

well as reduce the overall cost of manufacturing. Our results show that PNF is economical, stable, and can have a long-lasting effect on crops.

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Distribution and conservation status of the western tragopan *Tragopan melanocephalus* in Jammu and Kashmir, India

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In India, western tragopan is reported from Jammu and Kashmir (J&K), Himachal Pradesh and Uttarakhand. We documented the current status and distribution of western tragopan in J&K. We also predicted its potential distribution in the state. We used literature, field surveys and semi-structured questionnaire surveys to ascertain the distribution and conservation status of the pheasant species in J&K. Between 2007 and 2011, we conducted counts of western tragopan in five areas: Tattakuti Wildlife Sanctuary, Khara Galli Conservation Reserve (CR), Limber Wildlife Sanctuary (WLS), Lacchipora WLS and Kazinag National Park (NP) to assess its current status. We estimated 113 callers of western tragopan from Kazinag NP, Limber WLS, Lacchipora WLS, Tattakuti WLS and Khara Galli CR. We also discovered four new sites – Tattakuti WLS and Khara Galli CR (through direct surveys), Noorpur Galli and Narian-Ratannard (through secondary surveys) – of this species. We have confirmed the presence of western tragopan in Lacchipora WLS and re-confirmed its presence in Padder, Bhadarwa and Sudh Mahadev. Our habitat model predicted potential distribution of western tragopan, adding few additional potential sites. There is an urgent need to plan long-term monitoring and initiate appropriate measures to conserve the species.

Keywords: Conservation status, distribution, hunting, *Tragopan melanocephalus*.

WESTERN tragopan *Tragopan melanocephalus*, a threatened pheasant species¹, is endemic to the Western Himalaya². Its distribution ranges from northwestern Pakistan³ through Kashmir⁴ into Himachal Pradesh (HP)⁵ and possibly the western parts of Uttarakhand⁶. The current global population of western tragopan is reported to be between 2500 and 3500 individuals⁷, although earlier studies estimated it to be around 5000 individuals². The major reasons for its global decline are habitat degradation and

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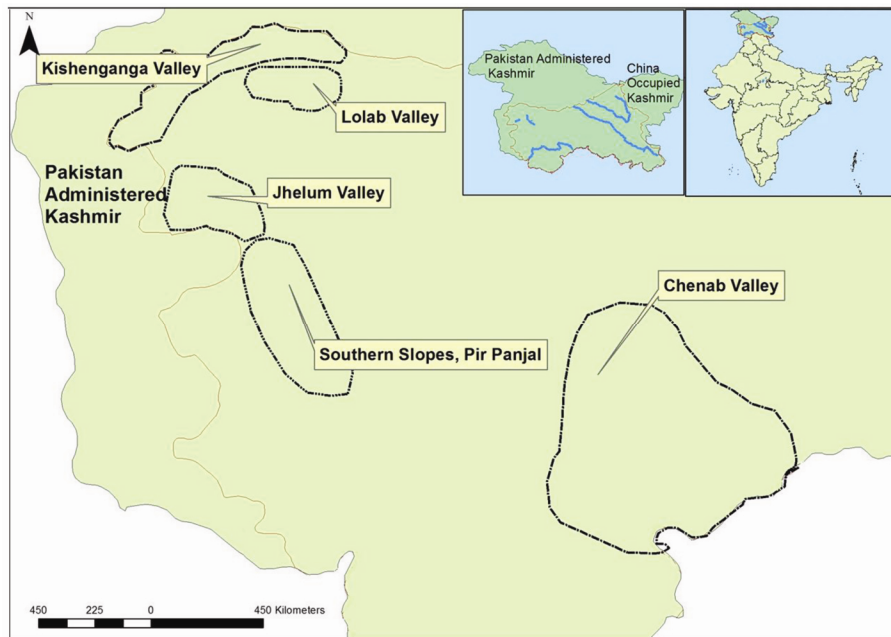


Figure 1. Study sites for the presence of Western tragopan marked in purple colour.

fragmentation, livestock grazing, fuelwood collection^{8,9}, disturbance by graziers and mushroom collectors^{8,10,11}, hunting and trapping for meat¹², and decorative plumage¹³. It is listed as Schedule 1 species in the Wild Life (Protection) Act of India, 1972.

In recent years, previously unknown populations of western tragopan were discovered from Limber Wildlife Sanctuary (WLS) in Jammu and Kashmir (J&K)¹⁴, and Chamba and Garhwal regions of HP and Uttarakhand respectively^{6,9,15,16}. In J&K, the surveys were carried out only in Limber WLS and Kishtawar region^{14,17}. Surveys reported a population of 60–80 individuals from Limber WLS¹⁷.

In J&K, historically, western tragopan has been reported from Rampur, Uri, Keran and Lolab areas, and also the southern slopes of the Pir Panjal Range⁷. Records of western tragopan have also been obtained from Kishtawar (part of which is now the Kishtawar National Park (NP), Padder⁷ and Bhaderwah⁸, which fall in the Chenab Valley of the state. In this communication, we present the current distribution and conservation status of western tragopan in J&K. We also model its potential habitats in major valleys based on current records of the species.

This study was conducted in J&K, which is located at the confluence of three bio-geographical realms, viz. the Trans Himalaya (1A), Northwest Himalaya (2A) and Semi-arid Plains (4A), and is thus biodiverse. Our study sites were in the Kashmir Valley and Jammu region of the state (Figure 1). The study area mainly covered the temperate regions of Jhelum, Chenab and Lolab valleys and the Pir Panjal Range of mountains.

We conducted surveys at five sites – Lacchipora WLS (34°07′–34°14′N and 74°0′–74°06′E), Limber WLS and Kazinag NP in the Jhelum Valley, and two areas in the

Pir panjal Range, i.e. Khara Galli (33°50′–33°55′N, 74°25′–74°30′E) and Tattakuti (33°40′–33°45′N and 74°25′–74°30′E). We also collected secondary information about presence of the species in the Chenab Valley (Kishtawar, Padder Valley, Doda and Bhaderwah), Pir Panjal (Noorpur Galli, Sanwjian-Narian, Sudh Mahadev), and Jhelum Valley (Rampur-Bunyar).

Tattakuti (66 sq. km), Khara Galli (20 sq. km), Sudh Mahadev (142 sq. km), Noorpur Galli and Sanwajian-Narian lie along the southern aspect of the Pir Panjal Range in the Jammu division (Figure 1). Kazinag NP (89 sq. km), Lacchipora (40 sq. km) and Limber WLS (26 sq. km) are located in the Jhelum Valley of Kashmir and occur close to the Line of Control with Pakistan.

The study area is dominated by conifer forests, although broadleaved and mixed forest, sub-alpine and riverine scrub, and alpine meadows are also found. Blue pine *Pinus wallichiana* and fir *Abies pindrow* are the dominant species in coniferous forests, whereas birch, *Betula utilis* is the dominant broadleaved species. Juniper *Juniperus squamata*, and *Salix* spp., *Rhododendron* spp. and *Lonicera* spp., are the major shrub species in the sub-alpine and alpine areas.

The entire area is steep and interspersed by precipitous cliffs. At the middle and lower elevations and along the riverine valley, broadleaf tree species such as maple *Acer caesium*, horse chestnut *Aesculum* spp. and walnut *Juglans regia*, and shrub species such as *Viburnum contitifolium*, *Spirea* spp. and *Indigofera heterantha* are the dominant vegetation.

During summer months (May–September), locals and nomads (Gujjars and Bakkarwals) use these areas for grazing their livestock. They also harvest fuelwood,

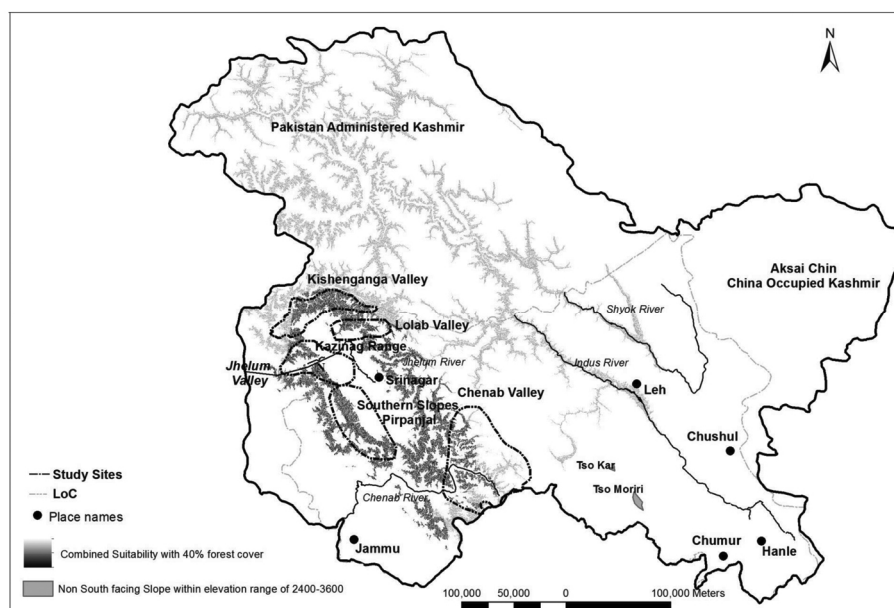


Figure 2. Potential Western tragopan habitats in and around the major valleys of Jammu and Kashmir, India as predicted by habitat modelling based on suitable altitude, aspect and vegetation cover.

mushroom and medicinal plants from the areas where they stay with their livestock. Locals also collect edible mushroom and fodder from these areas.

We followed multiple approaches to assess the current status of western tragopan in J&K. After understanding the historical distribution of the species in the state from the past literature², we collected secondary information from most of the historical and other potential sites. This was done by conducting 54 key-informant interviews in Lacchipora ($n = 12$), Tattakuti ($n = 14$) and Khara Galli ($n = 11$), Sanwajian-Narian ($n = 4$), Noorpur Galli ($n = 4$), Chenab Valley ($n = 8$) and Lolab Valley ($n = 3$). Based on these interviews, we established the current status of tragopan in these areas. We also conducted counts of western tragopan in many of the identified sites (Kazinag, Limber, Lacchipora, Tattakuti and Khara Galli protected areas (PAs) during its breeding season using the call count method^{3,18,19}.

Call count is an easy and reliable method for estimating relative abundance of vocal species of pheasants across the globe and especially in the Himalaya. This technique has been used successfully for western tragopan in Pakistan^{3,18}, Satyr tragopan in Nepal²⁰, Satyr tragopan in Darjeeling^{21,22}. The method is based on prior knowledge that during the breeding season, males vocalize to advertise their presence and defend territories²³. The calls are distinctive and each calling location is assumed to represent a calling male. Since the birds may not be visible, it is not known whether the calling bird (usually male) is accompanied by any other birds (usually females). Thus, usually a call location is referred to as a calling group.

For the present survey, three teams (two people in each team) were constituted with prior experience in such surveys. At each site, the team was stationed at pre-selected vantage points to detect and count the tragopan calls and callers. We placed these observers about 500 m apart as a tragopan call can be heard easily over this distance. The call count was terminated each day after an observer had spent 30 min at the observation point after hearing the first call. This was done to avoid double counting the caller, since the birds tend to approach adjacent callers and thus change positions after the initial calling from their roosts. Once the call was heard, the following information was collected: time and compass direction and approximate distance of the call. Later in the day, we confirmed and recorded the locality, aspect and vegetation types. Since birds may not call each morning, each observer recorded calling from the same point for three successive mornings before moving to the next location, to give a good chance for most birds to be recorded by the observer. Data were pooled for all observers for a morning and the number of calls heard for that particular morning was obtained. We eliminated the possibility of double counts by carefully cross-checking, with the neighbouring observer, the direction and time of the calls and the locality from where the call was heard. Finally, the highest number of birds heard on any given morning was considered as the minimum number of birds calling in that area. It is assumed that the male : female ratios is 1 : 1, but we refrained from providing estimates for the total number of birds. We have instead calculated the number of calling groups heard from each site and have used this as a relative index of measure. Calling

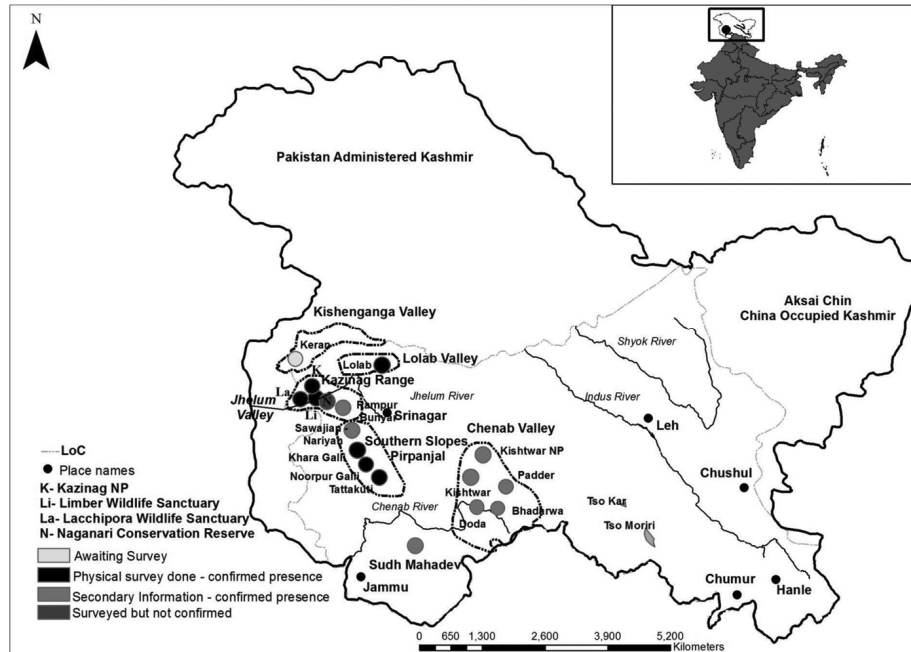


Figure 3. Current status of Western tragoan in the major valleys of Jammu and Kashmir, India revealed through direct and secondary information.

Table 1. Estimates of number of groups heard in the sites surveyed and number of calling stations. The localities from which the calls of tragoan were heard are also mentioned

Sites surveyed	No. of groups heard	No. of calling stations
Kazinag NP	59	15
Lacchipora WLS	5	3
Limber WLS	13	9
Tattakuti WLS	16	6
Khara Galli CR	20	6

NP, National Park; WLS, Wildlife Sanctuary; CR, Conservation Reserve.

group is the number of birds recorded calling by a team from a vantage point during one visit.

A coarse habitat suitability model was developed using the following parameters: elevation (2400–3600 m), aspect (non-south-facing slope) and vegetation (more than 40% forest cover). The elevation data were obtained from SRTM data having a resolution of 90 m. Using these data, slope followed by aspect was generated and used for the model. The forest cover map was downloaded from global forest cover site and resampled to 90 m. Various categories of forest cover such as ‘40% and above’, ‘20%–40%’, etc. were prepared and included in the model. Figure 2 shows the result of the habitat suitability model. In this method, the three mentioned parameters were given the highest rank and other parameters such as slope, land use, etc. were assigned the lower ranks. Since the species and its habitat occur in a vast expanse, additional parameter of vegetation (20%–40% forest cover)

within the elevation range 2400–3600 m was overlaid on the model result to obtain the probable habitat of western tragoan¹⁸.

Call counts confirmed the presence of western tragoan from Kazinag NP, Limber WLS, Lacchipora WLS, Khara Galli Conservation Reserve (CR) and Tattakuti (proposed) WLS. In all, we heard 113 calling groups of western tragoan from 39 observation points, giving an average of 2.60 ± 0.47 per calling point (59 from Kazinag NP, 13 from Limber WLS, 5 in Lacchipora WLS, 20 in Khara Galli CR and 16 in Tattakuti WLS) (Tables 1 and 2).

Apart from the Kazinag area, we documented the presence of western tragoan in Tattakuti WLS and Khara Galli CR through direct surveys, and Noorpur Galli and Narian-Sanwajian areas through information generated from secondary sources. The species has also been recently sighted in Doda area of Chenab Valley (Muzafer Kitchloo, pers. commun.) In addition, we reconfirmed the presence of western tragoan in Padder, Kishtwar, Bharderwa, Sudh Mahadev and Rampur-Bunyar from secondary sources (Figure 3). Secondary information gathered during the study suggests that the tragoan has either become locally extinct in Lolab Valley or has declined drastically (Figure 3). We could, however, not get information about the historical site of Keran in the Kishenganga Valley.

The habitat modelling indicated that there are more core spots of potential western tragoan habitat in J&K as highlighted by rule-based modelling approach (Figure 2). The total western tragoan potential habitat in J&K is

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Table 2. Areas of western tragopan with call count locations, caller male estimates and habitat types from which the calls were heard. Moderate conifer consists of conifer trees with tree cover between 20% and 40%, Mix forest consists of conifer and broadleaf trees. Dense forest indicates forest cover more than 40%

Site	Locality	Vegetation type	Call count location	Latitude	Longitude	Number of calls			Highest count for a morning
Kazinag NP	Gujjar Nalla	Moderate conifer, dense mixed forest	Trinari	34°13'24.35	74°5'39.67	2	2	2	15
			Sabainadij	34°13'13.25	74°5'58.13	2	1	2	
			Mohribahak	34°13'37.30	74°5'49.39	4	5	4	
			Bun bahak	34°13'43.81	74°5'6.46	3	3	4	
			Hamadon	34°14'8.27	74°5'25.89	3	3	3	
	Malangan Nalla	Dense mixed forest, moderate conifer	Anadab	34°12'41.13	74°3'33.22	2	2	6	6
	Methwani/Viji Nalla	Moderate conifer, mix moderate	Lachidona 1	34°13'29.27	74°9'35.75	4	3	nd	14
			Lachidona 2	34°13'34.99	74°9'37.90	3	4	nd	
			Methwanibahak 1	34°13'34.50	74°9'23.52	8	5	nd	
			Methwanibahak 2	34°13'40.59	74°9'14.43	8	2	nd	
			Kumdinad	34°13'5.29	74°8'12.07	3	2	2	
	Gamalitter Nalla	Mix moderate, moderate conifer	Bapal	34°14'0.88	74°8'6.20	3	2	1	11
			Khallipaddi	34°13'38.23	74°7'58.21	5	4	4	
			Hokhyan	34°13'8.90	74°7'55.05	4	3	3	
	Thulthulan Nalla	Open conifer, mix moderate, moderate conifer	Semikan	34°13'4.98	74°7'37.16	3	5	3	13
Bod dranne			34°13'5.46	74°7'25.23	6	2	2		
Total callers								59	
Lacchipora WLS	Malangan Nalla	Moderate conifer Dense mix	Norzodon	34°12'37.43	74°4'15.45	1	2	2	5
			Balapud	34°13'4.49	74°3'31.81	2	3	3	
	Total callers							5	
Limber WLS	Brathjan/Kanzaldara	Moderate conifer, mix moderate	Point 1	34°12'28.98	74°8'1.43	1	1	nd	7
			Point 2	34°12'23.91	74°7'56.89	rn	1	nd	
			Point 3	34°12'16.63	74°7'55.61	rn	2	nd	
			Point 4	34°12'7.41	74°8'7.84	rn	3	nd	
Sari	Open conifer, mix moderate, moderate conifer	Sari pajja	34°11'36.13	74°8'28.63	1	1	nd	2	
		Sari rechal	34°11'31.79	74°8'35.09	1	1	nd		
Gratenad	Mix moderate, moderate conifer	Kawchi	34°13'22.41	74°9'55.30	0	0	0	4	
		Kotherpal	34°13'24.43	74°9'48.10	2	1	1		
		Burzapather	34°13'29.01	74°9'50.88	2	1	2		
Total callers							13		
Tattakuti WLS	Hingli	Moderate conifer, dense mixed forest	Hingli	33°38'46.31	74°28'15.00	3	3	3	9
			Hingli-gass	33°38'51.46	74°27'50.32	3	2	3	
			Hingli-tarkana	33°39'8.48	74°27'50.21	2	2	2	
	Kalamund	Dense conifer, mixed forest	Bagla	33°39'60.00	74°26'18.80	1	1	1	7
			Kalamund	33°40'9.15	74°26'30.59	5	3	4	
Total callers							16		
Khara Gali CR	Dorian Hoi	Moderate conifer, dense mixed forest	Doria	33°52'0.47	74°20'47.99	3	4	4	6
			Hoi	33°51'48.14	74°21'18.25	2	2	2	
	Godenuk	Moderate conifer, dense mixed forest	Pathra	33°51'31.43	74°22'19.16	2	2	3	9
			Godenuk	33°51'31.43	74°22'18.86	3	5	4	
	Domail		Godenukbahak	33°51'13.25	74°22'22.76	1	2	1	
Total callers		Domail	33°51'2.77	74°22'39.72	2	4	3	4	
								19	

Nd, Not detected; rn, Raining; CR, Conservation reserve.

about 7087 sq. km, of which only 156 sq. km is under PA network, and the rest outside.

The distribution of western tragopan in J&K fits the general global distribution pattern across the Western Himalaya. Extant presence of this species has been reported across the Line of Control with Pakistan to the west, and our distribution fits largely the pattern observed by Awan *et al.*¹⁸. However, our model predicts

suitable habitats in the Greater Himalayan Mountains to the north of the Kashmir Valley, but there are no historical records from these areas other than those in the Lolab Valley. Perhaps, more surveys need to be undertaken in this region.

This study confirms the presence of western tragopan in Tattakuti (proposed) WLS, Khara Galli CR, Noorpur Galli and Sanwajian-Narian in the Pir Panjal Range, and

reconfirms presence of the species in Lacchipora WLS and Rampur-Bunyar in Jhelum Valley. Secondary information reveals that tragopan still survives in quite a few sites in the Chenab Valley. This is an indication that the Pir Panjal Range, Jhelum Valley and Chenab Valley are the potential tragopan distribution areas in J&K. The Kishenganga Valley, a historical tragopan site, needs to be explored.

Looking at the global status of western tragopan, J&K is one of the strongholds for the species. The modelling of habitat also showed that there is a reasonably good potential tragopan habitat in the state, although its presence needs to be confirmed through field surveys. Only a small portion of this potential habitat falls under the PA network, and thus more such habitats need to be included in the PA network for long-term conservation of the species. This may be due to the rugged and remoteness of the tragopan areas¹⁸, but it is also because of the insurgency for last more than two decades which made surveys of these areas extremely difficult.

Except the Jhelum Valley, the other two strongholds, i.e. the Pir Panjal and Chenab Valley are poorly protected. Thus large-scale hunting could result in local extinction of western tragopan, particularly in the Pir Panjal and Chenab Valley, and if not contained now, its population may become locally extinct. All the tragopan sites are being used for livestock grazing and collection of Non Timber Forest Produce, resulting in disturbance and degradation of the tragopan habitat and thus threatening its survival.

The restricted global distribution of tragopan with its declining trend and threatened status makes every single population of western tragopan globally important. This study marks the beginning, after insurgency, to explore more populations of western tragopan and collect baseline information for conservation planning. With baselines now established in quite a few of the sites, future monitoring should detect changes, if any, and take appropriate measures to conserve these populations.

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