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Current distribution and conservation status of Bhutan Takin *Budorcas whitei* Lydekker, 1907 (Artiodactyla: Bovidae)

Tiger Sangay [1], Rajanathan Rajaratnam [2] & Karl Vernes [3]

[1] Ugyen Wangchuck Institute for Conservation and Environment, Lamai Goempa, Bumthang, Bhutan
[2] Geography and Planning, University of New England, Armidale, NSW 2351, Australia
[1,3] Ecosystem Management, University of New England, Armidale, NSW 2351, Australia
[1] sangay@uwice.gov.bt (corresponding author), [2]rrajarat@une.edu.au, [3]kvernes@une.edu.au

Abstract: The Bhutan Takin *Budorcas whitei* Lydekker, 1907 is endemic to Bhutan and it is categorized as Vulnerable by the IUCN Red List of Threatened Species. While the other Takin species have been studied in China (Golden Takin *B. bedfordi*; Sichuan Takin *B. tibetana*) and India (Mishmi Takin *B. taxicolor*), only one study has focused on the Bhutan Takin. In this paper, we report the current distribution and conservation status of the Bhutan Takin using the information gathered through field surveys, interviews and unpublished reports. Bhutan Takin are seasonal migrants, occurring between 1500–5550 m, preferring areas in close proximity to river valleys and geothermal outlets (hot springs). Takin avoid areas that are disturbed by road construction and power transmission lines, and where they have to compete for forage with domestic livestock. Takin conservation in Bhutan requires: (1) a commitment to reduce disturbances from domestic livestock through better herding and animal husbandry practices, (2) environmentally friendly road construction, inclusive of wildlife corridors, (3) establishment of satellite offices and regularizing anti-poaching patrol systems, (4) development of education programs to enlist support for Takin conservation, and (5) encouragement of more research on the ecology and management needs of the species.

Keywords: Bhutan, *Budorcas*, conservation, habitat, migration, Takin.

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Author Details: Tiger Sangay is a PhD student at the University of New England (UNE), Australia, and works for the Ugyen Wangchuck Institute for Conservation and Environment, Bhutan. He is interested in large mammalian ecology and biodiversity conservation in the Himalayan region. Rajanathan Rajaratnam is a biogeographer at UNE, with research experience and interest in small carnivores, primates and biodiversity conservation within the agricultural landscape of Borneo, as well as research experience on mammals in Bhutan. Karl Vernes is an Associate Professor in wildlife ecology and conservation at UNE, with research interests in mammal ecology and conservation. He has worked on a diversity of mammals in Canada, Australia and Bhutan.

Author Contribution: TS: obtained funding, designed the study, analysed data, and prepared the manuscript. RR & KV: helped design the study and prepare the manuscript. All authors read and approved the final manuscript.

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INTRODUCTION

The Takin *Budorcas taxicolor* (Hodgson, 1850) is a threatened forest-dwelling bovid native to the temperate and subtropical forests in eastern Asia. It primarily occurs in Bhutan, China, northeastern India, and northern Myanmar (Neas & Hoffmann 1987; Shackleton 1997) with four extant subspecies previously described (Fig. 1). Each of these four subspecies is now considered a full species (Groves & Leslie Jr. 2011). The Golden Takin *B. bedfordi* and the Sichuan Takin *B. tibetana* are both confined to China. *B. bedfordi* occurs in southern Shaanxi while *B. tibetana* is distributed southerly from the Sichuan-Gansu provincial border to the border with Yunnan Province (Song et al. 2008). The Mishmi Takin *B. taxicolor* ranges from southeast Tibet to the north-western Yunnan in China, with the central part of its range occurring in Arunachal Pradesh (India) and northern Myanmar (Song et al. 2008; Dasgupta et al. 2010; Mahar et al. 2011). The Bhutan Takin *B. whitei* distribution is mostly in Bhutan with records also from Xizang in China and Sikkim, and Arunachal Pradesh in India (Song et al. 2008; Groves & Leslie Jr. 2011).

The Takin is a socially aggregating generalist herbivore that migrates between sub-tropical forests as low as 700m in winter to sub-alpine regions up to 5,550m in summer (Smith & Xie 2008; Sharma et al. 2015). Migratory routes often traverse several transitional vegetation types at mid-altitudes ranging from conifer forests to broad-leaved forests. These varied habitat types are sources of an equally diverse diet for the Takin that comprises grasses, herbs, bamboo, and the leaves of shrubs and trees. For example, the diet of Takin in China has been shown to comprise 138 plant species (Schaller et al. 1986) and 161 plant species for the Golden Takin (Zeng et al. 2001) while Bhutan Takin in Jigme Dorji National Park (JDNP) consumes at least 68 different plant species (Wangchuk 1999).

Mineral supplements are critical for the Takin's growth as they are for other bovids, forcing herds to travel great distances to reach mineral licks. These herds congregate in large numbers—about 100–200 individuals at these licks—often remaining there for several days (Ali & Santapau 1959; Neas & Hoffmann 1987; Smith & Xie 2008; Sharma et al. 2015).

Because Takin are poorly studied, there are no reliable estimates of their global population size. Of the four species, the Golden Takin has been best studied with regard to population, and its population size is estimated at between 1200–1300 animals (Schaller 1985; Shackleton 1997), although other authors (Zeng et al. 2002; Ma & Wang 2008) report higher numbers of between 3,000 and 5,500 animals. Several thousand Sichuan Takin are thought to inhabit the Qionglai and Min Mountains (Schaller 1985; Shackleton 1997) while the Mishmi Takin's population is estimated at about 3,500 animals in China (Song et al. 2008) and about 220-300 animals in India (Dasgupta et al. 2010; Mahar et al. 2011); while the best estimate of the Bhutan Takin population size in Bhutan is 500–700 animals (Sharma et al. 2015). Based on these various estimates, there are approximately 7,000–12,000 wild Takin across the range of the four recognized species.

The IUCN Red List of Threatened Species (version 2012.2) lists the Takin as Vulnerable (A2cd) based on a probable population decline of at least 30% over the last three generations, which equates to approximately 24 years (Song et al. 2008). In China, all Takin species are listed as Class I species under the National Wildlife Law (1988) which prohibits the hunting of wildlife species that are rare or facing extinction (PRoC 1989). In India, the Takin is listed under Schedule I of the Indian Wildlife (Protection) Act (1972), which bans the hunting and trade of listed animals (GoI 1972). In Bhutan, the Takin is totally protected under Schedule I of the Forest and Nature Conservation Act of 1995 (RGoB 1995), and it is the national animal of Bhutan.

Although legislatively well protected, the Takin faces many threats throughout its range. Despite stringent protective legislation, Takin are hunted illegally for trophies and meat in India (Mishra et al. 2006; Aiyadurai et al. 2010; Dasgupta et al. 2010; Mahar et al. 2011). Furthermore, habitat throughout the Takin's range has been lost to deforestation and habitat disturbance. The Bhutan Takin is also seriously threatened through competition for grazing habitat with domestic livestock, and the potential for interspecific zoonotic disease cross transmission (Shackleton 1997).

This paper reports the distribution and conservation status of the Takin in Bhutan and makes recommendations for appropriate conservation measures. Our review, which is the first to focus on the Bhutan Takin, lays the foundation for a dedicated conservation and management programme in Bhutan.

METHODS

We assessed the distribution and status of the Bhutan Takin from British expedition reports, contemporary biodiversity field surveys and management reports, and interviews with the rural residents and public servants

of JDNP in early 2015. These interviews revealed information on the Takin's locational data, residents' knowledge and perception of the Takin, as well as cultural significance and conservation threats. Residents (n=170) from diverse occupational groups (farmers, yak herders, public servants and school children) were interviewed in the Laya Geog within the Takin's summer habitat, and from the Khatey and Khamey Geogs within their winter habitat (Fig. 2).

RESULTS

Distribution and habitat association

Takin historically ranged throughout the northern territories of Bhutan, resulting in the Royal Government in 1974 declaring three protected areas in the north of the country: Laya Wildlife Sanctuary, Gasa Wildlife Sanctuary and Jigme Dorji Wildlife Sanctuary in 1974 (MoTIF 1974). These protected areas were later consolidated as the Jigme Dorji Wildlife Sanctuary (MoTIF 1974; Wollenhaupt 1990) before being designated as Jigme Dorji National Park in 1993 (Fig. 2). Takin are present in the valleys of Bhutan's major rivers (Fig. 2) (Wangchuk et al. 2008), and associated with hot springs in Bhutan notably Tsharijathang (Wangchuk et al. 2008) (Fig. 2; Image 1), and monasteries which are located in remote rural areas (Fig. 2).

Takin also frequent natural salt lick sites such as Shingju in Laya and Ralam in Lingzhi (Sharma et al. 2015) (Fig. 2). Takin have been historically known from the Pemaling area in Tashiyangtse (Fig. 2), but because there are no hot springs or salt licks in the area, it is unlikely that a resident population of Takin can be supported (Jigme Wangyal, District Forest Officer, Tashigang District, pers. comm. 21 July 2011).

Takin have strongly featured in the popular Bhutan myth of divine cloning by the 'Divine Madman' Lam Drukpa Kuenley, reinforcing the Takin's cultural and religious significance in Bhutan. Although Takin are shy animals and prefer to inhabit remote areas away from high density human habitation (Sharma et al. 1995), they are often recorded near Buddhist sacred sites such as monasteries which offer protection (Fig. 2).

Development activities have possibly contributed to changes in the movement patterns of migrating Takin. Takin have been recorded in new areas such as the Dochula pass (Tenzin Phuntsho, Environmental Educator, pers. comm. 28 September 2011), and in Phrumsengla National Park, where they were first captured by a camera trap in 2011 (Wangchuk 2011)



Image 1. A herd of Bhutan Takin utilizing the mineral rich hot spring at Tsharijathang, Jigme Dorji National Park, Bhutan.

(Fig. 2). They have also been recorded at Khenpajong in Lhuntse (Ugyen Tenzin, Forester, pers. comm. 12 March 2014), Mangdiphu, Gagar and Sinphu Goempa in Trongsa (Khenpo Sonam, Spiritual Monk Leader, pers. comm. 8 August 2013), while a dead Takin was recorded at 2,549m in Bjakhatap, Mangdiphu (Gem Dorji, District Forest Officer of Trongsa District, pers. comm. 21 April 2013) (Fig. 2).

The only known captive population of Bhutan Takin is at Motithang Takin Preserve, which was established as a small zoo at Motithang (Fig. 2) on the outskirts of Bhutan's capital city of Thimphu in 1979. This small (3.3ha) fenced enclosure currently houses about 31 Takin.

Awareness and conservation perception

The majority (87%; n=149) of interviewed respondents from the respective geogs (local government areas) within the Takin's summer and winter habitat were aware of the Takin's status as the national animal (Fig. 3). Also, (80%; n=139) of respondents were aware of its legislative protection and provision. Similarly, 87% of the respondents (n=149) claimed to like the Takin while 92% (n=158) strongly agreed that the Takin warranted protection because of its national significance. Attacks by Takin on people are exceedingly rare with only one documented fatal attack on a grazier in Sikkim (Sharma et al. 2015). In our study, Takin were not perceived as a threat by the majority (68%; n=117) of respondents, and none of the respondents reported any attacks.

Additionally, 81% (n = 139) of the respondents

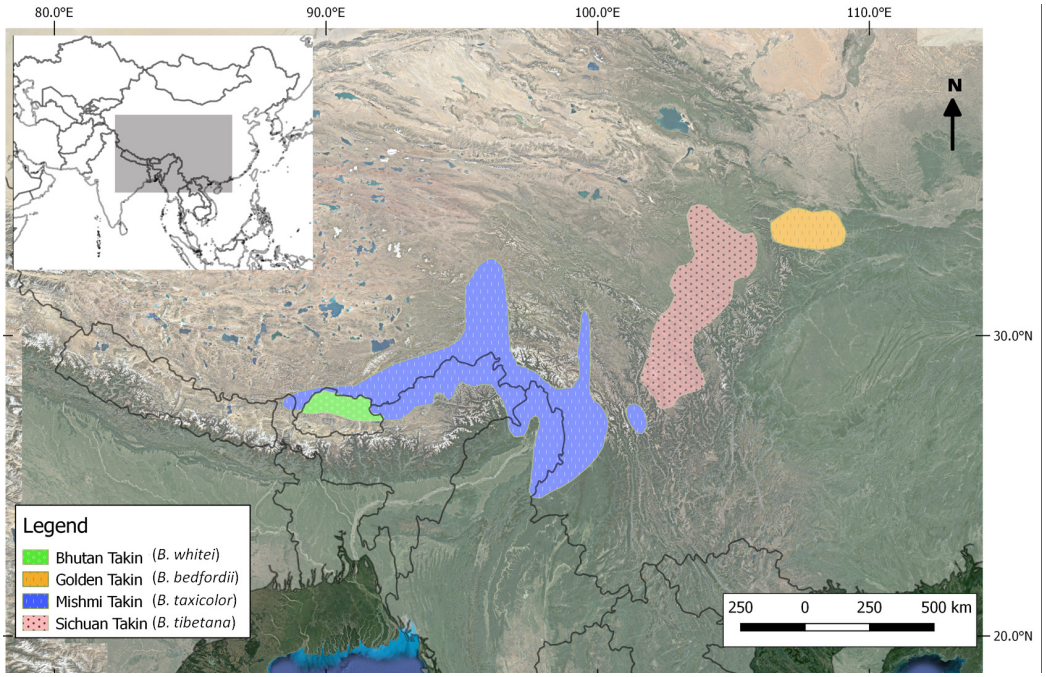


Figure 1. The current distribution of the four takin species in southern Asia.

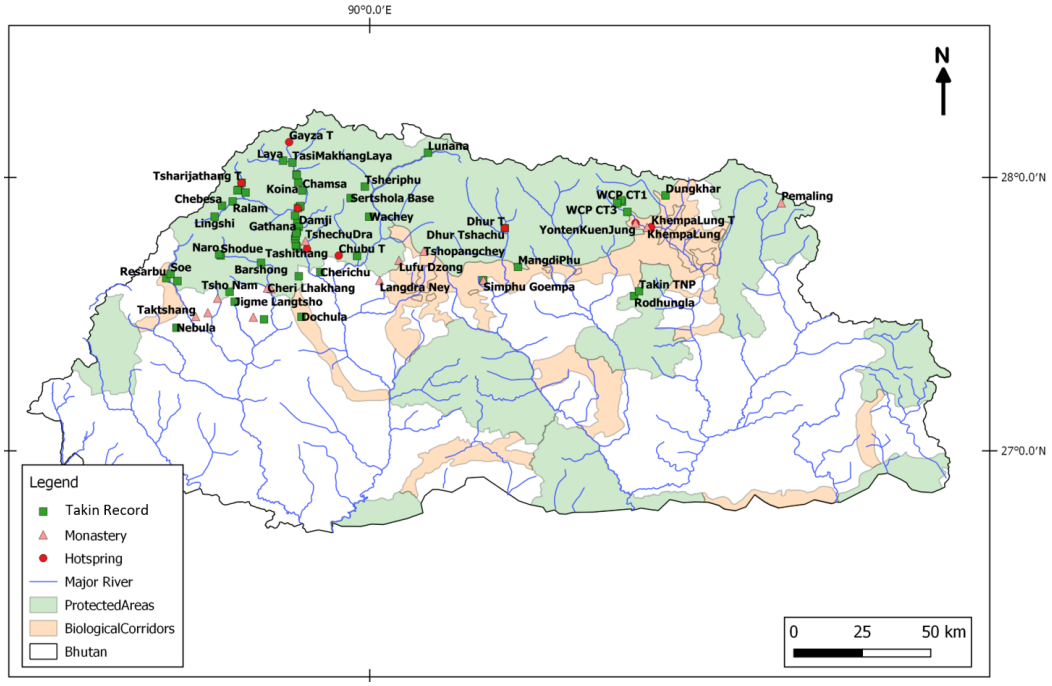


Figure 2. Current distribution of the Bhutan Takin *Budorcas whitei* along major river valleys, and in close proximity to hot springs (minerals) and Buddhist monasteries (refuge). All the point locations on the map represents either a takin or takin herd observed or reported as well as captured on camera traps in the area.

were willing to support Takin conservation measures, of which, 20% (n=36) said they would not harm or kill Takin, while 20% (n=34) advocated the protection and management of Takin habitat. A further 17% (n=29) were willing to assist conservation efforts while 15% (n = 26) were willing to support Takin conservation by becoming informants on illegal activities, and through labour contribution and awareness creation (9%, n=15).



Image 2. The alpine meadow at an altitude of 4,000m at Tsharijathang in Jigme Dorji National Park, Bhutan where Takin congregate in summer.

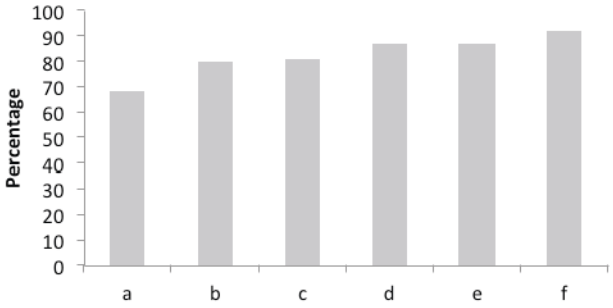


Figure 3. Degree of park residents' perceptions of the Bhutan Takin, as determined from questionnaire interviews in Jigme Dorji National Park.
a - takin perceived as not being a threat; b - aware that takin are legislatively protected, c - would support takin conservation; d - aware that the takin is the national animal; e - liked the takin; f - the takin warrants better protection.

DISCUSSION

Taxonomic Distribution

Although the Bhutan Takin was claimed to exist in Sikkim, India and it is still listed as such by the IUCN Red List (Song et al. 2008; Groves & Leslie Jr. 2011), our research uncovered this information to be incorrect. The confusion began from an event, when Tongsa Penlop of Bhutan (who later became the 1st Hereditary King) presented a Takin calf to the visiting Commissioner John C. White in 1906. The calf later died in Sikkim, India, after eating poisonous aconite (*Aconitum* sp.) and the dead Takin calf was incorrectly recorded as having come from Sikkim without specifying the true place of origin (Bailey 1907).

However, there have been two other reports of Takin sightings in Sikkim in 1995: a solitary Takin was seen walking with a flock of sheep at Padamchen, and another sighting was made of a Takin in Kyongnosla Alpine Wildlife Sanctuary (Dasgupta et al. 2010; Mahar et al. 2011). Without conclusive evidence of a resident Takin population despite these isolated sightings, Dasgupta et al. (2010) and Mahar et al. (2011) concluded that Takin are absent in Sikkim. Wollenhaupt (1990) also reported that Bhutan constitutes the westernmost range of global Takin distribution (Fig. 1).

There is also no distinct geographic boundary between the Bhutan Takin and the Mishmi Takin (Song et al. 2008; Dasgupta et al. 2010; Mahar et al. 2011) (Fig. 1). Takin have been recorded in the Tawang district of Arunachal Pradesh, India in close proximity to Bhutan's eastern border. However, these records are anecdotal, relying on indirect evidence based on footprints, dung and resting sites (Dasgupta et al. 2010), with no clear indication of species. Until the specific genetic relationship between the Bhutan and Mishmi Takin can be resolved, we consider the Bhutan Takin as endemic to Bhutan.

Disturbance and disruption to migration routes

Jigme Dorji National Park (JDNP) is considered core habitat for Takin in Bhutan (Thinley & Tharchen 2015). However, JDNP has experienced on-going disturbance from road construction since 2001 with scheduled roadwork yet to be completed. A prime example of disturbance to Takin migration is the current farm road construction from Gasa to Laya which commenced in 2014 (Wangmo 2013). As Takin are shy animals, construction activities associated with this road are likely to have disrupted Takin migration over the short term, and the completed road has the potential to impact future Takin migration (Thinley & Tharchen 2015).

Developmental activities related to road and power infrastructure have also led to the destruction of vast tracts of primary forest that serves as habitat for other wide ranging threatened Himalayan species such as Tiger *Panthera tigris*, Black Bear *Ursus thibetanus*, Musk Deer *Moschus* spp., Serow *Capricornis thar*, Goral *Naemorhedus goral*, and Wild Dog *Cuon alpinus* (Thinley & Tharchen 2015). These activities have been on-going since 2012 with no clear policy on timeline for completion. Whilst managers of JDNP have exercised vigilance over infrastructure development, it is evident that stronger policies surrounding habitat disturbance and mitigation of impacts are required for infrastructure development in Bhutan's national parks.

Impacts from domestic livestock

The JDNP park management has impressed upon park residents the importance of the Tsharijathang valley as a prime Takin sanctuary (Lhendup Tharchen, JDNP Park Manager, pers. comm. 20 February 2014) (Image 2). As a result of dialogue sessions and community consultation, JDNP park management, the local government and the local community signed an agreement to exclude domestic livestock in Tsharijathang annually from April, a month prior to the migratory Takin's arrival, until August when Takin migrate to lower elevations. However, this exclusion period overlaps the collection season for Cordyceps *Ophiocordyceps sinensis*, a highly prized medicinal caterpillar fungus that generates significant rural cash income. Consequently, livestock are left unattended and free-ranging in the valley despite this agreement.

Impacts from domestic dogs

Domestic dogs in Bhutan number about 1,16,000 individuals, of which approximately 40% are free ranging stray dogs (Rinzin et al. 2016). Takin are naturally wary of domestic dogs, and become visibly alert to the presence of a barking dog up to 500m away (Tiger Sangay, pers. obs. 5 June 2012). The Tsharijathang Valley in which Takin spend each summer has many abandoned yak herding dogs which have gone feral. Additionally Penjor (2015) reports increased predation by both feral dogs on domestic livestock in Lunana, JDNP. Free ranging dogs have been noted to chase female Takin and dependent calf into the Tsharijathang River, causing females to abandon calves.

Disease transmission

Bhutan Takin live and migrate through a landscape frequently used by domestic livestock (cows, horses, dogs and cats) in winter and share their summer alpine habitat with yaks, horses and dogs (Wangchuk et al. 2015). Accordingly, the prevalence of zoonotic diseases through exposure to domestic livestock is a notable threat (Shackleton 1997; Wangchuk et al. 2015). The issue of disease transmission in JDNP is further influenced by the fact that the locals restock their livestock from communities elsewhere in Bhutan without any screening for diseases that might be transmitted from the domestic livestock to wild Takin. For instance, Wangdi (2014) found that in the Tsharijathang Valley, yaks originating from Laya had a high prevalence of hypodermosis (warble fly infection) of up to 16%.

Other potential disease threats to the Takin include the bacterial based black quarter (*Gangraena emphysematosa*) disease, for which, an outbreak was reported in the Takin's winter habitat at the Khatey and Khamey geogs in the Gasa Dzongkhag of JDNP in 2015 (NCAH, 2015). Sharma et al. (2015) reported the presence of threadworm (*Strongyloides* sp.) in Takin fecal samples, and a blood test on Takin during our study tested positive for *Anaplasma*.

Furthermore, most yak herding dogs harbour the dog tapeworm *Taenia multiceps*. In yak and other sympatric species, the tapeworm's intermediate stage can cause *coenurus cerebralis*, a destruction of brain and spinal cord tissue that results in a neurological condition called 'gid' or 'staggers' (Wangdi 1996).

Predators

The natural predators in Takin winter habitat are Tiger, Common Leopard *Panthera pardus*, Wild Dog, and Black Bear, while Wangchuk et al. (2015) reported the presence of Snow Leopard *Panthera uncia* and Wolf *Canis lupus* in the summer habitat. In our study, we discovered two Takin carcasses resulting from bear predation at Kabina, Gasa. Both carcasses showed similar predatory characteristics of a bear, i.e., the prey's hide was rolled up toward its head as the bear progressed feeding from the hind. There was also a report of a male Takin killed by a tiger around Barshong, Lingshi (Tenzin Phuntsho, Park Ranger, pers. comm. 28 September 2011). Wangchuk (1999) has also reported up to 12 Wild Pigs *Sus scrofa* following a Takin herd at Khawza possibly in search of post-natal discard (Tendrel Zangpo, Forester, pers. comm. 16 March 2014) and sick or weak calves.

Conservation awareness

The strong awareness by JDNP residents on the national status of Takin and acknowledgement of efforts to conserve it, can largely be attributed to park management's festival-based conservation programmes on Takin, Red Panda and Mount Jomolhari (Bhutan's highest mountain). These festivals have educated residents through innovative approaches involving songs, dances (traditional and mask), plays, posters, exhibits, and flyers. These conservation awareness campaigns are underpinned by a national commitment to conserve nature and associated ecosystem services, valued at USD15.5 billion a year (Kubiszewki et al. 2013).

Recommendations

Conservation awareness

In order to increase stewardship and encourage community support for JDNP park management efforts, priority should be given to developing an information and interpretation centre for park visitors and local residents to raise awareness of JDNP's biodiversity and, in particular, the presence of the Takin, Bhutan's national animal. It is imperative that funds are secured to continue the Takin festival especially in the prominent communities of Laya, Lingzhi, Lunana, Khatey and Khame within the Takin's summer and winter habitat, where local residents have indicated their awareness and willingness to conserve Takin.

Animal husbandry

Domestic livestock in Bhutan are grazed freely and Takin share the landscape with yak, cattle, horses and dogs. As such, improved animal husbandry through better herding practices and effective corralling (Sangay & Vernes 2008; Rajaratnam et al. 2016) is needed to mitigate the threat from the cross-transmission of zoonotic diseases. The agreement to exclude livestock from Tsharijathang Valley where Takin congregate during their summer migration has been ineffective due to a lack of enforcement. Increased vigilance by JDNP personnel can be achieved through a manned satellite office at Tsharijathang during summer. This must be coupled with a stricter enforcement of existing penalties on errant livestock grazers, with a possibility of increasing the current penalty rates (USD 2.25 per animal per day) as a firm deterrent against illegal grazing. Livestock grazers should be encouraged to use the allocated grazing areas outside the Tsharijathang Valley throughout the duration of the Takin's presence during summer.

Road construction

Clear planning guidelines on road construction should be implemented in JDNP to mitigate habitat fragmentation and disruption to Takin migration routes. The Gasa-Laya farm road will specifically disrupt Takin migration routes at Chamsa, Koina, and Tongshudra. As such, wildlife corridors and relevant road construction strategies like maintaining gentler slope gradients must be implemented at these localities to facilitate the movement of Takin and other large mammals, without the construction of retaining walls where possible.

Anti-poaching issues

Anti-poaching activities should focus on known Takin summer hotspots like Tsharijathang, and the Singju and Ralam salt lick areas following discovery of illegal trapping and snaring in our study. Because summer coincides with the lucrative Cordyceps collection with a marked increase in human activity, anti-poaching should also cover known collection localities like Ridrushi, Tabdrushi, Gokula, and Chebesa. A manned satellite office at Tsharijathang during summer will facilitate adequate anti-poaching activities in addition to monitoring illegal livestock grazing.

Research

Priority research is needed on Takin population ecology focusing on demography and fecundity. Additionally, zoonotic disease hotspots in Takin habitat within JDNP must be spatio-temporally mapped to better prepare for disease outbreak through the post outbreak intervention strategies. The impact of habitat degradation from Cordyceps collection within Takin habitat must be investigated. Research on impact of feral yak herding dogs on the native wildlife at Lunana is an urgent priority.

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