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Contribution to the Theme Section 'Conservation and ecology of slow lorises'

Threats to the Bengal slow loris *Nycticebus bengalensis* in and around Itanagar Wildlife Sanctuary, Arunachal Pradesh, India: impediments to conservation

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ABSTRACT: The present study provides data collected during rescue operations involving Bengal slow loris *Nycticebus bengalensis* which were carried out opportunistically in and around Itanagar Wildlife Sanctuary, Arunachal Pradesh, India. A total of 27 individuals consisting of 21 males and 6 females were rescued from the study sites; 81% of these were adult and 19% sub-adult. Of the 27 individuals, 12 were rescued from private gardens. All rescued individuals were kept under observation in the Biological Park zoo situated within the sanctuary, where they received the necessary treatment, and were then released to the wild in the sanctuary. Various anthropogenic threats were recorded in the study; these included illegal logging, firewood collection, forest fires and habitat encroachment to enable the traditional practice of shifting cultivation, and infrastructural developmental activities. The present study highlights factors impeding the conservation of slow loris in and around the sanctuary.

KEY WORDS: Nocturnal primates · Habitat encroachment · Hunting · Pristine habitat · Vulnerable

INTRODUCTION

Primates are reliant on primary forest habitats, where they play a fundamental role in forest ecosystems as seed dispersers and predators (Chapman & Onderdonk 1998, Kays & Allison 2001). Habitat structure, quality and anthropogenic disturbance are known to affect primate diversity and abundance in tropical forests (Rylands 1987, Chapman & Peres 2001, Pyritz et al. 2010). Thus, any kind of habitat alteration or disturbance elicits varied levels of responses among primate species (Schwitzer et al. 2011). Some primate species react to disturbance by temporary or permanent emigration, crowding tendencies or altered sex ratios, while others continue to remain in the same area despite anthropogenic threats (Marsh et al. 1987, Chiarello & De Melo 2001, Peres 2001, Baranga 2004, Martins 2005, Rode et al. 2006, Schwitzer et al. 2011). Animals living in disturbed, degraded or fragmented habitats may also face reduced food resources, loss of roosting sites, escape cover and migratory routes (Kumar & Solanki 2004, Malhi et al. 2008, Sarma et al. in press) and may become more vulnerable to natural disasters such as hurricanes, floods or to changes resulting from global climate change, such as seasonal droughts (Malhi et al. 2008, Alho & Silva 2012). Harcourt & Doherty (2005) stated that primate richness generally decreases with fragment size. However, in some highly fragmented or isolated small forest patches (<50 km^2) primate densities have been found to increase, possibly owing to the absence of main predators such as large cats and birds of prey (González-Solís et al. 2001), the density compensation phenomenon (Peres & Dolman 2000), and the ecological plasticity of some primate species

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(González-Solís et al. 2001). Laurance et al. (2006, 2008) reported that both nocturnal and diurnal species within the same community may respond differently to habitat disturbance.

Bengal slow loris *Nycticebus bengalensis* is found in India, Bangladesh, Bhutan, Myanmar, Cambodia, southern China, Lao PDR, northern Thailand, and Vietnam (Brandon-Jones et al. 2004, IUCN 2008). In India, the species is confined to the 7 northeastern states (Choudhury 1992, Srivastava 1999, Brandon-Jones et al. 2004, Radhakrishna et al. 2006, Swapna et al. 2008, Das et al. 2009, Nandini et al. 2009, Kumar & Devi 2010) and is reported to occur in tropical, subtropical evergreen, semi-evergreen and moist deciduous forests (Choudhury 2001, Swapna et al. 2008). Habitat destruction and disturbance due to shifting cultivation, encroachment, selective logging, road kills, bushmeat hunting and forest fire have been reported as major threats to the slow loris population in northeast India (Choudhury 1992, Srivastava 1999, Radhakrishna et al. 2006, Kumar & Devi 2010). As a result of these threats, slow loris is listed in Schedule I of the Indian Wildlife (Protection) Act, 1972. It has also been categorized as Vulnerable (A2cd ver 3.1) in the IUCN Red List (IUCN 2008) and listed in Appendix I of CITES.

Bengal slow lorises prefer forest edges because of the seasonal high density of insect prey found there (Rowe 1996). Thus, any kind of disturbances such as clear felling and burning for shifting cultivation (*jhum*) at the forest edge increases the vulnerability of the species and forces individuals to move towards secure habitat for survival (Radhakrishna et al. 2006, Kumar 2009). However, more data are needed to determine the full extent to which the species is affected by such disturbances. Only a few field studies (Mishra et al. 2006, Radhakrishna et al. 2006, Swapna et al. 2008, Biswas et al. 2009, Das et al. 2009) have been conducted in the last decade in northeast India which confirm the presence of Bengal slow lorises in disturbed (fragmented) and undisturbed habitats and also highlight the conservation issues.

Bengal slow loris populations have been declining due to escalating habitat destruction in the form of shifting cultivation, the construction of roads, houses, hydro-electric dams, development of orchards, anthropogenic forest fires, hunting, road accidents, and the medicinal and pet trades (Wolfheim 1983, Srivastava 1999, Srivastava & Mohnot 2001, Radhakrishna et al. 2006, Nekaris & Bearder 2007, Nekaris et al. 2008, Das et al. 2009, Kumar & Devi 2010). Hunting and deforestation have been reported as the 2 prime threats to the continued existence of the species (Choudhury 1992, Srivastava 1999). A few studies have described rescues of slow lorises affected by habitat disturbances in northeast India (Radhakrishna et al. 2006, Biswas et al. 2009, Kumar 2009, Nandini et al. 2009). Here, we present the data of Bengal slow loris rescued from 1996 to 2012 in and around the Itanagar Wildlife Sanctuary, Arunachal Pradesh, India.

MATERIALS AND METHODS

Study area

The study was conducted in and around the Itanagar Wildlife Sanctuary (IWLS) in the Papum Pare district of Arunachal Pradesh. The sanctuary (27° 05′ 39″ N, 93° 30′ 15″ E) covers an area of 140.8 km^2 and is located in the vicinity of the capital city of Arunachal Pradesh, Itanagar, and bordered by the Poma River in the east, the Pachin River in the south and the Neorch River in the northwest (Fig. 1). The terrain is rugged with steep slopes and dense vegetation and the altitude ranges from 250 to 2000 m above sea level (a.s.l.). The forest in the sanctuary is wet and semi-evergreen with a multistoried structure consisting of a large number of species belonging to different families and genera (Kaul & Haridasan 1987, Srivastava & Choudhary 2006).

Methods

The study is a compilation of data collected from 1996 to 2012 during rescue operations carried out opportunistically by the authors and Biological Park (zoo), Hanagar, forest staff. Information regarding the occurrence of slow lorises in human-dominated areas was received from local people. The slow loris is well known among the local people in the state, who hold the superstitious belief that the presence of the species is an ill omen; they thus tended to inform forest officials and the authors about any occurrence of the species in their locality. Immediately after the information was received, the sites were visited with a view to rescuing the individuals. Animals were kept for behavioural observation for 5 to 6 d at the Biological Park, Itanagar, where they received all necessary treatment. The rescued animals were released in the IWLS when this was convenient. Habitat disturbance data were collected from the slow loris occurrences reported by the local people and as a result of direct observations.

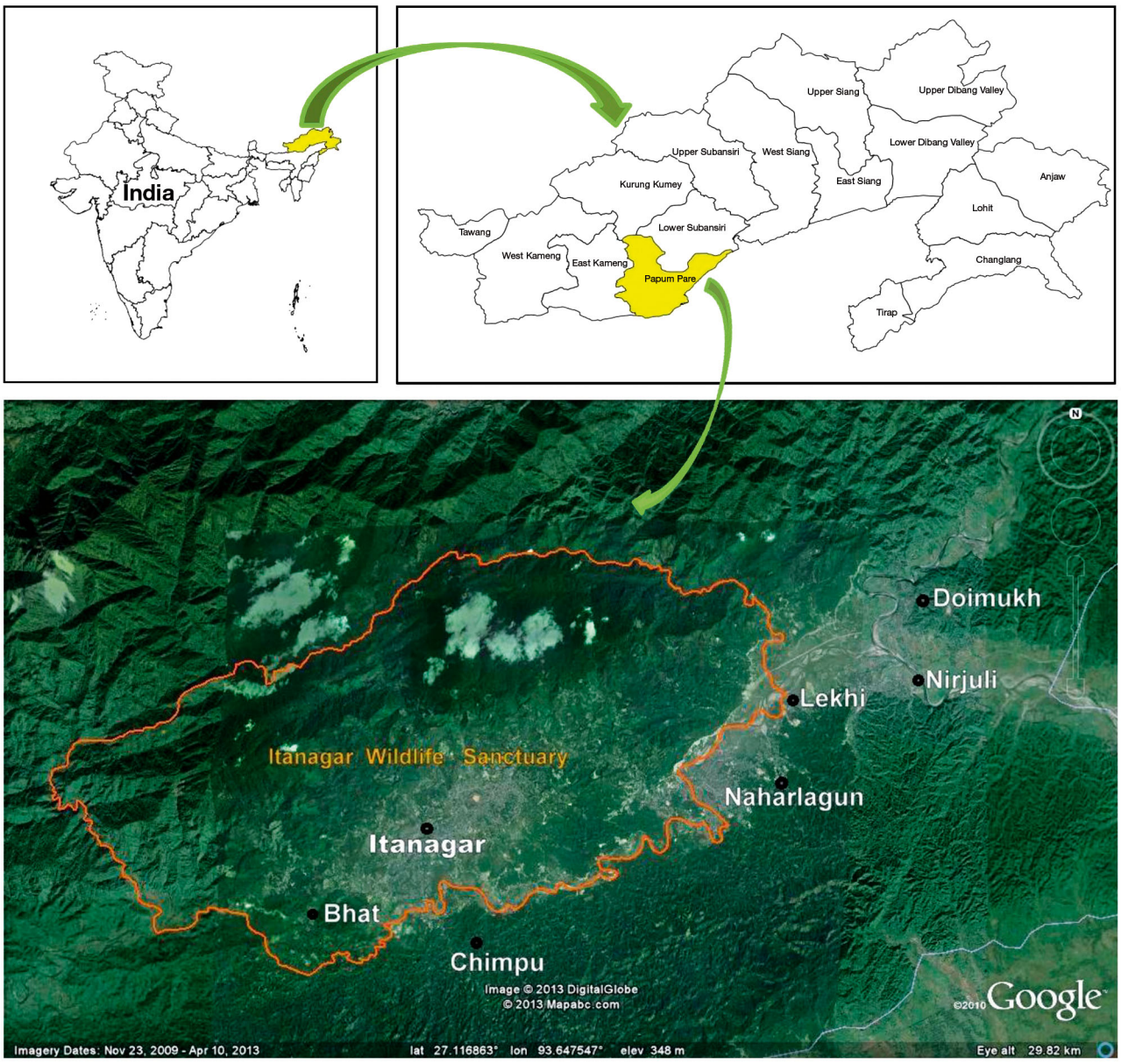

Fig. 1. Itanagar Wildlife Sanctuary highlighting the human-dominated areas from which *Nycticebus bengalensis* was rescued

RESULTS

Lorises rescued

A total of 27 individuals of *Nycticebus bengalensis* were rescued from the villages (human-dominated landscape) located in and around IWLS (Table 1). Of the total, 21 (78%) were male and 6 (22%) were female; 81% (n = 22) were adult and 19% (n = 5) were sub-adult. Of the 22 adults, 81% (n = 18) were males and 19% (n = 4) females; of the sub-adults recorded 60% (n = 3) were males and 40% (n = 2) females. The largest number of individuals (n = 8) were rescued from Itanagar, the smallest number (n = 1) from Bhat village. A high proportion (44%, n = 12) of individuals were rescued from the gardens situated near the disturbed forest areas such as *jhum*-cultivated lands or forest destroyed by highway and commercial building construction, followed by 37% (n = 10) from inside local houses, 11% (n = 3) from roadside plantations and 7% (n = 2) on the forest edges during the evening (Fig. 2). Dividing the study period into 3 yr spans, numbers were highest in 2010–2012 (33%, n = 9), followed by 2001–2004

(30%, n = 8), 1996–2000 (26%, n = 7) and 2004–2009 (11%, n = 3) (Fig. 3).

Release of lorises

Slow lorises were removed from the rescue sites and taken to the Biological Park (zoo) at Itanagar, Arunachal Pradesh. They were kept in cages for 5 to 6 d for observation under the constant supervision of a veterinary officer. The necessary treatment was given to injured animals until they recovered. Of the 27 rescued slow lorises, 4 individuals were kept at the zoo for conservation breeding and to serve the purpose of educating local people about the species; the others were released back into the wild in the core area of the sanctuary.

Conservation issues

Various anthropogenic threats including forest encroachment for developmental activities, and habitat disturbance in terms of illegal logging, firewood collection and shifting cultivation were recorded in and around the IWLS, particularly in the fringe area of the state capital city Itanagar, Arunachal Pradesh (Fig. 4). However, activities such as construction of roads and highways, multi-storied commercial and residential complexes, petrol pumps, and tea gardens contributed more to the process of habitat encroachment. Practices such as slow loris hunting, poaching and keeping live animals as pets was not observed in the study area because of superstitious beliefs among locals. The local people believe that the species brings misfortune to the family once it enters their premises as well as that its bite is poisonous. One of the authors (J.P.) was bitten on the finger during a rescue operation, and pain and swelling were recorded at the site of the bite. One more incident of biting was observed while rescuing an animal. In this case, there was a severe allergic reaction throughout the body and the person was hospitalized for a week. However, contrary to the belief of the local people, the bite of the species is not poisonous; it may sometimes cause an allergic reaction, which may in some cases lead to an anaphylactic shock. Wilde (1972) also reports that the victim of a slow loris bite immediately succumbs to anaphylactic shock followed by hematuria. Slow loris bites are rarely reported. However, based on our observations and published reports (Wilde 1972, Kalimullah et al. 2008), it seems that they are not poisonous. Nonetheless, due to the production of exudate from the brachial gland of the slow loris, which is similar to the Fel d 1 cat allergen, the anaphylactic shock experienced by vic-

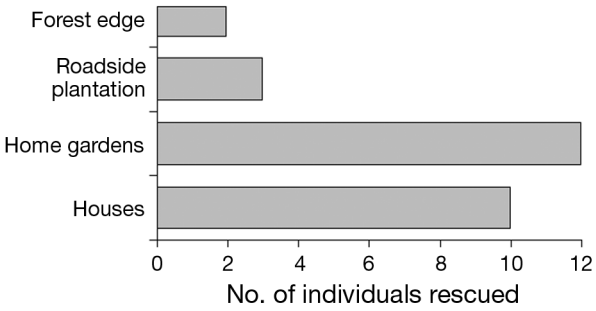

Fig. 2. *Nycticebus bengalensis.* Locations in and around the Itanagar Wildlife Sanctuary from which Bengal slow lorises were rescued

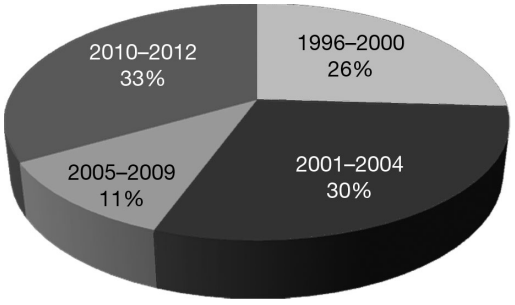

Fig. 3. *Nycticebus bengalensis.* Rescue statistics for slow loris for 1996 to 2012 in and around the Itanagar Wildlife Sanctuary

Table 1. *Nycticebus bengalensis.* Details of rescued slow loris individuals. SL: slow loris

SL no.	Location	No. of animals rescued	Adults		Sub-adults	
			Males	Females	Males	Females
1	Doimukh	5	2	1	2	–
2	Chimpu	6	3	2	–	1
3	Itanagar	8	6	1	1	–
4	Lekhi Village	2	2	–	–	–
5	Naharlagun	3	3	–	–	–
6	Nirjuli	2	1	–	–	1
7	Bhat Village	1	1	–	–	–
Total		27	18	4	3	2
Percentage (%)			67	15	11	7

Fig. 4. *Nycticebus bengalensis.* Major threats to slow lorises in and around the Itanagar Wildlife Sanctuary (IWLS): (a) forest cutting for shifting cultivation; (b) anthropogenic forest fire; (c) rapid expansion of urban areas in and around IWLS; (d,e) rescue of slow loris from local house; (f) slow loris in garden of local people; (g) construction of commercial complex near the IWLS; (h) highway construction; (i) shifting cultivation in and around the IWLS

tims is probably just a reaction to the exudate's allergen (Krane et al. 2003, Hagey et al. 2007).

DISCUSSION

Nycticebus bengalensis rescued from a human-dominated landscape is a subject of great interest. The increasing human population is intensifying the degradation of the pristine habitat of *N. bengalensis* throughout the northeast of India, which might compel the animals to migrate in search of food and shelter. Such a temporary migration of the species was reported from Assam by Radhakrishna et al. (2006), who found that *N. bengalensis* migrates toward the edges of the forest in response to habitat disturbance. Similarly, other species such as *N. coucang* have also been reported to move to the outer edges of the forest in response to logging pressure (Johns 1986). However, the other northeast states of India contribute to the rescue statistics for *N. bengalensis.* Radhakrishna et al. (2006) reported the rescue of a significant number of *N. bengalensis* (14 individuals over a span of 6 yr) from the 3 districts of Assam, viz. Tinsukia, Golaghat and Karbi Anglong. Biswas et al. (2009) also reported the rescue of 5 slow lorises from Dibru-Saikhowa National Park and Amchang Wildlife Sanctuary in Assam, which were then either kept in a zoo or released in protected forest. Nandini et al. (2009) reported a case in which the species was kept as a captive pet in Assam and Meghalaya, which were later released into nearby forest patches.

Kumar & Devi (2010) rescued an adult male slow loris from a roadside plantation of the NERIST university campus, Nirjuli, Arunachal Pradesh. The campus is surrounded by hills where *jhum* cultivation is practised. This rescued slow loris might have migrated from its original habitat due to a high degree of disturbance and threats posed by forest cutting, forest burning for *jhum* cultivation and used the home gardens, roadside plantation, tea garden and fragmented small forest patches as stepping stone to migrate in search of food and safe shelter. We observed that slow lorises entered the premises of locals in search of food (eggs) during the night. Most of the animals rescued were from backyard poultry houses. From observations made during the study, it seems that it is mostly the males which gather food for the family.

Over the last few decades, forest encroachment in and around IWLS for various purposes has increased the species' vulnerability. Although slow loris hunting has not been observed in Arunachal Pradesh, the species is hunted by inhabitants of other northeast Indian states for use as traditional medicine and as bushmeat (Southwick & Siddiqi 2001, Chetry et al. 2003, Radhakrishna & Sinha 2004, Biswas et al. 2009). Similarly, slow lorises are also captured and hunted in their global distribution range for food, to be kept as pets and for use in traditional medicine (Martin & Phipps 1996, Duckworth et al. 1999, Long et al. 2004, Walston 2005, Ashwell & Walston 2008, Nekaris et al. 2008, China Species Information Service unpubl. data).

The rescue of *Nycticebus bengalensis* from the human-dominated landscape is very important from a conservation point of view, particularly in Arunachal Pradesh, India, where *jhum* cultivation is the primary source of livelihood of the tribal people, and infrastructure development work is primarily a source of income for the more wealthy. Choudhury (2001) reported that the forest cover of northeast India is disappearing at an alarming rate, and in some areas more than 55% of the formerly dense canopy has been lost (Southwick & Siddiqi 2001, Ramakantha et al. 2003). MacKinnon & MacKinnon (1987) reported about 75% habitat loss of slow lorises in the Indo-Chinese region as a result of various anthropogenic threats similar to those in India.

Slow lorises are mostly threatened by hunting, habitat fragmentation and destruction in the form of shifting cultivation, accidental forest fire, encroachment for permanent settlement, construction of buildings, roads, bridges, road accidents and illegal timber logging as well as trading of live specimens (Choudhury 1992, Ahmed 2001, Singh 2001, Southwick & Siddiqi 2001, Chetry et al. 2003, Walker & Molur 2004, Radhakrishna & Sinha 2004, Ghose & Kaul 2005, Radhakrishna et al. 2006, Biswas et al. 2009, China Species Information Service unpubl. data) in this region. These factors are contributing to the decline of the slow loris population in Arunachal Pradesh and represent the most serious threats to the survival of the species worldwide (Southwick & Siddiqi 2001, Srivastava & Mohnot 2001, Walker & Molur 2004, Long et al. 2004, Ghose & Kaul 2005). Huy Huynh (1998) and Thanh (2002) also report that wild populations have declined critically and that further local extinctions are feared in some areas of the species' distribution range.

The major difficulty involved in releasing the animal into the wild is the lack of information on its habitat requirements. An arbitrary release may lead to the death of the animal; thus, it is imperative for the development of meaningful slow loris conservation strategies that more information should be obtained on habitat variables and population densities throughout the species' range (Radhakrishna et al. 2010).

CONCLUSION AND RECOMMENDATION

Throughout its global distribution range, and in northeast India in particular, the Bengal slow loris is affected by habitat encroachment and disturbances due to *jhum* cultivation, selective logging, development activities, and hunting. Reports of slow lorises in captivity are numerous throughout the range of these animals, including northeastern India (Nandini et al. 2009), especially in tribal-dominated areas (Duckworth et al. 1999). Conservation of this little studied primate species must be directed towards the mapping of their important habitats in the region and the assessment of the population in the disturbed and the undisturbed habitat ranges. The species' occurrence at the forest edge and in human-modified landscape should be ecologically analyzed to initiate an appropriate conservation management programme. Nandini et al. (2009) recommended forest corridors connecting disturbed habitat as an important conservation measure. Fuller et al. (2006) suggested the need for effective conservation plans which take into account both the need for protected area connectivity and the requirements of the local human population (Gillingham & Lee 1999), possibly through multi-criteria analysis (Moffett & Sarkar 2006) and ecological niche modeling (Thorn et al.

2009). It is necessary to raise awareness among the tribal people of Arunachal Pradesh for wildlife species, particularly for primate species such as the slow loris, which act as seed dispersal agents and which prey on several forest insect species (biological control). In addition, the need for the conservation and protection of the tropical forest ecosystem should be made clear to help ensure the future survival of the species. Local government should initiate appropriate steps to control unplanned developmental activities in and around the forest area of the sanctuary.

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