution of Smooth coated otter in Sindh, Pakistan

METHODOLOGY

Historical Distribution

An extensive literature review was carried out to explore the historic distribution of smooth-coated otter in Sindh. Apart from gathering secondary information from published and unpublished papers and reports, relevant people in different areas, including the officials of Wildlife, Fisheries, Forest and Irrigation departments, Fisher Folk Forum, local hunters, fishermen, fish farmers, fish traders, boatmen and some political and influential people were contacted to obtain information about the historical distribution of otters in Sindh.

Current Distribution

The study area represents different types of habitat and terrain comprising semi-desert plains, cultivated lands, wild lands, rivers, barrages, canals, lakes, ponds and fish farms. Therefore, different direct and indirect methods were applied to find out the evidence of otter occurrence. Fish markets in different districts, where the fishermen gather daily to sell their catch, were also visited to listen to different fishermen and fish traders and to have some information about the existence of the otter. A questionnaire was developed (Appendix 1) in order to interview different people and obtain information about the otter's historic and current distribution.

Based on the information obtained through all the sources, 36 sites in 12 districts entailing potential otter habitats were identified, marked on the map and visited to confirm the existence of otters. Recent otter tracks, holts, spraints and feeding remains were the means to confirm such existence. GPS co-ordinates were recorded using GPS receiver Garmin Map 76 at each of the sites where otter existence was confirmed. The geographical co-ordinates along with the localities and habitat information were entered into MS Excel for further processing. These geographic points helped in delineating the areas of the species presence. Most of the sighting locations were in the geographical co-ordinates of Degrees Minutes Seconds (DMS) format which were converted into Degrees Decimals (DD) using MS Excel. The geo-coded sighting point datasets were retrieved in the Arc-View GIS as event theme for displaying species existence to map its distribution.

RESULTS

Historical Distribution of Smooth-Coated Otter in Sindh (Before Ahmad, 1998)

Based on the available literature and personal communication with local communities and some biologists, the historical distribution of smooth-coated otter in Sindh Province was recorded and plotted on a map (Fig. 3). Smooth coated otter was reported along the Eastern Nara by Wroughton (1916), along the River Indus throughout the Sindh Province (Jerdon 1874; Sterndale 1884; Murray 1884; Blanford 1888; Mountfort and Poore 1968) and in upper Sindh, lower Indus valley and Eastern Nara including Sukkur and Eastern Khairpur (Pocock 1939 and 1941). Harris (1968) described its

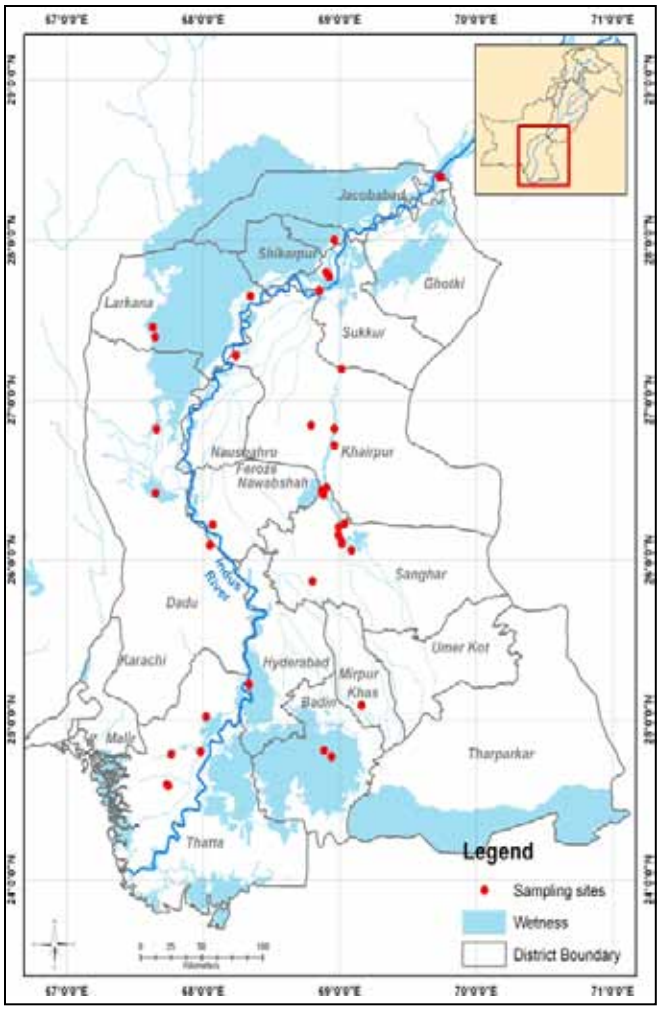

Fig. 3: Sampling sites in the study area

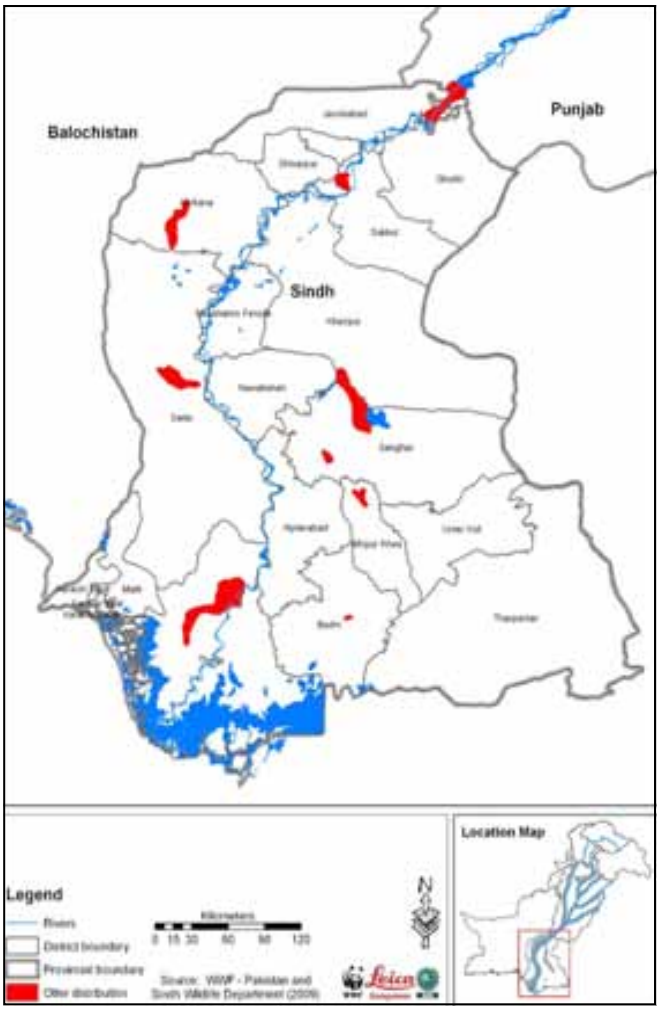

Fig. 4: Current distribution of Smooth coated otter in Sindh, Pakistan

range in Chak in Sukkur district of Sindh, the Indus valley from Bahawalpur southwards to Sindh, Eastern Nara and Khairpur. Roberts (1977 and 1997) reported the existence of the species at Keti Bunder, Sindh coast, Sundari Lake and East Nara swamps and described its range beyond the lower Indus. Its distribution range in Sindh was along Nara canal, Keenjhar and Haleji lakes, around Sukkur barrage and coastal area of Keti Bunder in Thatta District especially at the time of high and low tides (Ahmad 1998).

Current Distribution of Smooth-Coated Otter in Sindh (After Ahmad, 1998)

About 5,000 km distance was traversed in 12 out of 23 districts of Sindh province visiting 36 sites (Fig. 3) to record the existence of otter. At 25 sites (Table 1) in 11 districts the presence of otter was confirmed. Five out of 25 sites (Site No. 8, 10, 13, 15, 17) were considered potential otter sites where the species could be found throughout the year while the 20 sites of positive otter existence were visited by otters occasionally in different seasons.

Observation Records

At six different sites (Site No. 3, 8, 13, 15, 17, 24) the otter was observed directly; the existence of otter at the 20 sites was confirmed on the basis of indirect evidences like holts, tracks, spraints, feeding remains and interviews with different people including fishermen, fish farmers, hunters etc. (Table 2).

Table 1: Twenty five sites where otter existence was confirmed in Sindh				
Sr. No.	**Site**	**District**	**GPS Coordinates**	**Habitat Description**
1	Guddu Barrage;	Kashmore-Kandhkot	N 28º 23' .796" E 69º 44'.574"	Thick vegetation of *Typha domingensis, Saccharum spontaneum* and other plants that provide food, refuge and vast home range to otters.
2	Summanu Lake with adjoining ponds	Ghotki	N 28º 23' .748" E 69º 43'.869"	Vegetation includes *Typha domingensis, Saccharum spontaneum* and *Phragmites carca.* Small islands thickly vegetated with *Typha sp.* and *Phragmites sp.* in the lake offer shelter and refuge and plenty of fish in the lake make the site a good otter habitat.
3	Maachhko, Tehsil Ubaro	Ghotki	N 28º 17' 52.6" E 69º 42'18.7"	Natural and artificially constructed fish farms which local communities use to grow and harvest the fish annually. Vast area with wild as well as useful agricultural lands in-between fish farms with vegetation like *Saccharum sp., Phragmites sp., Prosopis juliflora* etc. provide shelter and cover to otters.
4	Keti Shah Riverine Forest	Sukkur	N 27º 48' .068" E 68º 54' .054"	River banks with *Tamarix indica, Saccharum spontaneum, Phragmites carca* and other vegetation are a secure and distant place with no human activities.
5	Keti Shah Riverine Forest	Sukkur	N 27º 46' .785" E 68º 55' .183"	River banks with *Tamarix indica, Saccharum spontaneum, Phragmites carca* and other vegetation are a secure and distant place with no human activities.
6	Hummal Lake	Qambar-Shahdadkot	N 27º 41' .159" E 68º 51' .166"	Sparse *Typha* growth in patches on small islands in the lake and wild lands around the lake offer shelter and refuge while plenty of fish in the lake makes it a good habitat.
7	Hummal Lake	Qambar-Shahdadkot	N 26º 49' .267" E 67º 39' .388"	Sparse *Typha* growth in patches on small islands in the lake and wild lands around the lake offer shelter and refuge while plenty of fish in the lake makes it a good habitat.
8	Upper Nara Canal	Khairpur	N 26º 27' .097" E 68º 54' .113"	Canal banks are thickly vegetated: Trees like *Prosopis juliflora*, *Dalbergia sissoo* and *Acacia nilotica,* shrubs like *Calotropis procera, Saccharum spontaneum* and *Phragmites carca:* small ponds along both the banks have thick vegetation of *Typha* and *Saccharum spontaneum*. Beyond the ponds along both the banks, there are agricultural fields hence some human activities.
9	Jamrao Headwork	Nawab Shah	N 26º 56' .005" E 68º 58' .327"	Thick *vegetation* of *Prosopis juliflora*, *Saccharum spontaneum* and *Typha domingensis* along canal banks and along seepage water ponds with agricultural lands on both sides of the canal beyond the seepage water ponds.
10	Baqaar Lake	Sanghar	N 26º 50' .744" E 68º 47' .399"	Sand dunes along one side while *Typha domingensis*, *Saccharum spontaneum, Prosopis juliflora* and other vegetation along the other sides of the lake.
11	Dhalor Mori	Sanghar	N 25º 05' .570" E 69º 09' .531"	Fish farms surrounded by thick vegetation of *Typha sp.* and *Saccharum sp.* and a canal with its seepage water lagoons having plenty of fish that attract otters.
12	Khipro Canal	Sanghar	N 26º 06' .103" E 69º 00' .926"	Canal banks covered by thick vegetation of *Typh sp.* and *Saccharum sp.* with agricultural lands all around.
13	Lower Nara Canal	Sanghar	N 26º 07' .049" E 69º 00' .790"	Canal banks thickly vegetated with *Typha domingensis*, *Saccharum spontaneum, Prosopis juliflora* and other shrubs with mostly sandy soil. Many small and large sized and inter- connected seepage water ponds along both the banks surrounded by *Typha sp.* and *Phragmites sp.*
14	Goath Leghari	Sanghar	N 26º 09' .275" E 68º 59' .470"	Mostly agricultural fields but inter-connected seepage water ponds surrounded by *Typha domingensis*, *Saccharum spontaneum* and *Phragmites carca* also exist.

15	Chotiari Dam	Sanghar	N 26º 12' .313" E 68º 59' .571"	A number of small and large sized islands within the dam vegetated with trees like *Tamarix indica, Acacia nilotica, Dalbergia sissoo, Eucalyptus camaldulensis* and others and shrubs like *Calotropis procera, Typha domingensis, Saccharum spontaneum*, and *Prosopis juliflora* . A few hamlets with livestock and a number of fishermen with their fishing boats remain active throughout the year.
16	Usman Ibopoto	Sanghar	N 26º 13' .617" E 69º 02' .206"	Agricultural fields with a number of inter-connected seepage water ponds surrounded by *Typha sp.* and *Saccharum sp.* near Chotiari dam.
17	Seepage water near Power House	Sanghar	N 26º 24' .412" E 68º 52' .766"	Small inter-connected seepage water ponds surrounded mainly by *Typha sp., Saccharum sp.,* and *Phragmites sp*. Most of the area represents agricultural fields with patches of waterlogged lands in-between.
18	Manchhar Lake	Jamshoro	N 26º 25' .097" E 67º 39' .113"	Sparse *Typha* growth in patches on small islands in the lake and hundreds of floating houses of fishermen.
19	Talaar village	Badin	N 24º 46' .244" E 68º 56' .414"	Agricultural fields but also some wild lands with a number of freshwater ponds having *Saccharum sp.* and *Typha sp.*
20	Mirpur Sakro	Thatta	N 24º 35' .349" E 67º 44' .668"	Agricultural fields with a large freshwater lake having thickly vegetated *Typha domingensis*, *Saccharum spontaneum* and *Phragmites carca.*
21	Mirpur Sakro	Thatta	N 24º 35' .855" E 67º 44' .023"	Agricultural fields with some seepage water ponds along a canal surrounded by *Typha domingensis*, *Saccharum spontaneum, Phragmites carca* and other vegetation.
22	Haleji Lake	Thatta	N 24º 47' .212" E 67º 45' .947"	Small islands inside the lake thickly vegetated with *Typha* and small but interconnected ponds along western side of the lake surrounded with *Prosopis juliflora*, *Phragmites carca* and *Saccharum spontaneum.*
23	KDA branch canal	Thatta	N 24º 48' .017" E 67º 58' .860"	Canal banks covered by thick vegetation of *Typha domingensis*, *Saccharum spontaneum* with a number of freshwater ponds along the banks
24	Keenjhar Lake	Thatta	N 25º 01' 254" E 68º 01' 215"	Thick vegetation *Typha sp.*, *Prosopis juliflora Saccharum sp.* etc. around the lake. A tourist spot where thousands of visitors come on weekends.
25	Jamrao canal	Mirpur Khas	N 25º 35' 33.8" E 69º 04' 40.4"	Canal banks covered by *Typha domingensis*, *Saccharum spontaneum* and *Prosopis juliflora*. Seepage water ponds beyond the banks and some water logged areas with sparsely vegetated *Prosopis juliflora.*

Table 2: Observation records of otter in the study area, Sindh

S r . No.	Location / Observation Site	Direct Observation / Sighting	Indirect Observations				
			Holts	Tracks and Trails	Spraints	Feeding Remains	Interviews with locals
1	Guddu Barrage	-	-	-	✓	-	✓
2	Summanu Lake	-	-	✓	✓	✓	✓
3	Maachhko; Ubaro	✓	-	✓	-	-	✓
4	Keti Shah Forest	-	-	✓	-	-	✓
5	Keti Shah Forest	-	-	✓	-	-	✓
6	Hummal Lake	-	-	-	-	-	✓
7	Hummal Lake	-	-	-	-	-	✓

8	Upper Nara Canal	✓	-	✓	✓	✓	✓
9	Jamrao Headwork	-	✓	✓	-	-	✓
10	Baqaar Lake	-	-	✓	-	-	✓
11	Dhalor Mori	-	-	✓	-	-	✓
12	Khipro Canal	-	-	-	-	-	✓
13	Lower Nara Canal	✓	-	✓	✓	-	✓
14	Goath Leghari	-	-	✓	-	-	✓
15	Chotiari Dam	✓	✓	✓	✓	✓	✓
16	Usman Ibopoto	-	-	✓	-	-	✓
17	Seepage water	✓	-	✓	✓	✓	✓
18	Manchhar Lake	-	-	-	-	-	✓
19	Talaar village	-	-	✓	-	-	✓
20	Mirpur Sakro	-	-	✓	-	-	✓
21	Mirpur Sakro	-	-	✓	-	-	✓
22	Haleji Lake	-	-	✓	-	-	✓
23	KDA branch canal	-	-	✓	-	-	✓
24	Keenjhar Lake	✓	-	✓	-	-	✓
25	Jamrau canal	-	-	✓	-	-	✓

DISCUSSION

A review of historical records and literature and personal communications with different biologists in the country revealed that the smooth-coated otter was found throughout the Sindh Province especially along the River Indus (Jerdon, 1874; Sterndale, 1884; Murray, 1884; Blanford 1888; Pocock 1939 and 1941; Harris, 1968; Roberts, 1977 and 1997 and Ahmad, 1998). After traversing around 5,000 km in 12 out of 23 districts of Sindh and visiting 36 sites (Fig. 3), the existence of the smooth-coated otter was confirmed at 25 sites in 11 districts (Fig. 4). The current study suggests that the otter population is facing a decline in the study area. The species, which was once distributed evenly and all along the Indus River and irrigation system in Sindh (Roberts, 1997), is now restricted in isolated populations and in fragmented habitats. Reasons for the decline of the Sindh otter in its type locality are poor economic conditions of local communities, unemployment, habitat fragmentation, otter fishermen conflicts and lack of awareness about otters. High demand for otter skins in international markets (IOSF, 2008) and its high price in the study area and low risk for the hunters due to weak enforcement of wildlife laws have encouraged the poor local communities to carry out otter hunting (Khan and Hasnain, 2008). Some of the man-made disturbances and inhibiting factors for otters like habitat destruction through vegetation removal, water pollution and planned annual forest fires, over hunting, lack of awareness and continuous and regular human intrusions in otter habitats have compelled smooth-coated otters to live in scattered populations in fragmented habitats and roam around continuously in search of adequate habitats for their survival in the study area where once it existed in vast areas almost all along the Indus river.

Despite all this, some of the local fishermen consider the presence of the otter a blessing as they get more fish trapped in their nets due to otter activity. Fishermen that used to keep otters as pets to assist in fishing in the past confided that the otter was a very intelligent and loyal animal and can be tamed in a short period of time.

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A number of people from different government departments including Fisheries, Wildlife, Irrigation and Forest Departments, Sindh Rangers, District Government and from non-government organizations like Pakistan Fisher Folk Forum, local influential people, local fishermen, fish farmers and hunters facilitated and supported the survey team. The authors are thankful to *Indus for All Programme* for its financial support and much obliged and grateful to all those people who facilitated and supported the survey team and sincerely acknowledge their assistance in this survey.

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APPENDIX 1

QUESTIONNAIRE

Investigating Otter's Existence in Sindh, Pakistan

Interview Date:

1. Name

2. Age

Day:	Month:	Year:

3. Education

Nil:	Primary:	Middle:	Matric:	Higher:

4. Occupation

Fisherman:	Fish Farmer:	Agriculturist:	Other:

5. Resident of

Village:	Tehsil:	District:

6. Contact No.

7. Have you ever seen an otter?

Yes:	No.

8. If you have seen an otter, When?

A week ago:	A month ago:	A year ago:	Other:

9. How it looked like?

Like a dog:	Like a cat:	something else:

10. Which color it had?

Black:	Yellow:	Brown:	Other:

11. Can you tell us about its size?

12. Where did you see the animal?

In water:	Near water:	Away from water:	On land:

13. At which time did you see the animal?

Morning:	noon:	after noon:	evening:	night:

14. What the animal was doing when you saw him?

Feeding:	Resting:	Walking:	Playing:	Grooming:

15. What was animal's behavior when he realized that he is being watched?

Ran away:	Stand still & Looking at you:	Other:

16. What was the group size?

Single animal:	A pair:	Other:

17. Can you show us any evidence of otter like tracks, holts, spraints, feeding remains?

Yes:	No.

18. Have you ever caught an otter?

Yes:	No.

19. Have you ever kept an otter as a pet?

Yes:	No.

20. Do you know someone who has kept or used to keep otters as pets?

Yes:	No.

21. Can you tell us about otter's behavior in captivity?

22. Do you know what do the otters eat?

23. Do you know about the preferred fish species of otters?

24. Why do the people hunt otters?

25. Have you ever seen an otter attacking the humans?

Yes:	No.

26. Do you know someone who kills otters for their pelts?

Yes:	No.

27. Do you know someone who deals in otter skins/pelts?

Yes:	No.

28. Otter damages fish stocks in fish farms, should otters be killed?

Yes:	No.

29. Do you know about the importance/ecological role of otter?

Yes:	No.

30. Can you tell us about otter's population trend in your area?

Increasing:	Decreasing:	Stable:	Don't know:

31. Should we save otters or not?

Yes:	No.

32. How the otters can be conserved in your area?

33. How can we control otter hunting?

34. How can we convince otter hunters for saving otters?

35. Any other information/story/remarks about otters

Population density of Small Kashmir flying squirrel (*Hylopetes fimbriatus*) at Dhir Kot, District Bagh, Azad Jammu and Kashmir

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Abstract: The study was conducted to estimate the population of the small Kashmir flying squirrel in the district Bagh. The study area was divided into two sampling sites depending upon the vegetation and overall climatic variation. Surveys were conducted in the study area from October 2008 to June 2009. Line transect method was used to estimate the population of Kashmir flying squirrel. Each site was visited twice in a month. Transects were randomly selected in each study site and observations were recorded while walking through transects. Population density was estimated as 2.28 per hectare. Population density of at site A (1370-1690 m) was estimated to be 2.23 per hectare whereas the density at site B (1690-1980 m) was 2.33 per hectare. Maximum number of squirrels was recorded in June, 2009 (5.04 squirrels per ha) while the lowest number was recorded in February, 2008 (0.18 squirrels per ha). Density of the Kashmir flying squirrel increased in summer and declined drastically in winter months.

Key words: Population dynamics, hardwood trees, temperate forest Indo-Malayan region, red Muirrels.

INTRODUCTION

Small Kashmir flying squirrel (*Hylopetes fimbriatus*) is mainly confined to Himalayan moist temperate forest and almost sympatric with *Petaurista petaurista* (Corbet and Hill 1992; Hoffmann *et al*. 1993; Roberts 1997). The range of *H. fimbriatus* extends from Afghanistan to Kashmir and Punjab, India, along the edge of the Himalayas. This squirrel resides in fir *Abies pindrow*, spruce *Picea* smithiana, deodar *Cedrus deodara* forests and chestnut *Aesculus indica* - oak *Quercus* spp. forests in the mountains of the northwest Himalayas. Small Kashmir flying squirrel is also widespread in drier forest zones characterized by deodar and Holly oak (*Quercus balut*) in southern Chitral, forests of Dir and Swat Kohistan. It also occurs in Murree hills and Gilgit (Roberts 1997).

Flying squirrels have always attracted the mammalogists worldwide. Various aspects of their ecology, biology and population dynamics have been investigated by a number of scientists. Corbet and Hill (1992) studied the distribution of flying squirrels in Indo-Malayan region and found that the small Kashmir flying squirrel is distributed with red giant flying squirrel (*Petaurista petaurista*) in Himalayan moist temperate forest ranging from 1,350 to 3,050 m elevation. Densities of northern flying squirrel (*Glaucomys sabrinus*) was found higher in older forest stands than in younger forest stands of north eastern California. Moreover heavy logging and intensive site preparation was found to have negative affect on flying squirrel population (Waters and Zabel, 1995). Nakagawa *et al*. (2007) found that abundance of terrestrial small mammals, were significantly negatively correlated with the percentage of fruiting trees with and/or two months lag. Wauters *et al.* (2002) reported that space used by one species did not affect on other species. In Estonia habitat of Siberian flying squirrel (*Pteromys volans*) has mainly decreased due to destruction of good nesting and hiding places (Tim and Kiristaja, 2002). Ransome and Sullivan (2004) reported that population of certain species of flying squirrels is not limited by the availability of nesting sites but food appeared to have a significant effect on the population. The densities of northern flying squirrels (*Glaucomys sabrinus*) and red squirrels (*Tamiascirus hundsonicus*) had a strong relationship with the density of large spruce (*Picea sp.*) and hardwood trees and snags in conifer sites (Holloway and Malcolm, 2006). Carey *et al*. (1992) reported that flying squirrel densities are twice as greater in old forest stands as compared to younger forest stands.

No specific study on small Kashmir flying squirrel has so far been conducted in AJ&K, so information on its population and biology/ ecology is not available. Presently this species has been declared as vulnerable (VU) in Pakistan (Sheikh and Molur, 2005). Present study aimed to estimate the population of small Kashmir flying squirrel in Dhir kot, AJ&K.

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MATERIAL AND METHODS

Study Area

The study was conducted at selected forest blocks in Tehsil DhirKot (33° 51' N 73° 29' E) located at western side of district Bagh, AJ&K. Dhirkot is located 25 kilometres from Kohala and 132 kilometres from Islamabad, at an altitude of 1676 meters. Study was conducted in an area of 10km^2 of the forest along the north eastern side of village Sanghar Bathara. The forest is located in the transition zone; blue pine (*Pinus wallichiana*) on higher elevations and chir pine (*Pinus roxburghii*) on lower. Other tree species like kau (*Olea ferruginea*) and white oak (*Qurecus incana)* were also present in the forest. Beside these many small trees, herbs, shrubs and grasses were also abundant in that area.

Study Design

The study area was regularly visited for a period of nine months from October 2008 to June 2009. The data were collected for four nights a month. Study site was divided into two sampling units (A and B) representing almost two different habitats depending upon dominant plant species and overall climate. Each sampling unit was visited twice in a month.

Site A is a low lying area mostly covered with chir pine and kau (*Olea ferruginea*). Beside these plenty of fruit trees e.g. walnuts, apples, pears, and citrus fruits were available in this area. Oak tree is less common in this sampling unit. As forest of this sampling unit is comparatively newer one so less number of old trees are available for feeding, nesting and roosting of Kashmir flying squirrel. Elevation of this sampling unit ranges from 1370 meters to 1690 meters. Climate of this site is relatively milder as compared to site B. Water is abundantly available in this unit. Snowfall although occurs but it is less common in this unit.

Site B is an upslope area having elevation range from 1690 meters to 1980 meters. This unit is mainly covered with blue pine and oaks. Forest in this unit is much thicker and older as compared to site A. Winter is too harsh in this site as snowfall occurs frequently and temperature falls below freezing. All of the above mentioned species of fruit trees were also found in this unit.

Population Estimation

To estimate the populations of flying squirrel line transect method was used. Transects were randomly selected in each sampling unit. Transects were selected which were representatives of a sampling unit or at least a part of sampling unit. Data were collected while walking through the transect length. Both direct as well as indirect method of population estimation was employed. Direct method entails searching actively for the animal along a predetermined strip of land using binoculars and searchlights. Activity sounds of flying squirrels were also noted with estimated distance. Length of strip and flushing distance was noted so that total area sampled could be extrapolated to get an estimate of total population in study area. Width of the transect was calculated by multiplying the average flushing distance with 2. Length and width of the transect was multiplied to the total area of the transect. Density of Kashmir small flying squirrel in a transect was calculated using the following formula;

$$\text{Density (per hectare)} = \frac{\text{Number of individuals flushed}}{\text{Area of transect (hectares)}}$$

In this way density of both sampling units were calculated. T-test was applied to compare the difference in densities of both the sites.

RESULTS AND DISCUSSION

Average population density (for both the sites) of small Kashmir flying squirrel was found to be 2.28 squirrels per hectare in the study area. Population density of small Kashmir flying squirrel at site A was 2.23 squirrels per hectare and at site B 2.33 squirrels per hectare (Table. 1). Value of T-test (0.36) showed that there was no significant difference between the densities of two units.

Table 1 Month wise densities per hectare at site A and B

Month	Density at Site A	Density at Site B
October	1.46	3.34
November	3.32	2.14
December	0.79	1.07
January	0.25	0.67
February	0.38	0.00
March	3.00	2.10
April	2.78	3.27
May	4.26	3.24
June	4.86	5.24
Mean (S.E)	**2.23±0.55**	**2.33±0.54**

The density of small Kashmir flying squirrel did not remain constant through the year rather it varied with the season. There was a sharp decline in population density at the start of winter; the minimum during the coldest months (December to February). Maximum

number of individuals were recorded in June, 2008 (5.04 squirrels per ha) while lowest number of squirrels was recorded in February (0.18 squirrels per ha). The sharp increase in the density of small Kashmir flying squirrel in the beginning of spring showed the increasing trend throughout summer (Table 2). It is presumed that increasing trend in the density may persist after the study period until the start of next winter.

Table 2. Month wise average density per hectare (for sites A and B)

Month	Density per hectare
October	2.39±0.69
November	2.23±0.12
December	0.99±0.33
January	0.45±0.31
February	0.18±0.18
March	2.25±1.29
April	3.02±0.37
May	3.75±0.59
June	5.04±0.29
Mean (S.E)	**2.28±0.5**

Small Kashmir flying squirrel prefers to live in old and mature forest as compared to newer one, because there are more roosting, nesting and feeding cover available in old and thick forest vegetation. Lower density of Kashmir flying squirrel (2.23 squirrels per ha) was recorded at site A which suffered from severe logging, resulting in the reduction of roosting, nesting and feeding resources at this site. Holloway and Malcolm (2006) also found that density of flying squirrels (*Glaucomys sabrinus* and *Tamiascirus hundsonicus*) were higher in old forest stand than newer ones. Waters and Zabel (1995) reported that heavy logging is negatively affecting northern flying squirrel (*Glaucomys sabrinus*) density in north eastern California.

Present study reveals that small Kashmir flying squirrel resides at the elevation higher than 4450 feet (1356 m) in moist temperate forest, and its range of distribution extended beyond 6500 feet (1981 m). Corbet and Hill (1992) described that small Kashmir flying squirrel is distributed in Himalayan moist temperate forest between elevations of 1350m to 3050m.

From November, 2008 to February, 2009 density of small Kashmir flying squirrel was slightly higher at site A as compared to site B, for temperature dropping radically in site B. Furthermore site B is characterized by early freezing temperature, frequent rainfall and snowfall from December to January. Because of these harsh winter conditions density of Kashmir flying squirrel decreases at site B. To overcome these ruthless conditions some individuals of small Kashmir flying squirrel may locally migrate towards low lying areas (site A) while rest of them hide themselves in wintering shelters. These shelters are mostly the grass stocks which local people erect for safe wintering diet of their cattle. During the period Kashmir flying squirrels used stored food in the form of acorns, walnuts, seeds of cone and many different fruiting plants and other starch rich food items.

On the other hand, in winter density of site A was a bit higher than site B. It was because, winter was relatively milder in site A as compared to site B. Temperature is more favorable and rainfall occurs less frequently. In winter food resources were plentiful in site A than that of site B. Snowfall although occurs but it was less intensive in site A. Kashmir flying squirrel prefers to spend its winter in site A because of these appropriate conditions.

A sharp decline in density of Kashmir flying squirrel was observed at the start of winter. As the winter begins the temperature starts decreasing rainfall become frequent and food resources diminished. So Kashmir flying squirrels hide themselves in wintering shelter and holes or nests to cope these challenging conditions. Lowest density (0.38 squirrels per hectare) has been recorded in February. This is because temperature was too low at food was limited during this coldest month. At the beginning of spring density of Kashmir flying squirrel starts increasing gradually and reaches at its peak at the end of summer.

In summer conditions become more favorable as temperature rises to normal and choice of food also increases. But in summer the density of Kashmir flying squirrel in site B was faintly higher than site A. This is because of less availability of roosting and nesting sites site A. Moreover, in summer plentiful food resources were also available for small Kashmir flying squirrel at site B.

Although feeding resources were almost similar in both sites but flying squirrel preferably used site B. In summer nests were required for flying squirrels to breed. So availability of more nesting and roosting sites in site B attracts flying squirrel to live in this old forest. Population density of small Kashmir flying squirrel declined in winter in similar fashion as that of site A where the population density declined more sharply. The reason of this sharp decline was that winter was more prolonged and harsh at site B. Like the site A, minimum density of site B was recorded in January and February. In January density of Kashmir flying squirrel was 0.67 per hectare while in February no squirrel was observed at site B.

As the spring turn up sudden rise in population density of Kashmir flying squirrel has been recorded in site B. This increase in population density of Kashmir flying squirrel is much similar to that of site A. In April when suitable conditions were available density of Kashmir flying squirrel increase rapidly. This may be due to the upward movement of those individuals which were migrated to low lying areas (site A). Now more food resources were available and more suitable condition exists so Kashmir flying squirrel prefers to live in this habitat type. Population density progressed in this site as the summer proceeds. Maximum density has been recorded in June (5.24 squirrels per hectare) at the end of study period. But population density of Kashmir flying squirrel increased in similar fashion till the next winter arrived.

Comparison of densities of Kashmir flying squirrel at two sites viz. A and B from October 2008 to June 2009. Densities at both sites decrease in winter and increased in summer in almost similar fashion. It is also clear that during winter decline in density of Kashmir flying squirrel was much sharper at site B.

Values of estimated population densities of Kashmir flying squirrel from October, 2008 to June, 2009 with their standard error has been given in Table. 2, that explains the trend of population density of Kashmir flying squirrel at the study sites from October, 2008 to June, 2009.

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Study of Atherosclerotic Lesions in Non-human Primates of Assam

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Abstract: Atherosclerosis is a major age-related process and public health problem. Occurrence of atherosclerosis in non-human primates is not common. In the present study, aortas of 10 adult non-human primates of Assam State Zoo and Department of Forest and Environment, Government of Assam were collected and examined by Sudan IV stain for the presence of spontaneously occurring atherosclerotic lesions. The lesions recorded in two animals were fatty streaks (1) and fatty dots (1).

Key words: Atherosclerosis, atherogenesis artercosclerosis, pathogenesis, fatty streaks, fatty dots, non-human Primates

INTRODUCTION

Atherosclerosis is a major age-related process and public health problem. Its clinical manifestations continue to be responsible for approximately 50% of all deaths occurring annually (Cefalu and Wagner 1997). Atherogenesis has long been accepted as the pathologic process that leads to occlusive arterial lesions principally responsible for myocardial and cerebral infarction, gangrene of the extremities, and subsequent loss of function (Sasahara *et al*. 1994).

The pathogenesis of naturally occurring arteriosclerosis in primates differs significantly from that induced in them by feeding cholesterol (Lindsay and Chaikoff, 1965). Spontaneously occurring aortic atherosclerosis in monkeys and baboons had been reported by Migaki *et al.* (1971) and McConnell *et al.* (1974). Robert and Vesselinovitch (1977) were of the opinion that non-human primates provided the best approximation of the ideal model for studies of the various parameters of the atherosclerosis for the purpose of better understanding the human condition. Goswami (1994) examined the presence of spontaneously occurring atherosclerotic lesions in aortas of 25 adult captive non-human primates. The only lesion recorded was the deposition of lipid in the form of fatty streaks in 9 animals. Atherosclerosis scarcely occurred in both the left and right coronary arteries of rhesus monkey (*Macaca mulatta*) and Japanese monkey (*Macaca fuscata*) at old age (Tohno *et al*., 2008).

MATERIAL AND METHODS

In the present study, a total of 10 aortas of non-human primates *i.e.* rhesus macaque (*Macaca mulatta*) (5), Assamese macaque (*Macaca assamensis*) (1), Slow loris (*Nycticebus coucang*) (2) and golden langur (*Presbytis geei*) (2) were collected from Assam State Zoo and Department of Forest and Environment, Govt. of Assam during the period from December, 2007 to November, 2009. After removing the adventitial fat, they were split open, cleared in tap water, flattened over a tray and subsequently fixed in 10% formalin saline for 24 to 48 hours. The vessels were examined for any arteriosclerotic lesions, lipid deposits, fibrous thickening, calcium deposits, ossifications, aneurysms, presence of parasitic tracts etc. The fixed aortas were stained with Sudan IV stain according to the technique of Holman *et al.* (1958) to delineate fatty lesions. The gross lesions were graded according to the criteria recommended by the WHO study group on atherosclerosis (1958).

RESULTS

In the present study, the spontaneous atherosclerotic lesions were recorded in rhesus macaque and an Assamese macaque two animals. The unstained aortas showed no visible lesion. After staining with Sudan IV, aorta of a rhesus macaque showed fatty streaks ranging from pinpoint dots to about 0.5 cm in length (Fig. 1) and aorta of an Assamese macaque showed fatty dots (1-2mm). The streaks were smooth, soft and non elevated and were stained orange red in colour. They occurred as longitudinal streaks arranged parallel to long axis of the aorta mostly in and around the aortic branching.

DISCUSSION

Spontaneously occurring atherosclerotic lesions in non-human primates was recorded earlier by Migaki *et al.* (1971), Robert and Vesselinovitch (1977) and Goswami

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Fig1. Photograph showing atherosclerotic lesion of fatty streaks (→) in a stained aorta

(1994). Robert and Vesselinovitch (1977) reviewed the earlier works on different species of non human primates, and few lesions such as fatty streaks and necrotic foci in aortas were documented. The present finding is similar to the findings of Goswami (1994). Chakraborty (1991) examined spontaneously occurring atherosclerotic lesions in captive wild herbivores in the Assam State Zoo and recorded several types of lesions in addition to the lesions recorded in the present study. They suggested that types of food, the geo-climatic condition of soil and the physiological status of the animal might have played a role on the causation of atherosclerotic lesions in aortas and the present study also endorsed their views.

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Poisoning and Mycotic Infection in Golden Langur (*Trachypithecus geei*) of Chakrashilla Wildlife Sanctuary, Assam

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Abstract: The present study examined two carcasses of golden langur (*Trachypithecus geei*) of Chakrashilla Wildlife Sanctuary, Assam, received by the Department of Pathology, College of Veterinary Science, AAU, Khanapara. The diseases recorded in two animals were organochlorine insecticide poisoning and zygomycotic gastritis. In the poisoning case, organochlorine compounds were detected from liver, kidney and intestine by the State Forensic Science Laboratory, Guwahati, India. In zygomycotic gastritis, growth on the serosal surface of stomach was observed and broad, aseptated fungal hyphae could be seen in both H&E stain and PAS stain sections. The study revealed that the use of organochlorine insecticide and other pesticides on rubber plants cultivated nearer to the Sanctuary might be the cause of the diseases in those animals.

Key Words: Non-human primates, Manash National Park,Cynomolgus monkey necrosis, insecticide poisoning, zygomycotic gastritis

INTRODUCTION

Non-human primates are an important group of animals for their closeness to human beings. They form an integral part of biodiversity and a cognizable link between human and nature. Golden langur (*Trachypithecus geei)* is one of the endangered species of non-human primates of South Asia. The species is endemic to the border of northwestern Assam, India and south central Bhutan. In India, except for a part of Manash National Park and Chakrashilla Wildlife Sanctuary, majority of the population of the species live in reserved forests and other unclassified forests with less or no protection coverage.

Primates are susceptible to wide varieties of infectious diseases of which many are transmissible to man (Wallach and Boever 1983). Though mycotic infection in non human primates is not common, a few reports have been published (Brexnock *et al*. 1975; Migaki; Daniel *et al*. 1984; 1982 and Chakraborty and Goswami 1996). Torres-Urbano *et al.* (2010) recorded disseminated zygomycosis in a 4 year cynomolgus monkey. The poisoning cases like lead poisoning (Zook and Sauer 1973; Joel and Zdenek 1984; Zook *et al.* 2005) and organophosphorus poisoning (Goswami 1994) have been recorded in non-human primates.

MATERIALS AND METHODS

The study examined two carcasses of golden langur of Chakrashilla Wildlife Sanctuary, Assam at the Department of Pathology, College of Veterinary Science, AAU, Khanapara. The gross lesions were recorded and tissue samples preserved in 10% formalin saline solution were processed and stained by routine haematoxyline and eosin (H&E). Special staining technique/methods such as Brown and Brenn, Zeihl-Neelsen's and modified Periodic Acid Schiff (PAS) were undertaken.

RESULTS

Poisoning

At post mortem examination of a golden langur, no significant gross lesion could be detected in any organ except that liver showed focal areas of necrosis. Organism could not be isolated from the heart blood culture. Microscopically, the lung showed severe congestion in the pulmonary capillaries and hemorrhage into the alveoli. Inflammatory cells were noted in the interstitial spaces. There was marked necrosis of the hepatic lobules and a few hepatocytes were present at the perilobular areas. Pieces of liver, kidney and intestinal loop were sent to the State Forensic Science Laboratory, Guwahati and laboratory results confirmed the case as organo-chlorine insecticide poisoning as the tissues of liver and kidney and intestinal content were positive for the insecticide.

Mycotic infection

At necropsy of another golden langur, a growth on the serosal surface of the stomach was recorded

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and mucosal surface showed suppurative lesions. No organism could be isolated from any organ. Histopathological examination of growth of the stomach showed central area of caseous necrosis with infiltration of mononuclear cell surrounded by thick connective tissue capsule. Focal necrotic areas were also seen in the mucosa and submucosa and within the necrotic tissue thin walled, broad, aseptated fungal hyphae (Fig. 1) could be noticed in H&E stained sections and upon staining by modified PAS the hyphae were clearly demonstrated. The fungus was identified as zygomycotic fungus.

DISCUSSION

Poisoning and mycotic cases in non-human primates are not very common. In the present study, the poisoning case reported in the present study was a free ranging animal whereas Goswami (1994) recorded in a captive animal and the source could not be confirmed. Fungal diseases such as mucormycosis in the alimentary tract of nonhuman primates have been reported, with candidiasis and mucormycosis observed most often. Torres-Urbano *et al.* (2010) reported disseminated zygomycosis in cynomolgous monkey and found nonseptated, branching hyphae in sections of the stomach and mediastinal lymph nodes consistent with a zygomycete. Similar fungal hyphae were also recorded in the present study.

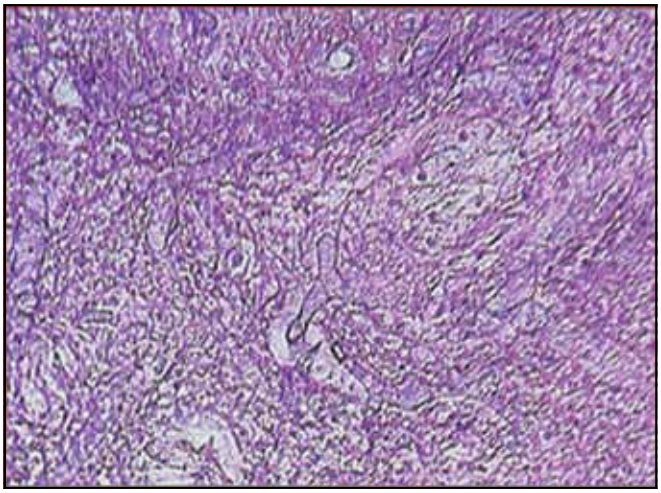

Fig. 1 Photomicrograph of stomach showing broad aseptated fungal hyphae embedded within the necrotic tissue. H&E X 400

Both the animals were from Chakrashilla Wildlife Sanctuary and the disease diagnosed gave an idea that the source of the diseases was same. It was known that nearer to the protected area extensive rubber cultivation was going on and organo-chlorine insecticide and other pesticides were routinely used in those plantations. The langur often eats the tender buds of the rubber plants and may consume these toxic materials in low doses. This could have resulted in chronic toxicity and as a result the immune system may be lowered down. As the immune system lowers down, the opportunistic fungus gets the chance to infect and cause disease in animals. The hot and humid climatic condition of the region is congenial to rapid development of fungal growth; this may be a reason of high incidence of fungal infection in animals of this region. The need of the hour is to evolve a policy so that the golden langur can be conserved in its natural habitat and rubber plantation is also not affected or damaged.

ACKNOWLEDGEMENTS

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Ethno-Botanical Study of Wild Medicinal Plants of Neelum Valley, Azad Jammu and Kashmir, Pakistan

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Abstract: The study was aimed to document the medicinal plants and their traditional uses in the Neelum Valley, Azad Jammu and Kashmir, Pakistan during 2010. Neelum Valley represents phyto-geographic features of Sino-Himalayan region and is rich in natural resources. The area supports moist temperate forest, dry temperate forest, sub-alpine scrub, alpine pastures and cold deserts. Data was ere collected through direct observations during field surveys, questionnaires and interviews of local inhabitants. A total of 67 medicinal plants were identified, traditionally used for remedial measures against 32 diseases. seven plant species were commercially extracted and sold to the market. Maximum (14) plant species were used as antiseptics followed by weakness (9) and anti worm (8). Leaves of these species were used more commonly (38.46%) as compared to roots (24.36%). There was a medium level of use of maximum plant species (44%) followed by low (34%) and high (22%) level. Low income and lack of facilities increased the dependence of majority of the local communities on the available natural resources for their subsistence. Study revealed that at least 16 species were threatened locally due to habitat degradation including deforestation, livestock grazing, over-exploitation and unscientific ways of collection from their natural habitat. Information gathered would be useful for the conservation of wild medicinal plants of the valley.

Keywords: sub-alpine scrub, alpine pastures, cold deserts, Sino-Himalayan reegion, Himalayan region, herbal medicines, medicinal plants.

INTRODUCTION

It is centuries old practice to extract and process the medicinal plants for daily human use, local economic uplift and for animal treatment (Ahmed, 1999; Khan, 1951). Around 700 plant species are used for medicinal and aromatic purposes in the Himalayan region (Shengji, 1992). Pakistan has a diverse flora containing about 6000 plant species. About 80% of the people belonging to the rural areas still depend upon the local herbal medicines (Ahmed, 1999). In the recent years, efforts have been made to document the traditional knowledge about local medicinal flora. In this regard traditional utilization and conservation status of 160 plants has been described form Margalla Hills National Park (Shinwari and Khan, 2000). Similarly, Shah (2001) listed about 58 species of medicinal plants from Ayubia National Park near Nathia Gali. Indigenous knowledge about the use of about 25 medicinal herbs from Kahuta, district Rawalpindi has been reported by Qureshi and Khan (2001).

In the Neelum valley, majority of medicinal plants are reported to be naturally occurring in moist temperate coniferous forest, sub-alpine and alpine pastures (Qamar and Minhas, 2006). These habitats are either occupied by permanent human settlements or visited by seasonal graziers and nomads (bakkarwals). In the lower part of Neelum valley (Kutla and Lachrat forest divisions) these plants have so badly been exploited in the past that new generation hardly knows their indigenous values (Qamar and Minhas, 2006). In remote areas about 60% of the local population is engaged in collection and processing of different medicinal herbs. These collectors are ignorant of the proper time of collection, methods of processing, storing and marketing. Their mishandling causes enormous damage to these plants as well as to other biodiversity.

Lack of scientific knowledge about the useable parts, proper time of collection and wasteful methods of collection lead to misuse of these plants. The proper timing of collection of desired part(s) of a plant often determines the yield percentage and quality of ingredients (Adnan *et al*. 2003). The medicinal flora of Neelum Valley is still unexplored and needs to be documented and studied for its status and traditional uses. Keeping this in view, the present study was conducted to explore and document the medicinal plants diversity of Neelum valley; indigenous knowledge of local people about uses

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of these plants; and also to find out the major threats to the medicinal flora of the valley.

MATERIALS AND METHODS

Study Area

The Neelum valley supports moist temperate and dry temperate forests, sub-alpine scrub, alpine pastures, high peaks and cold deserts (Champion *et al*, 1965). The area experiences long severe winters starting from mid November to end of April and a very short mild summer from mid-June to mid-August. These physiographic and climatic features offer a great ecosystem diversity supporting a wide variety of vegetation. Seven species of gymnosperms, 404 species of angiosperms, 46 species of grasses, 33 species of ferns and 14 species of fungi have been reported from the area. Many high quality herbs are collected for local as well as commercial uses, some of which are exported to other countries (Shah, 2006).

uses from the local people during different seasons of the year 2010. A questionnaire was used to document the indigenous knowledge about medicinal plants and their uses from local communities and collectors. The interviews were also carried out from knowledgeable persons of the community and herdsmen who were the main users / collectors of medicinal plants. About 300 randomly selected informants were interviewed. Secondary data from various relevant departments was also collected. The medicinal plants having traditional utilization among the people were selected as reference specimens.

RESULTS AND DISCUSSION

During the study, a total of 67 plant species belonging to 39 families, having medicinal value were identified.

Medicinal plants are a valuable natural resource, regarded as safe medication and playing an important role in curing human sufferings particularly in rural and

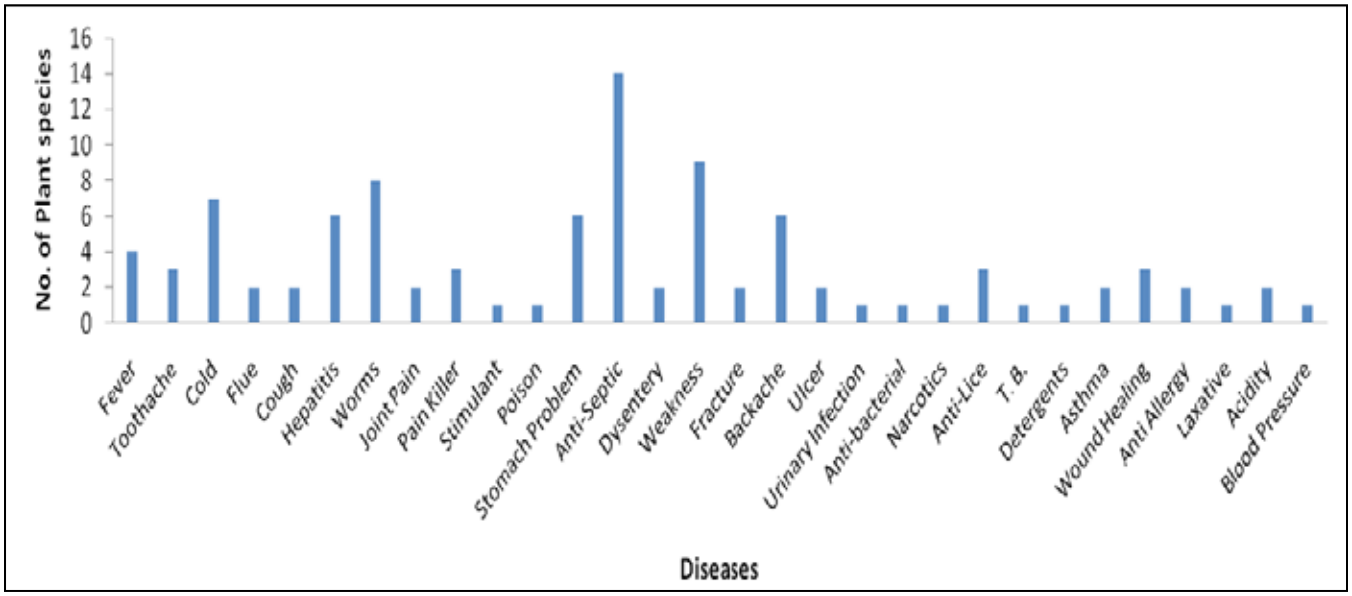

Fig 1. Number of plant species used by local people in the cure of different diseases in the study area during 2010.

The main study sites in the Neelum Valley included Machiara National Park, Jagrain, Lawat, Surgen, Ghamot National Park, Shounther valley and Musk Deer National Park. Primary data were collected through personal field observations while walking along the transect lines during the organized survey of study sites. During the field survey, various geophysical, climatic and biological factors were recorded. Plant specimens were photographed, collected, preserved and got identified from the Botany Department of AJ&K University Muzaffarabad along with the citation of the available taxonomic literature (Nasir & Ali, 1971- 2001).

Field trips to the study area were conducted to collect data on medicinal plants and their ethno-medicinal

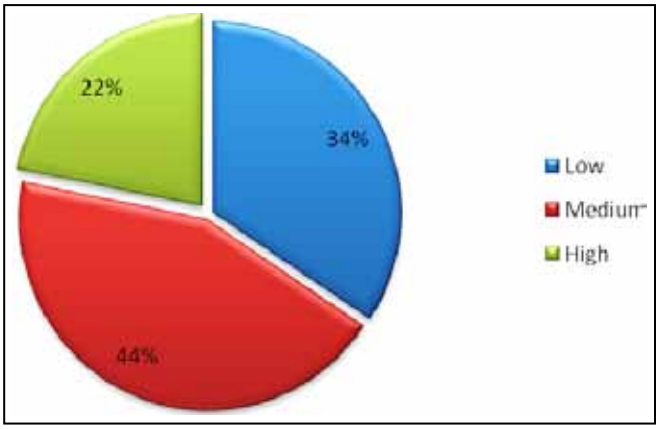

Fig 2. The percentage, level of the use of different plant species in the study area during 2010diseases in the study area during 2010.

remote hilly areas (Zaidi, 2001). Neelum valley is one of the remote and under developed hilly areas of Azad Jammu and Kashmir, lacking modern health facilities. Hence, local medicinal plants play a vital role in the remedy of various diseases. The other reason for their wide use is high prices of allopathic medicines and their side effects (Zaidi, 2001). It is believed that medicines of natural origin are harmless with no risk to consumers. However, precautionary measures are needed when using toxic plants by mistake or preparing herbal medicines where chemical contents of plants are not fully known (Ahmed and Sher, 2001).

A total of 30 diseases were reported to be cured with 67 different medicinal plant species. Fourteen plant species were used as antiseptics, nine for weakness (energetic) and eight as anti- worms. Important diseases cured using more than one medicinal plants species included hepatitis, blood pressure, cough, stomach problems, fever, ulcer, cold and dysentery (Fig 1).

We divided the use of plants into three categories including low, medium and high level use. Results revealed that the use of 44% plant species was of a medium scale, 34% plant species had the low use status and 22% plant species were rated as the most used (Fig 2).

Different parts of plants are used to cure various diseases. Leaves were the most used part (38.46%) of the plant as they were easily available, contained high amount of chemicals and could be easily extracted and used in various forms followed by roots (24.36%) and the whole plant (9%) (Fig. 3). Majority of the people residing in the periphery of the valley are poor, undernourished and illiterate. They need to cut the forests to sell as timber and fuel wood for making their living. Resultantly, forests of *Abies pindrow, Cedrus deodara, Juglans regia, Pinus roxburgii, Pinus wallichiana, Picea smithiana and Taxus wallichiana* are disappearing at an alarming rate.

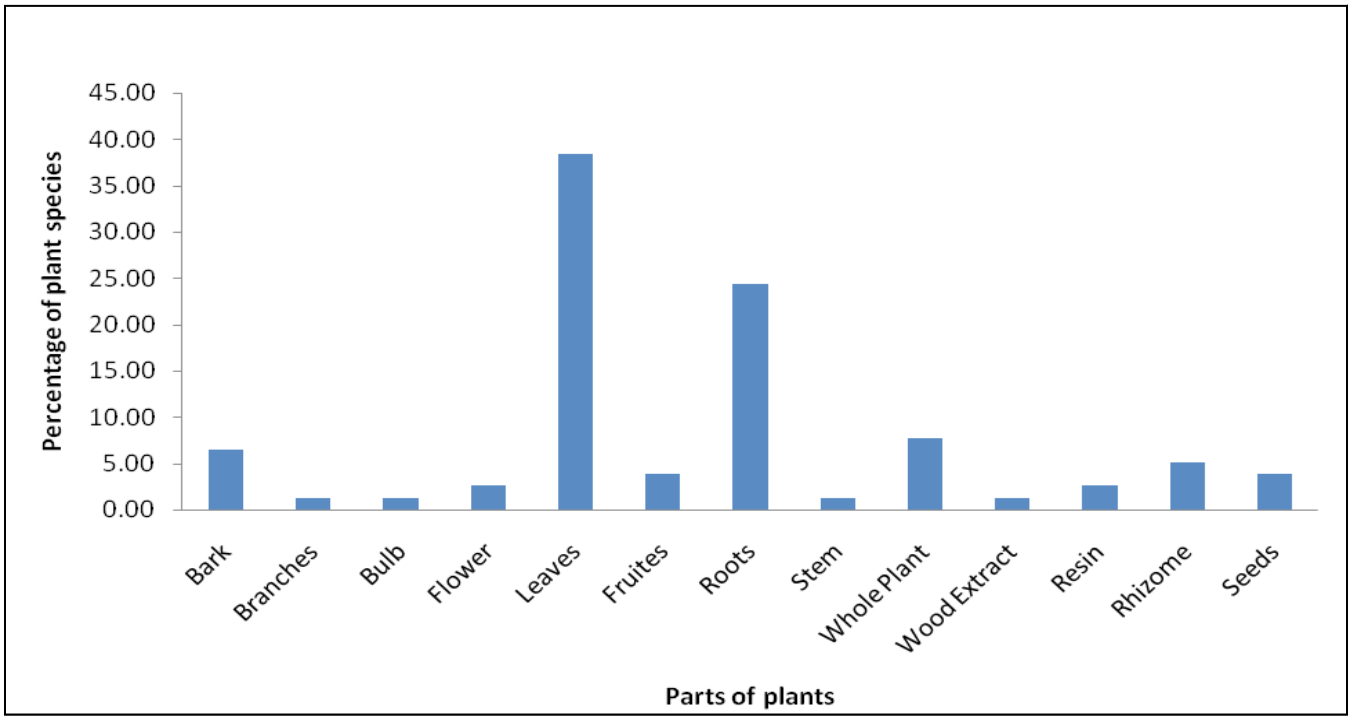

Fig 3. The use of various parts of the plant species in the remedy of different diseases in the study area during 2006

Threats to the medicinal plants

Medicinal plants are under heavy biotic pressure in the form of human related activities including deforestation, overgrazing, overexploitation and unscientific ways of collections of plants. Increase in human population has increased their daily needs which have accelerated natural resource depletion through unsustainable use. The natural forest cover which provides protection to the medicinal plants is shrinking with time. Rapid increase in the number of livestock has posed a serious threat to the natural ecosystems of the area. Naturally having low regeneration potential and constant high rate of extraction, medicinal plants are becoming sparse from their potential habitats. This condition is coupled with the loss of soil moisture and rapid soil erosion. Following are the major threats to the medicinal plants of this area.

1. Habitat degradation

Habitat degradation and fragmentation is the biggest immediate problem caused by human population, threatening medicinal plants in the valley. This trend is most evident in moist, dry and sub-alpine eco-zones of the valley. Study revealed that at least 17 species have

become threatened locally due to habitat degradation including deforestation, livestock grazing, over-exploitation and unscientific ways of collection (Table 1). Following factors are contributing towards this problem;

Timber and fuel wood cutting

During the cutting and collection of timber and fuel wood, local people haphazardly traverse the area damaging medicinal plants. Felling of trees from steep slopes damages the medicinal plants and the vegetation cover thus exposing soil that is readily eroded causing gullies and land sliding in the area.

Grass cutting for stall feeding

In the study area, land suitable for agriculture is very scarce, thus livelihood is supplemented through livestock rearing. Fodder needs of livestock are mostly met from adjacent forest areas and pastures. Grass cutting is the accepted right of the local people since the start of forest management. During this activity majority of the medicinal plants are also cut before maturity. This annual practice poses a great negative impact on the natural regeneration of medicinal plants.

Collections of black mushroom

Gucchhi or Black mushroom (*Morchella esculenta*) is a precious mushroom found in the moist and dry conifer forest zones of the study area. Traditionally, the local people collect the black mushroom from the forest floor which fetches high price in local market. Majority of remote areas of Neelum valley provide suitable habitat for black mushroom. Resultantly, local people search the forest to collect it damaging young seedlings of medicinal plants and disturb the moist humid layer as well, causing negative impact on propagation of mushroom and other natural flora.

Soil erosion

Soil erosion is a common phenomenon in the high hilly areas resulting from heavy grazing and exploitation of vegetation. Soil erosion occurs with a slight rain leading to landslides. This results in the loss of upper fertile soil layer which adversely affects floral diversity of the area.

Fires

During the collection of timber, fuel wood, medicinal plants and mushroom, illegal hunting, trekking and livestock grazing, the people often blow fire to warm up which are not extinguished properly. These fires spread in the forest damaging the medicinal plants and other natural flora. As majority of threatened medicinal plants are found in sub-alpine and alpine eco-zones, nomads using these areas from June to September are also a source of these fires.

Overgrazing and browsing

Livestock is major source of subsistence for the local people, also providing milk and meat for their food. Donkeys and horses are used for transportation and bullocks are used for ploughing. Moreover, nomads from Pothwar, Jhelum, Hazara and Kohistan also stay with their livestock in these areas from June to September. They own livestock numbers much beyond the carrying capacity levels thus overgrazing the natural vegetation and pastures. Resultantly, vegetation cover is depleted and the soil surface becomes vulnerable to erosion and land sliding. These livestock also compete with wild ungulates inhabiting these areas. Mixing with wild ungulates also causes transmission of diseases between them.

Over-exploitation

Local communities of the study area are not well aware of the modern values of the medicinal plants and the environmental consequences of loss of biodiversity and its effect on their livelihood. Their primary concern is to earn more and more from the existing resource of medicinal plants to meet their immediate needs for survival. Medicinal plants are being utilized unsustainably by the locals since long. AJ&K Forest Department auctions the collection of some plants, under which many medicinal plants are collected indiscriminately reducing the chances for their regeneration. A list of threatened plants of the valley is given in Table 1.

2. Poverty

Being underdeveloped and remote area, limited jobs or other income generating opportunities are available for local people. Therefore, they mostly rely on available natural resources for their livelihood. In early summer season local people and nomads start collecting the medicinal herbs and other plants. In order to earn more money, they extract all the plant parts without any consideration of their regeneration resulting in degradation of majority of plants. Medicinal plants exploited for commercial purposes in the valley are given in Table 2.

3. Lack of awareness

People in the study area are mostly illiterate and not aware of the environmental consequences of loss of biodiversity and its impact on their livelihood. They are exploiting the natural flora for their livelihood irrespective of its status in this area. Little efforts have been made for awareness raising in this regard in the past, therefore, the communities remained ignorant about the sustainable use of medicinal plants.

Table 1. Plant species threatened locally due to excessive use and habitat destruction in Neelum valley

S. No.	Scientific name	Local name
1	*Aconitum chasmanthum*	Mohri
2	*Aconitum heterophyllum*	Patrees
3	*Ajuga bracteosa*	Ratti Buti/Jan-e-Adam
4	*Angelica cyclocarpa*	Chora
5	*Arnebia benthami*	Gaozaban
6	*Berberis lycium*	Kala Sumble
7	*Bergenia ciliate*	Batbhyva
8	*Dioscorea deltoidea*	Kanees
9	*Ephedra garardiana*	Ephedra
10	*Inula royleana*	Poshgar
11	*Jurinea dolmiaea*.	Gugaldhoop
12	*Podophyllum hexandrum*	Ban Khakhri
13	*Rheum emodi*	Gol Chotial
14	*Rheum webbianum*	Chapti Chotial
15	*Saussurea lappa*	Kuth
16	*Taxus wallichiana* *	Barmi/Thuni
17	*Valeriana jatamansi*	Mushk Bala

Table 2. Plants species being extracted by local communities for revenue generation in the study area.

S. No.	Scientific name	Local name
1	*Aconitum heterophyllum*	Patrees
2	*Valeriana jatamansi*	Mushk bala
3	*Saussurea lappa**	Kuth
4	*Podophyllum hexandrum*	Ban Khakhri
5	*Morchella esculenta*	Guchi
6	*Dioscorea deltoidea*	Kanees
7	*Arnebia benthami*	Gaozaban

4. Smuggling

Smuggling of medicinal herbs is another severe threat to these plants in the area. AJ&K Forest department annually auctions the collection of some plants, under the cover of which many medicinal plants are collected indiscriminately. The contractors and their middle men extract the medicinal plants many times more than permitted. This extra quantity is smuggled to the local as well as to other markets in the country. Nomads are also involved in illegal extraction and smuggling. From upper Neelum Valley, bark of *Taxus wallichiana* is often smuggled to Gilgit Baltistan province of Pakistan. This debarking poses great negative impact on the population of this threatened species.

5. Weak law enforcement

AJ&K Forest Department is solely responsible to check the extraction process of medicinal plants in order to reduce their illegal exploitation. However, it seems to be their least priority to check this illegal practice. Instead they mostly remain involved in timber and fuel wood collection operations throughout the year. This attitude of forest staff often enhances the exploitation and smuggling of medicinal plant.

CONCLUSION AND RECOMMENDATIONS

The Neelum Valley contains diverse vegetation zones due to variation in climatic conditions and altitude. Hence, it is rich in medicinal and other economic plants, some of which are considered to have potential for curing Cancer, AIDS, blood pressure and Hepatitis. It is, therefore, imperative that those plants are further studied to explore their potential of curing such hard to cure diseases. There is also a need to properly protect the natural range of these valuable plants in the valley for their long term sustainability. The potential for propagation of the most important and threatened plants also needs to be explored for their sustained supply and conservation. The exploration and use of important medicinal plants will provide local material for many diseases saving foreign exchange spent on import of drugs. Furthermore, proper management and plantation of these plants could be source of foreign exchange earnings for the country.

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Notes on morphology, habits, ecology and distribution of short-tailed ground agama *Brachysaura minor* (Hardwicke and Gray 1827).

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Abstract: Peculiar morphology of *Brachysaura minor* makes it a lizard of zoological interest. It has been reported from some localities falling in barren, stony and scrubby arid fields in subtropical temperate, Indo-Gangetic landscape across the plains of India and Pakistan. The biotope houses several other sympatric species of agamids, whip-tail sand-lizards, geckos and snakes. Present report sums up data gleaned from earlier reports and adding fresh observations on morphology, habits, ecology and distribution of *B. minor*.

Keywords: *Brachysaura minor*, natural history, ecology, zoogeography

INTRODUCTION

Hardwicke deposited a collection of 366 coloured sketches drawn by himself and other Indian artists of Indian vertebrates and invertebrates, in the Library of British Museum of Natural History. Hardwicke and Gray (1827) took sketch number 82 to describe a new lizard *Agama minor.* The lizard was allegedly caught from Chittagong (now in Bangladesh), since no second report exits from that locality, apparently an erroneous record of locality. Blyth (1856) described a similar lizard from Saugor (central Indian state Madhya Pradesh) as *Brachysaura ornata,* putting *Agama minor* in its synonymy. For long time the lizard remained illusive in nature Günther (1864: 205) placed the lizard in Genus *Calotes,* because of lack of its detailed morphological data. However, Stoliczka (1872) reported five specimens from the western Indian state of Kachchh, followed by Cockburn (1882) who collected several of them from Banda in Bundelkhand region, Uttar Pradesh. He reported some details of lizard's morphology and habits.

Almost all recent publications reporting on lizards of India, mention the presence and distribution of *B. minor*, not dealing with details of its morphology (Das, 2002; Mertens 1974; Manthey and Schuster 1999; Murthy 2010; Sherma, 2000, 2002; Vyas 2000, 2002; Tikader and Sherma 1992; Vyas and Singh 1996; Chakraborty and Gupta 2009). IUCN has placed *B. minor* in the list of Data Deficient Species list.

Khan (1972) and Khan and Mirza (1977) reported a specimen from the lawns of Talimul Islam College, Rabwah, District Jhang (nortn-western, Punjab, Pakistan (31° 45′ 10″ N 72° 55′ 20″ E), Mertens (1974), (Senckenberg Museum, Frankfurt, Germany) authenticated the identification. There are two lizards from Pakistan referring to this taxon in Walter Auffenberg's collection (housed in Florida Museum of Natural History, University of Florida, USA): one from Rani Kot, District Dadu, Sindh; the other from Mastung, Kalat, Balochistan (29° 48' 0" N 66° 51' 0" E), which extends range of *B. minor* to SW Pakistan.

MATERIALS AND METHODS

Brachysaura minor population around Bhuj (Kachchh) was observed in its natural habitat for its behaviour and reaction to each other and human presence. Some specimen were caught and released after study of their morphometrics, in view not to harm natural population of this already rare agama. Morphometric values conformed with minor differences in counts reported in morphology section, so are not reported separately.

RESULTS AND DISCUSSIONS

One of us (Manoj Kumar) observed and photographed *Brachysaura minor* in its natural habitat in Bhuj (Kachchh). Following description of *B. minor* is based on Rabwah specimen supplemented by Cockburn's (1882) remarks.

***Brachysaura minor* (Hardwicke and Gray, 1827)**

Brachysaura minor Khan 2006. Amphibians and reptiles of Pakistan: 88-89.

Agama minor Hardwicke and Gray, 1827. *Zool. Jour.* **3**:218.

Brachysaura ornata Blyth 1856. *J. Asiat. Soc. Bengal* **25**: 448-449.

Acanthosaura minor Boulenger 1890. *The Fauna of British India*: 127.

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Agama minor Smith 1935: *The fauna of British India*: II. Sauria: 225-227.

Brachysaura minor Manthey and Schuster: 1999: 26.

Type locality: Chittagong, Bangladesh

Morphology

Brachysaura minor is a small (snout-vent length 45-90 mm) stocky and pot-belly lizard with short (43-88 mm) tail. The head is large, elongated, flat above, sloping towards snout, covered with heterogeneous, irregular, obtusely ridged scales, arranged in a whorl at its top. Canthal and supracillary ridges are sharp; round naris is in a circular nasal tubercle, lying below canthus, between 3rd and 4th supralabials, visible from above. Eye large, more than half the diameter of the tympanum, pupil round, eyelids thick, eyeball yellow. Tympanum large, round, shallow; a supraotic and another occipital tuft of 3-5 spines, on each side, which are not well developed in juvenile and female. Orbito-otic space with large tri- to quadrihedral tubercles; 4-6 rows of elongated scales between orbit and supralabials. Supra and infralabials 10-15. Gulars smooth, broader than high, slightly keeled, arranged in transverse rows. Neck with small triangular slightly keeled scales. A feeble, short, oblique, black shoulder fold.

Body slightly depressed, laterally bulging; dorsal scales homogeneous, broad, strongly keeled, imbricate, mucronate, arranged in vertical rows on sides of the body, keels form oblique postero-dorsally directed rows; 48-60 scales around midbody, 104-125 scales when counted from posterior most nuchal spine to the tail tip. In adult male vertebral scales elevated in a ridge, distinct at nuchal region, feebly marked in female and juveniles. Ventral scales smaller than dorsals, slightly keeled. No preanal pores and callous scales.

Tail short, cylindrical, not annulated, with gradual taper, covered with strongly keeled homogeneous scales to the tip, in adult male distinctly swollen at base, with hemipenial protuberances underneath.

Limbs rather long, weak, not compressed; covered to the tip of digits with strongly keeled scales. Fingers and toes short, weak, fifth shorter than first, claws weak. Anterior limb when laid backwards reaches to the inguinal region, while posterior extends to the angle of the mouth or a little beyond. Snout-vent length: male 50-85 mm with the tail 38-75 mm; female 53-90 mm with the tail 45-86 mm.

Fig. 2a Fig. 2b Fig. 2c

Fig. 2. *Brachysaura minor*: variations in dorsal pattern: 2a, 2b, 2c.

Color pattern: Dorsum olive brown to brownish dark with yellow tinge (Fig. 2a, 2b; 2c)**.** Head with inter-nasal, frontal and inter-orbital light brown cross-bars; white streak at nape, another from eye to the angle of the mouth, a dark line extends across eye from canthus to temporal. Dorsum with a pattern of three rows of rhomboidal to circular blotches: blotches of median row edged with white, are medially confluent with each other; median row extends to tail tip; lateral rows consist of six smaller cuboid blotches, separated from the median row by irregular white spots (Fig.2a, 2b, 2c). Throat yellow spotted with gray; belly yellowish; limbs and digits cross-bared. Reproductively, active female colored crimson and yellow. A well marked deep black short shoulder fold in adult.

The color pattern of the lizard blends it with its stony dark gray soil. In juveniles, light-dark blotched pattern is more

Fig. 1. *Brachysaura minor*: adult male

Fig. 3. *Brachysaura minor*: adult female

Fig. 4. *Brachysaura minor*: in natural habitat

Fig. 5. *Brachysaura minor:* in resting posture

compact, blotches of middorsal row are separated by narrow white transverse bars (Fig. 2a) or are confluent with each other (Fig. 2b, 2c), and are laterally edged with white.

Comparison with sympatric agamid lizards: Several species of terrestrial agamids, whip-tail sand-lizards, and snakes occur sympatric with *Brachysaura minor,* agamids recorded belong to six genera: *Brachysaura*, *Bufoniceps*, *Phrynocephalus, Sitana, Trapelus* (four species) and *Saara* (*Uromastyx*), (Daniel 1983; Khan 2006).

Short tail, docile sluggish habits; homogenous vertically arranged broad, strongly mucronate, keeled scales; distinct round tympanum; sharp canthus; long weak limbs and small weak claws; and three-row blotched dorsal pattern, make *B. minor* distinct from its sympatric agamids. Granular body scales and spiny tail separate *Saara hardwickii* from sympatric lizard. However, following combination of characters, key out *Brachysaura minor*:

1. Body slightly depressed……..…….....….2
Body laterally compressed……..... *Sitana ponticerina*

2. Tympanum large, round ……...……3
Tympanum small indistinct, slit..... ..... *Bufoniceps laungwalansis*

3**.** Tail equal or shorter than body……..... ..... *Brachysaura minor*
Tail much longer than body…….…..... .....… *Trapelus agilis, Trapelus megalonyx*

Sexual dimorphism and reproduction: *Brachysaura minor* female is larger than male, has prominent pendulous abdomen; becomes bright crimson during breeding season (July-August), with dusky olive to light brown back, and a deep black shoulder fold (Fig. 3). Sexually excited female seeks attention of male by her body movements. Cockburn (1882) observed a receptive female "taking decided advances on an unconcerned male, by siding up to him in a most insinuating way by crouching wriggling motion of her body, and ceasing him by its nuchal crest." 4-6 eggs with hard white shell are laid in burrows in the roots of vegetation. Male is comparatively smaller with narrower shorter belly, longer tail, swollen at the base with distinct hemipenial protuberances. Uniform dusky dorsum with smaller blotches (Fig. 1).

Habits: *Brachysaura minor* is crepuscular, diurnal (though some authors regard it nocturnal, a habit unusual for an insectivore agamid). It is seen picking insects around at mid-day. The lizard is stupidly docile, when approached it freezes, staring in the eyes of the trespasser, moves sluggishly away, is easily get caught, emits a short squeak, lunges with wide opened mouth; its bite is a slight pinch, maxillary teeth being small and tricuspid. It does not excavate its burrow, mostly retreats under stones etc., or creeps into unused burrows of sympatric lizards like *Saara hardwickii* and rodents. During monsoons (July-August) it comes out in great numbers to feed and mate. Brightly colored females are actively involved in mating rituals as compare to male. Cockburn (1882) reports *B. minor* and *Sitana ponticerina* of having common habits of hanging upside down from branches of low bushes of *Calotropis* and *Zizyphus*, similar habit has been noted in *Calotes versicolor* while in Karachi, Pakistan.

Food: The lizard feeds on different kinds of arthropods, beetles, termites, centipedes, scorpions, spiders, caterpillar, grubs, termites, ants, grasshoppers, and butterflies etc., however, Chakraborty and Gupta (2009) reported seeds in its diet.

Habitat: Gujarat state is one of the most diversified states in India with respect to ecology and biodiversity. Different types of habitats from dry desert to moist deciduous forests, and seashore along coastal islands with mangrove forests and mud flats are available. Kachchh district covers an area of 45652 km^2 which is about 24% of the total area of Gujarat State. The district falls in the arid tract of Gujarat. The district has a tropical monsoon climate and the annual average precipitation is 340 mm. The average rainfall ranges between 266-417 mm, being very erratic (Babbar *et al*., 1994).

Environment of this region is conducive for several groups of animals, particularly reptiles, which are well

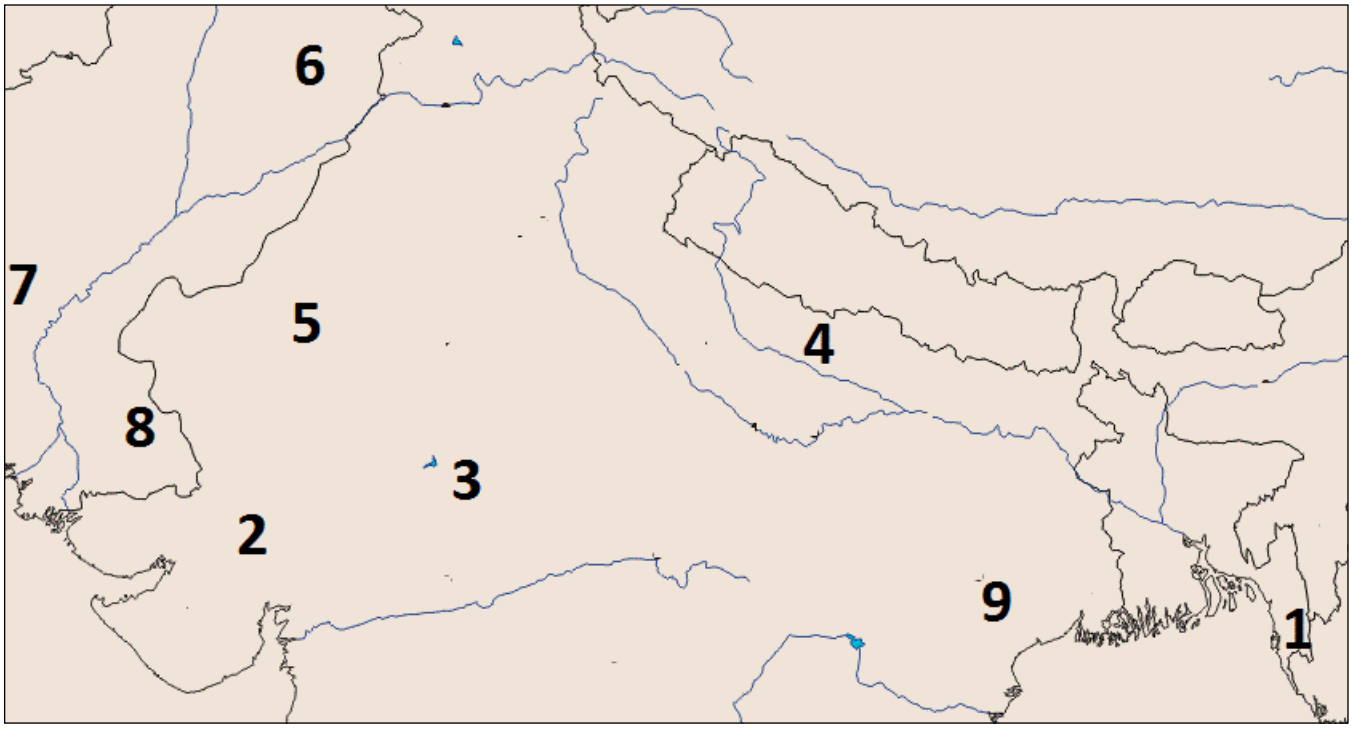

Fig. 6. *Brachysaura minor*: Distribution range

1. Chittagong, Type locality (Smith, 1935)
2. Gujrat state: Kachchh District (Boulenger 1890, Narayan Sarovar Sanctuary (Vyas 2002); Kathiawar (Smith 1935)
3. Madhya Perdesh (Tikader & Sherma 1992; Sharma 2000, 2002; Das 2002)
4. Banda, Saugor, Ratlam, Allahabad, Uttar Pradesh; , India (Cockburn, 1882; Smith, 1935)
5. Baran, Eastern Rajasthan (Vyas 1998)
6. Rabwah, District Chiniot, Punjab, Pakistan (Khan 1972, 2006; Khan & Mirza 1977)
7. Mastung, Kalat, Balochistan, W. Auffenberg Collection (Florida Natural History Museum (Zoological Survey Dept. collection, 1990)
8. Ranikot, District Dadu, Sindh, Pakistan (W. Auffenberg Collection (Florida Natural History Museum (Zoological Survey Dept. collection, 1990)
9. Satkosia Sanctuary, Orissa (Chakraborty & Gupta 2009)

documented in literature (Stoliczka 1872; Bhaskar 1978; Auffenberg *et al.*, 1990; Akhtar and Tiwari 1991; Vyas 1998). *B. minor* is recorded from diverse habitats: rocky with scrubby vegetation; sand mixed rocky areas with stunted tufts of grasses; dark lava soil with scrub; stony sandy soil with stunted scrub vegetation, thorn fields in subtropical temperate environs, with extremes weather conditions in the Indo-Gangetic plains (Fig. 4).

Status: Though Chittagong (south eastern Bangladesh) is believed to be the type locality of *B. minor*, which is very unlikely because of environment and no subsequent specimen has been recorded from the area. However, the lizard is reported from several other localities throughout the Indo-Gangetic plains (Fig. 6), pushing this species among most wide raging lizards in the subcontinent. It is significant to note that single or few specimens have been recorded from each locality, perhaps because of secretive habits of this lizard. However, Cockburn (1882) found it abounding in Banda, and Vyas (2000, 2002) in Narayan Sarovar sanctuary, Gujrat, India. It is stated to be rare in southern Rajasthan (Vyas and Singh, 1998). Chakraborty and Gupta (2009) reported one road killed and observed three live specimens in Satkosia wildlife sanctuary, Orissa. This report widens range of *B. minor* to south-eastern India (20° 09′ N 85° 30′ E).

Docile sluggish disposition of *Brachysaura minor* makes it vulnerable to the increasing anthropogenic activity around its natural habitat, especially when it is considered poisonous by general public and is killed at sight (Minton, 1966: 89). In nature its docility makes it highly vulnerable and easy prey to a battery of local diverse carnivores: dogs, cats, mangoes, foxes, jackals, falcons, monitor lizards, and snakes etc., so common and hungry in desert habitat. Incidentally its breeding season coincides with sowing season of major crops in the region, when it is unscrupulously killed in large numbers.

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