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FEASIBILITY STUDY REGARDING RE-INTRODUCTION OF PYGMY HOG (*PORCULA SALVANIA* HODGSON, 1847) AT GORUMARA NATIONAL PARK, JALPAIGURI, WEST BENGAL

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INTRODUCTION

Captive breeding and subsequent re-introduction of a threatened species is an important and in some cases very successful tool for species conservation. Now-a-days re-introductions using captive-bred individuals are not uncommon than the translocations of wild species.

In the year 1998, International Union for Conservation of Nature & Natural Resources (IUCN) provides the following definition "Re-introduction is an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct". It can also be defined as "The release of captive-bred or wild-caught animals into areas they no longer inhabit or in which their numbers have been seriously depleted within their historical range" [Laidlaw , 2001].

However, re-introduction is always a very lengthy, complex and expensive process and requires a multidisciplinary approach involving a team of persons drawn from a variety of backgrounds. They may include persons from governmental organizations; natural resource management agencies; non-governmental organizations; funding bodies; universities; veterinary institutions and zoos (and or private animal breeders), with a full range of suitable expertise [IUCN, 1998].

The Pygmy Hog (*Porcula salvania Hodgson, 1847*) has long been categorized by IUCN as Critically Endangered [Red List Category C2a(ii)] – is among the most threatened of all mammals. It is listed on Appendix-I of CITES and Schedule-I Part-I of the Indian Wildlife (Protection) Act, 1972 [Anonymous, 2007b; CITES, 1983]. However, it was formerly presumed to occur across a narrow strip of early successional tall grassland plains along the Himalayan foothills, extending from south Nepal to Sikkim, northern part of West Bengal, through parts of Bhutan and north-western Assam. By the early or mid 1980's the species was reduced to a single, fragmented population in the Manas Tiger Reserve, and all of other smaller populations were confirmed or feared extinct [Oliver, 1980 & 1981; Oliver & Deb Roy, 1993; Narayan *et al.*, 2008a]. Pygmy Hog Conservation Program (PHCP) was formally launched in 1995 for conservation of the Pygmy Hogs and alongwith other endangered species of tall grasslands of the region through field research, captive breeding and re-introduction of the hog after adequate restoration of degraded former habitats [Narayan *et al.,* 2010]. Under this programme, 16 captive bred Pygmy Hogs (7 male and 9 female) were re-introduced in Sonai Rupai Wildlife Sanctuary of Assam (in May, 2008). Again in May 2009, nine hogs (4 male and 5 female) were released in the same Protected Area [Narayan *et al.*, 1999; Narayan, 2001, 2004 & 2006; Narayan & Deka, 2002; Narayan *et al.*, 2008b]. It is always very difficult to monitor these released animals in the absence of any direct sightings. However, it is clear from the secondary evidences

(i.e. nests, forage marks, hoof marks and pellets/scats) that these re-introduced animals are thriving well in wild [Deka *et al.*, 2009].

Therefore, it is high time to re-introduce these captive born Pygmy Hogs to other Protected Areas (where they have been extirpated or became locally extinct) which falls under its known historic distribution.

HISTORICAL REVIEW

Distribution

Due to its long absence and no available data from wild, zoologists thought that the species might have been extinct. Even, E. P. Gee (1964) wrote in his literature that this interesting and unusual member of the pig family is feared to be extinct. Fortunately, Pygmy Hog reappeared dramatically in March, 1971. A twenty four hour long wood fire in north western Assam (Barnadi Reserve Forest, a buffer zone of Manas Tiger Reserve) forced the Pygmy Hogs to migrate and take shelter in the tea garden alongwith another closely associated species Hispid Hare (***Caprolagus hispidus***) [Mallinson, 1971 & 1977; Tessier-Yandell, 1971a & 1971b; Oliver, 1978 & 1980]. It created great impetus among interested zoologists. They ventured to study the breeding and population biology of this animal. Though their works are mainly concentrated on captive animals, yet the results have great role to play in determining the status of this the tiniest pig in the world [Ghosh, 1988]. After several attempts the animals were found in the core area of the Manas Tiger Reserve [Oliver, 1991].

The former known distribution of the species is not clearly known, as most of the records are dependent on occasional chance observation, mainly '*shikari*' accounts. However, this species has been reliably recorded from typical lowland savannah possibly indicating poor migratory ability [Oliver, 1978].

The species was formerly widely, but possibly discontinuously, distributed among the Himalayan foothills from north-west Assam, through parts of Bhutan, northern part of West Bengal and Sikkim to South Nepal. This species has never been recorded as far west as Uttar Pradesh. In Assam, the distribution of Pygmy Hog is limited eastwards by the disappearance of the thatchlands in the region of North Lakhimpur with an increasing abundance of evergreen forest and heavier rainfall [Oliver, 1985 & 1989]. The width of this belt is approximately 5-15 miles [Mallinson, 1971] [Figure 1]. However, loss and degradation of forest habitat due to the expansion of human settlement and agricultural encroachment, uncontrolled dry season grass burning, injudicious high land during flood and replacement of these grasslands with commercial tree plantations make this Pygmy Hog to become shrunken to a small and last viable wild population only at Manas Tiger Reserve. Unfortunately this area is also threatened by political instability and also has been included on the IUCN List of Threatened Protected Areas [Bezbarua *et al.*, 2005].

In West Bengal very little informations is available regarding its distribution. In December, 1989 some dome-shaped nests made up of grass and other vegetation was observed in the 'low alluvial savannah woodland' of Gorumara Wildlife Sanctuary. This was thought to be that of Pygmy Hogs and was reported first time from the Sanctuary [Sanyal, 1995]. Later, Deuti, 2006 and Sanyal and De, 2008 published reports on general habit, habitat and distribution of Pygmy Hog in the state. However, no further records of this animal are available from Gorumara National Park till date.

PURPOSE OF THE STUDY

The principle aims and objectives of any re-introduction is to establish a viable, free-ranging population in the wild, of a species, subspecies or race (to enhance the long-term survival); to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy; to promote conservation awareness; or a combination of these [IUCN, 1998].

For a successful re-introduction, feasibility study and background research has to be done prior to the release of animals [Kleiman, 1989 and

IUCN, 1998]. For this, an assessment on taxonomic status of the species to be re-introduced and detailed studies regarding the status and biology of wild populations (if they exist) is to be done to determine the species' critical needs. Special emphasize is to be given on habitat preferences, intra-specific variation and adaptations to local ecological conditions, social behaviour, group composition, home range, shelter, food requirements, foraging and feeding behaviour, predators and diseases. Then, choice of release site and its evaluation is also needed. Re-introduction can only be done within its known historic range and where the habitat and landscape requirements of the species are satisfied. Before re-introduction, it is to be confirmed that there should be no remnant population to prevent disease spread, social disruption and introduction of alien genes. The previous causes of decline (which may include diseases; over-hunting or other human activities; over-collection; pollution; poisoning; predation pressure; habitat loss; intra or inter-specific competition, etc.) has to be addressed before re-introduction in the same habitat. However, there is no universal format for a feasibility study. Feasibility studies can be adapted and shaped to meet the specific needs of any given situation.

The main objective of the project is to study the habitat (general overview, vegetation type, geo-topographical features, etc.), food availability, predator pressure and resource partitioning for the Pygmy Hog at Gorumara National Park and other anthropogenic pressure before introduction in the Park.

According to Project Proposal (submitted to the Directorate of Forests, Govt. of West Bengal), the assessment of habitats were done at four basic levels:

1. Study of vegetation pattern of the survey sites with special emphasize on variance of tree species, tree height, abundance and density of grasslands, shrubs and herbs. Availability of foods *viz.* fungi, roots, tubers, bulbs, green vegetation, grains, nuts, invertebrates, small vertebrates and carrion are also to be studied.
2. An examination of the level of human induced disturbances of the area. Ecological conditions *viz.* rainfall, temperature, source of water etc., will also be taken into consideration.
3. To locate possible re-introduction sites.
4. To monitor the introduced specimens (if, re-introduction takes place).

Surveys were conducted to Manas Tiger Reserve, Assam (where last known wild population of Pygmy Hog is surviving) and Sonai-Rupai Wildlife Sanctuary, Assam to get basic idea about Pygmy Hog's habitats. To study the behaviour of this animal in captivity, one survey was also conducted to Pygmy Hog Conservation (Breeding) Centre (PHCC), Basistha, Assam (where large numbers of captive born Pygmy Hogs are kept).

DESCRIPTION OF STUDY AREA

The main surveys were conducted at Gorumara National Park located in the Malbazar Sub-Division of Jalpaiguri district, in the state of West Bengal in India. Other surveys were conducted at Manas Tiger Reserve, Assam (last surviving population of Pygmy Hog in wild); Sonai-Rupai Wildlife Sanctuary, Assam (where, captive-bred Pygmy Hogs were successfully re-introduced) and Pygmy Hog Conservation (Breeding) Centre (PHCC), Basistha, Assam (where large number of captive bred Pygmy Hog's are kept for last 15 years).

Gorumara National Park

Gorumara National Park is situated between latitude 26°47'12.5" N to 26°43'25.6" N and longitude 88°52'4.2" E to 88°47'7.3" E. The total area of the National Park is 79.84 sq. km [Figure 5]. Gorumara National Park belongs to the bio-geographical zone 7B-Lower Gangetic Plain [Rodgers & Panwar, 1988]. As because, this Park is located towards the foothills of Eastern Himalayas, therefore, the area boast a rich biological diversity. The terrain of Gorumara National Park is differentiated into a distinct

plateau and a plain area. The soil profile of the area is of alluvial and bhabar formations. The river system of the National Park comprises three main rivers - Murti, Indong and Garati River. These rivers intermingle and meet the Jaldhaka River that forms the boundary of the National Park in the eastern side. *Hatidoba, Shealdoba, Gairadoba, Bandiabil, Chukchukie Lake* are other perennial source of water that flow through Gorumara National Park. There are few rivulets and streams passing through Gorumara National Park which are seasonal in nature, carrying water only during rainy season and remain dry rest of the times. Some of them are *Bamni jhora, Saraswati jhora, Mukaddam nala, Neora jhora, Amba khola* and *Chang khola*. South-west monsoon is the main source of rainfall. Maximum precipitation occurs from mid June to September, with a peak in July and August. The average annual rainfall is about 382 cm. Maximum recorded temperature is 37°C (in summer) and a minimum of 4°C (in winter).

The entire forest cover of Gorumara National Park comes under the North Indian Moist Tropical Forest [Champion & Seth, 1968]. On the basis of the composition of the vegetation, the forest can be classified into four distinct types, Riverine forests – North Dry Deciduous Seral Sal Khair Sissoo Association (Tondu – 1,2,3,4a,4b and Selkapara – 1b), Sal forests – Eastern Bhabar Sal and Eastern Terai Sal (Gorumara, South Indong 1,2,3 and Bhogolmardi), Wet Mixed forests – Sub-Himalayan Secondary Wet Mixed Forests (Barahati – 1,3, Central – 1, Medlajhora – 1, Dhupjhora – 1b, 2 and Kakurjhora – 2) and Savannah Forests & Lower Alluvial Savannah – Sal Savannah (Jaldhaka – 1b and Dhupjhora – 1a,1b,1c) [Anonymous, 2007a]. Gorumara National Park has only 10% (18.41 sq. km) of its total area covered by grassland. Gorumara National Park has a total of 326 identified plant species (tree species – 158, herbs – 35, shrubs – 77, grasses – 32, climbers – 15 and orchids – 9). Also, sizeable area is covered with bamboo brakes [Anonymous, 2007a**].** The species which are commonly found within the forest and having importance from the economical and ecological standpoint is *Sal* (*Shorea robusta*). This species occurs with its usual associates, namely *Chilauni* (*Schima wallichii*), *Chikrasi* (*Chukrassia tabularis*), *Champ* (*Michelia champaka*) and *Bahera* (*Terminalia belerica*). The other important tree species which are also commonly seen are *Sidha* (*Lagerstroemia parviflora*), *Panisaj* (*Terminalia myriocarpa*), *Lampati* (*Duabanga sonneretoides*), *Lali* (*Amoora wallichi*), *Lahasune* (*Amoora rohitaka*), *Kainjal* (*Bischofia javanica*), *Simul* (*Bombax ceiba*), *Khair* (*Acacia catechu*), *Sissoo* (*Dalbergia sissoo*) and *Siris* (*Albizia* spp.).

Gorumara National Park has approximately 48 species of mammals (carnivores and herbivores), approximately 193 species of birds, 22 species of reptiles including 7 species of turtles, 40 species of fishes and other macro and micro fauna [Anonymous, 2007a]. This Protected Area is famous for one of the last small pockets in Eastern India, that harbours natural population of Greater One-horned Rhinoceros (*Rhinoceros unicornis*), alongwith other mega-herbivores like Asian Elephant (*Elephas maximus*), Gaur (*Bos gaurus*) and other Deer species.

A total of 23 villages lying in the fringe areas of the National Park, of those, Uttar Dhupjhora, Dakshin Dhupjhora, Hazipara, Dangapara, Vellordanga, Chorai Mahal, Kalipur Forest Village and Murti Forest Village are present around the park boundary. A total of six numbers of tea gardens namely Baradighi, Batabari, Jadavpur, Bamandanga, Tondu and Sunrise are there in the peripheral zone of the Gorumara National Park.

Manas Tiger Reserve

Manas Tiger Reserve in Assam is situated in the northern bank of the river Brahmaputra. The Reserve runs along the Indo-Bhutan international border, with contiguous wildlife habitats in Bhutan. The river Manas flows from the gorges of Bhutan and splits into two major streams as it enters India. In India, the Reserve area falls in six districts namely Kokrajhar, Bongaigaon, Barpeta, Nalbari, Kamrup and Darrang. Barnadi Wildlife Sanctuary is located in the buffer of the Reserve. There are numerous rivers criss-crossing the Reserve, namely, Sankosh, Saralbangha, Hel,

Tanali, Courang, Sidli (Bhor) Aio, Manas, Beki, Pathimari, Kaladia, Tihunala, Morapagaldia, Braalia, Pbornodi and Dhansiri.

The core zone, the Manas National Park, is a pristine wildlife habitat; the rest of the Reserve is a collection of eighteen Reserve Forests intertwined with revenue villages [Figure 6]. While traversing the Reserve from west to east, one comes across sal forests (both virgin and degraded), moist deciduous forests, grasslands of both savannah and terai types, and miscellaneous forests. Manas habitat provides an excellent abode to the Tiger as well as prey species: Hog Deer (*Axis porcinus*), Sambar (*Cervus unicolor*), Swamp Deer (*Cervus duvaucelii*), Asiatic Wild Buffalo (*Bubalus arnee*) and Gaur (*Bos gaurus*). These species migrate freely across the international border. Tiger population was estimated to be 89 during the 1997 Tiger census.

Recorded major forest types are Sub-Himalayan High Alluvial Semi-Evergreen Forests, Eastern Valoor Type of Forests, East Himalayan Moist Mixed Deciduous Forests, Low Alluvial Savannah Woodland and Assam Valley Semi-Evergreen Alluvial Grasslands. A total of 374 species of dicots and 139 species of monocots are recorded from the Park. Grass species like *Imperata Cylindrica, Narenga porphyrocoma, Panicum* spp., *Saccharum arundinaceum, Thysanolaena maxima,* etc. are common. There are 21 recorded endangered species of mammals.

There is only one forest village, Agrang, in the core of the Tiger Reserve. However, there are 57 villages surrounding the Tiger Reserve. The population beyond these fringe villages is also heavily dependent on the Reserve for income and energy resources.

Sonai-Rupai Wildlife Sanctuary

Sonai-Rupai Wildlife Sanctuary spreads all the way along the foothills of the Great Himalayan range, is situated on the river bank of Gabharu, in Sonitpur district of Assam. The total area of the sanctuary is 220 sq. km, however, according to reliable sources the area has been reduced to 120 sq. km due to continuous pressure of encroachment by local people. Sonai-Rupai Wildlife Sanctuary has sufficient grasslands to house Asian Elephants (*Elephas maximus*), Greater One-horned Rhinoceros (*Rhinoceros unicornis*), Leopards (*Panthera pard*us), different small cats and other animals also. Moreover, the unique climatic condition of the area helps in the growth of valuable wood and medicinal plants. A considerable area is covered by grasses. Problems of encroachment and poaching are common in the Sonai-Rupai Wildlife Sanctuary, especially in the remote Assam-Arunachal Pradesh border.

Pygmy Hog Conservation (Breeding) Centre (PHCC)

The Pygmy Hog Conservation Programme (PHCP) was launched collaboratively by Durrell Wildlife Conservation Trust, IUCN Pig Specialist Group, Government of Assam and Government of India, for the protection of Pygmy Hog and its habitat. It is administered in Assam by EcoSystems-India. One of its main activities is conservation breeding of Pygmy Hogs. In-connection with the above mentioned project, the Pygmy Hog Conservation (Breeding) Centre (PHCC) was established in March, 1996 at Basistha, on the outskirts of Assam State capitol Dispur, in Guwahati City, with a stock population of six (2 males and 4 females) wild hogs, that were captured from Manas National Park and were transferred to Basistha. Generally two types of enclosures are there, inner and outer. Outer enclosures were planted with tall grasses brought from known former hog habitats. This type of enclosures are not very big, more or less triangular-shaped, brick-walls up to a height of 3 ft, then iron-net fencing upto a height of 8 ft and the roof of the enclosures are also enclosed with iron rope, to nullify the attacks of crows, raptors, etc. predator birds on piglets. Every open-air outer enclosure is leading to a room [Figure 7]. Within the enclosures some clusters of live grasses mainly '*ikra*' or '*barenga*' are plotted, but no '*kher*' or '*thatch*' grasses. However, Pygmy Hogs built nests throughout the year, for that thatching grasses are supplied from outside. Artificial food items are supplied daily inside the inner enclosure. The present population of Pygmy Hog in the Pygmy Hog Conservation (Breeding) Centre (PHCC) is

male – 16, female – 14 and young – 19 (as on 14.06.2010).

MATERIALS AND METHODS

Field Surveys

The field surveys were conducted in Gorumara National Park from June 2009 to January 2011. Three camps namely Bamni (North Range), Garati and Medla (South Range) were primarily selected as base camps, from where the entire survey was conducted. These camps are located in the transition zones between high forests and grasslands.

The forest trails/fire-lines/observatory lines in different representative habitats were used as fixed transects for survey of the grasslands and adjacent areas. Random surveys were also conducted in different grassland habitats to assess habitat density. The entire survey was conducted on elephant and/or on foot (when departmental elephants were not available) for six hours per day, 06:00 hrs to 12:00 hrs.

Geographically, the area of Gorumara National Park falls under tropical monsoon climate, with four distinct seasons – summer (April-May), monsoon (June-September), a short autumn (October-November) and winter (December-March). Therefore, a total of six surveys were conducted considering all the major seasons. Special emphasize were given on monsoon time, to see the water-logging condition of the grassland areas.

The results obtained from various surveys conducted at Gorumara National Park, have to be compared with the data available (habitat, food items availability etc.) and obtained from Manas Tiger Reserve, Assam (the last remaining home of endangered Pygmy Hogs) and Sonai-Rupai Wildlife Sanctuary, Assam (where captive bred Pygmy Hogs were successfully re-introduced), before declaring suitability of any habitat at Gorumara National Park for re-introduction and survival of Pygmy Hog. Therefore, **two surveys** were conducted to Manas Tiger Reserve (from 7-10 June 2010 and 13-15 January 2011 respectively) and **one survey** from 11-12 June 2010 at Sonai-Rupai Wildlife Sanctuary. As Pygmy Hogs are small in size and secretive animal, it is hard to locate a single hog in its natural habitat. Therefore for its generalized habit, behaviour, food preferences it is necessary to rely heavily on observation of the behaviour of captive animals. In this context, **one survey** to Pygmy Hog Conservation (Breeding) Centre (PHCC), Basistha, Guwahati, Assam (from 13-14 June 2010) was also conducted.

Collection of Data

Grassland, shrubland, and water are the sources of food and cover. These cover types, in relation to the limitations of altitude; determine whether a place is a primary, secondary, or non-suitable habitat type. As per the Project Proposal (submitted to the Directorate of Forests, Govt. of West Bengal) surveys were carried out in different habitats of the Protected Area, with special emphasize on grassland areas. Data were collected regarding the following parameters -

To Survey Vegetation Status: Random survey was made in different areas. Sample of botanical specimens were collected from the field and herbariums were prepared [Jain & Rao, 1977]. These were sent to Botanical Survey of India, Shibpur, Howrah, West Bengal for systematic identification. The reports of the same had already been obtained. Soil samples were collected and preserved accordingly for analysis of presence of micro-organisms. For calculating vegetation density, frequency and basal area, data were collected through randomly placed quadrates: 10m×10m quadrates for trees, 3m×3m quadrates for shrubs and 1m×1m quadrates for tree seedlings and herbs.

To Survey Faunal Status: Animal data were collected by considering both direct sighting (primary data) and indirect evidences (secondary data, such as call, pellets or droppings, pugmark or hoof-mark, scratch-mark, killed or dead animal, etc.).

To Survey Availability of Food Source: Surveys were conducted to find out the availability of preferred food items of Pygmy Hog

like roots, tubers, bulbs, green vegetation, grains, nuts, annelids, small vertebrates, carrion, etc.

To Survey Availability of Sources of Water: Regular surveys were conducted regarding availability of water sources (rivers, rivulets, lake/bill/doba and other perennial sources) in different seasons. As because, this animals are primarily grassland species, thus, data were also collected on how long this areas remain submerged under water during peak monsoon period.

To Survey Human-induced Disturbances: An examination of the level of human induced disturbances of the area and other anthropogenic pressures were also taken into consideration during the survey period.

Co-ordinates: GPS (Garmin eTrex Vista) was used to obtain the latitude, longitude and altitude of the surveyed/respective areas.

RESULTS AND DISCUSSION

Gorumara National Park has only 10% (18.41 sq. km) of its total area covered by grassland, majority of which is distributed along the river banks of Jaldhaka and Murti River (very small area) (Table 1). Some natural grassland is there in blocks like Jaldhaka – 1a, 1b and Dhupjhora – 1b. To study the entire grasslands in Gorumara National Park the field surveys were conducted from three camps namely Tondu (North Range), Garati and Medla (South Range) and the findings are described under three headings for better comparison [Table 1].

CONCLUSION

As per the Guidelines for Re-introductions prepared by the IUCN/SSC Re-introduction Specialist Group (1995) the choice of release site can be chosen depending on the following factors –

- Selected site is to be located within the known historic range (former natural habitat) of the species concerned.
- For a successful re-introduction, it is to be verified that no remnant population exists, to prevent disease spread, social disruption and introduction of alien genes.
- The re-introduction area should have assured long-term protection.
- Re-introduction should only take place where the habitat and landscape requirements of the species are satisfied (keeping in consideration of species' critical needs).
- The area should have sufficient carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run. Long term post-release monitoring of all (or sample of) individuals required.
- Before the final re-introduction - identification and elimination or reduction to a sufficient level of previous causes of decline should be addressed (diseases, over-hunting, poisoning, habitat-loss, competition with domestic livestock, etc.). Also capacity building of the departmental staffs and continuous public relation activities (such as awareness campaigning among villagers from adjacent localities, to prevent escaping of any re-introduced animal) are required for conservation of Pygmy Hog.

Identifying Suitable Release Sites

For successful re-introduction of Pygmy Hogs in the wild, first the captive born animals have to be pre-conditioned by keeping them in larger enclosures, the so called 'pre-release' enclosure. The facility must include grasses and vegetation from their known natural habitats. This pre-conditioning of the animals are for maintaining them in integrated social groups, to encourage natural foraging (in simulated natural habitats), nest-building and other behaviours and also to minimize human contact to mitigate tameness and other behavioural characteristics which are common in captive management. This pre-conditioning of the animals may lasts for 5-6 months. Then the animals are to be transferred into temporary 'soft-release' enclosures constructed in the selected site for re-introduction. The site must have easy access to the

TABLE 1: Major flora associated with grassland in the Gorumara National Park.

	Scientific Name	Local Name	Family
1	*Urena lobata* L.	Okra	Malvaceae
2	*Melastoma malabathricum* L.		Melastomataceae
3	*Pueraria phaseoloides* (Roxb.) Benth.		Fabaceae
4	*Lantana camara* L. var. aculeata (L.) Moldenke	Putus	Verbenaceae
5	*Aristida* spp.		Poaceae
6	*Fimbristylis* spp.		Cyperaceae
7	*Eupatorium odoratum* L.		Asteraceae
8	*Ageratum conyzoides* L.		Asteraceae
9	*Polygonum capitatum* Buch.-Ham. ex D. Don		Polygonaceae
10	*Spermacoce hispida* L.		Rubiaceae
11	*Diplazium esculentum* (Retz.) Swartz.		Athyriaceae
12	*Cajanus scarabacoides* (L.) du Petit-Thou.		Fabaceae
13	*Mimosa pudica* L.		Mimosaceae
14	*Ziziphus mauritiana* Lam.	Kul	Rhamnaceae
15	*Ziziphus xylopyrus* (Retz.) Willd.	Kul	Rhamnaceae
16	*Lippia geminata* H. B. & K.		Verbenaceae
17	*Stephania japonica* (Thunb.) Miers		Menispermaceae
18	*Merremia umbellate* (L.) Hall. F.		Convolvulaceae
19	*Mikania micrantha* Kunth.	Assamlata	Asteraceae
20	*Paspalum scrobiculatum* L.		Poaceae
21	*Digitaria* spp.		Poaceae
22	*Panicum* spp.		Poaceae
23	*Isachne* spp.		Poaceae
24	*Phragmites karka* (Retz.) Trin. ex. Steud.	Khagra	Poaceae
25	*Arthraxon* spp.		Poaceae
26	*Commelina diffusa* Burm. F.	Kanchira	Commelinaceae
27	*Desmodium heterocarpon* (L.) DC.		Fabaceae
28	*Alpinia nigra* (Gaertner) B.L.Burtt	Purundi	Zingiberaceae
29	*Arundinella bengalensis* (Sprengel) Druce	Chhoto Jharu	Poaceae
30	*Arundo donax* L.	Nol	Poaceae
31	*Imperata cylindrica* (L.) Räusch.	Thatch, Kush	Poaceae
32	*Saccharum arundinaceum* Retzius	Madhua	Poaceae
33	*Saccharum narenga* (Nees ex Steudel) Hackel	Dhadda	Poaceae
34	*Saccharum spontaneum* L.	Kasia, Kash	Poaceae
35	*Themeda arundinacea* (Roxburgh) Ridley	Baro Chepti	Poaceae
36	*Acacia catechu* (L.f.) Willdenow	Khair	Mimosaceae
37	*Cynodon dactylon* (L.) Persoon	Durba	Poaceae
38	*Dalbergia sissoo* DC.	Sissoo	Papilionaceae
39	*Bombax ceiba* L.	Simul	Bombacaceae
40	*Clerodendron viscosum Vent.*	Bhant	Rubiaceae
41	*Colocasia esculenta (L.) Schott*	Kochu	Araceae
42	*Diascorea spp.*	Banalu	Dioscoreaceae
43	*Leea spp.*		Leeaceae

TABLE 2: Comparative Accounts of the three main grassland areas.

	Tondu Area (Figures 8, 9)	**Garati Area** (Figures 10, 11, 12)	**Medla Area** (Figure 13)
Landscape (overall altitude)	River plains (120-130 m above MSL)	River plains (110-120 m above MSL)	River plains (105-110 m above MSL)
Forest types	Majority *Sal* forest and also mixed forests of *Simul-Siris* and *Khair-Sissu* association.	Mostly riverine forests of *Simul-Siris* type. Also mature *Sal* forests and dry-mixed forests are recorded.	Mostly riverine forests of *Simul-Siris* type. Large patch of mature *Sal* is also there.
Grassland	Some riverine natural grassl and of *Kasia, Thatch, Nol* and *Khagra*. Small part converted into fodder plantation, dominates species *Dhadda.*	Highest accumulation of natural grassland of *Kasia, Thatch, Nol* and *Khagra*. In recent times major part has been converted into fodder plantation of *Dhadda,Chepti* and *Madhua.*	Second highest accumulation of the natural grassland of *Kasia, Thatch, Nol* and *Khagra*. Major part has been converted into fodder plantation of *Dhadda, Chepti* and *Madhua.* In lowland areas *Purundi* is the dominat species.
Water sources	• River Jaldhaka • Mukaddam nala • Sealdoba	• River Jaldhaka • River Garati • Garati Lake • Madhuadoba • Gandardoba (or Gairadoba) • Two man-made wallow pools	• River Jaldhaka • River Murti • Bandibil • Two man-made wallow pools
Water-logging situation during monsoon	Heavy shower may cause prolonged inundation in natural grassland. Fodder plantation area well-drained.	In lowland area heavy rainfall may cause water-logging situation, but not for prolonged duration. Mostly fodder plantation areas are weel-drained.	Some portion of the grassland is well drained, but, heavy rainfall may cause water logging situation in certain areas.
Distance from grassland to high forest	0.05-0.5 km	0.05-2.0 km	0.1-2.0 km
Food source availability	Roots, tubers, bulbs, green vegetation, annelids, small rodents, lizards, etc. moderately present.	Roots, tubers, bulbs, green vegetation, annelids, small rodents, lizards, etc. are in plenty.	Roots, tubers, bulbs, green vegetation, annelids, small rodents, lizards, etc. are in plenty.
Presence of herbivores/ carnivores	Leopard, Greater One-horned Rhinoceros, Gaur, Sambar, Spotted Deer, Barking Deer are common. Wild Pig population is less than other part of the forest.	Leopard, Greater One-horned Rhinoceros, Gaur, Sambar, Spotted Deer, Barking Deer are very common. Wild Pig population is also very high.	Leopard, Greater One-horned Rhinoceros, Gaur, Sambar, Spotted Deer, Barking Deer are very common. Wild Pig population is also very high.
Nearest human habitation/ villages/ tea-gardens	• Hazipara (3.5 km) • Dangapara (4.0 km)	Nil	• Kalipur Forest Village (0.5 km) • Ramsai (2.0 km)
Domestic cattle grazing	Part of block Tondu 2 and 3 are badly affected.	Not affected	Part of block Mdelajhora 1 and 2 are affected.
Anthropogenic pressure	Except monsoon, villagers regularly enter into the fringe areas for collection of fuel woods and NTFPs.	Almost none	Except monsoon, villagers regularly enter into the fringe areas for collection of fuel woods and NTFPs.
Visitor pressure	Nil	Nil	Yes, visitors enter into the Park by riding elephant. Medla Watch Tower is also there for day visitors.

natural habitat. These enclosures have to be well protected (by electric fencing or by any other means) and under continual surveillance (24 hour) as a precaution against potential predators and attack of wild elephants. The animals can be maintained for a further two to four weeks in these enclosures before final release.

Taking into consideration of all the above mentioned facts detailed studies on the species' critical needs both in wild and captive conditions were made, these include habitat preference (biotic and abiotic habitat requirements), social behaviour, reproductive biology, home range, group size, dispersal, shelter and food requirements, foraging and feeding behaviour, predators and diseases. Almost two years of thorough field surveys in all the areas in Gorumara National Park especially Tondu, Garati and Medla areas [Table 2], one area (situated between latitude 26°46'48.02'' N to 26°47'12.42" N and longitude 88°51'21.93" E to 88°51'54.88" E; total area - 0.4 sq. km; average altitude – 111-115 m above MSL) is primarily selected for re-introduction (construction of 'soft-release' enclosure) of Pygmy Hog (*Porcula salvania*) at Gorumara National Park, West Bengal, through proper management's procedure [Figure 15]. This area is very close to the Garati Camp (Gorumara National Park - South Range). This area is preferred as because; it has suitable habitats for the survival of this tiny Suids in the wild, alongwith availability of adequate food base and water sources. This area is flat, well drained, thinly forested and has high forest land adjacent to the grassland. No tourist is allowed in this area and is not affected by domestic cattle grazing and other anthropogenic disturbances. If, everything goes right and re-introduction takes place then, the re-introduced animals can easily be monitored from the Garati Camp (due to its geographic position). Also this area is well protected, two nearby patrolling camps (Zero Bundh and Tondu) are within 2 km radius of this site.

Constraints

- However, certain difficulties are there. First of all, total coverage of the grassland in Gorumara National Park is only 10% of the total area, which is considerably less than the total grass cover area of Manas Tiger Reserve, Assam (39% of the total area) (Baruah *et al*., 2003). Majority of the existing grassland is under fodder plantation [Dhadda (*Saccharum longisetosum*) is the dominant species, Chepti (*Themeda arundinacea*), *Madhua (Saccharum arundinaceum) and* Purundi (*Alpinia* spp.) *are also there*] and rest is natural grassland [grass species like Kasia (*Saccharum spontaneum*), *Thatch (Imperata cylindrica),* Nol (*Arundo donax*), Khagra (*Phragmites karka*) etc.]. This natural grassland is concentrated on the riverbanks thus subject to destruction during monsoon, where flash floods are not uncommon.
- The degraded tall grass community has been gradually converted into community of short grass species. Some non-grass species/weeds namely *Leea* spp., *Eupatorium* spp., *Lantana camara* and *Bombax ceiba* have been found growing extensively in the grassland.
- Although, the grassland of Gorumara National Park is not subjected to annual burning for regeneration of tender grasses, for new fodder plantation and to control weeds, but, burning is followed/ practiced by Forest Department once in every three or five years.
- Due to successful management practices in this National Park, the population of large herbivores like Asian Elephant, Greater One-horned Rhinoceros, Gaur and Deer species is increasing day-by-day, causing more straying out of this animals into locality (leads to man-animal conflict) and may also cause food scarcity (the grass cover is not increasing). It is a big challenge for the Park managers to maintain these animals within the boundary of this Protected Area.

- The population of Leopard (*Panthera pardus*) in Gorumara National Park is also high. The park is home for other carnivores like Fishing Cat (*Prionailurus viverrinus*), Leopard Cat (*Prionailurus bengalensis*), Jungle Cat (*Felis chaus*), Jackal (*Canis aureus*) and Indian Fox (*Vulpes bengalensis*). As because Leopard and other carnivores may or may not be a direct predator of Pygmy Hog, thus, the effect on the re-introduced species cannot be ascertained.
- Pygmy Hogs are successfully re-introduced in the Sonai-Rupai Wildlife Sanctuary in Assam and a viable population has been established. For Gorumara National Park the same model may be adopted to build up the released population considering various sets of condition, like number of animals to be released, age group, sex ratio etc.

If these problems can be addressed, then Gorumara National Park may be considered as suitable for final re-introduction of Pygmy Hog (*Porcula salvania* Hodgson).

SUMMARY

The Pygmy Hog, *Porcula salvania* was first described by B.H. Hodgson in 1847 and he placed it in a new genus of Family Suidae under Order Artiodactyla. This hog was formerly presumed to occur along the foothills of Himalayas, extending from south Nepal to Sikkim, northern part of West Bengal, through parts of Bhutan and north-west Assam. But in the early or mid 1980, this tiny suid is confined to Manas Tiger Reserve due to its habitat destruction, habitat fragmentation and other anthropogenic activities.

First re-introduction of captive bred Pygmy Hog was successfully done by a team of workers under the guidance of Dr. Gautam Narayana and his team, in Sonai-Rupai wildlife Sanctuary, Assam during 2008 and 2009. These re-introduced hogs are thriving well in the wild.

The Forest Directorate, Government of West Bengal has taken up one project to re-introduce this tiny suid in their earlier habitat i.e. at Gorumara National Park, Jalpaiguri, West Bengal, where it has been extirpated or become locally extinct. Accordingly, the Forest Directorate, West Bengal assigned Zoological Survey of India to make feasibility study for re-introduction of Pygmy Hog at Gorumara National Park, Jalpaiguri and necessary funds were provided to the Z.S.I.

After making several extensive surveys at Gorumara National Park for the last two years, it can be concluded that part of Jaldhaka 1B Block (near Garati Camp) within the Park may be suitable for re-introduction of the Pygmy Hogs. Before re-introduction, it is recommended to set up one pre-release camp for maintaining them in integrated social groups, to encourage natural foraging, nest buildings and other behaviours for about five to six months. Then the animals can be maintained for a further two to four weeks in temporarily build soft-release enclosure in the selected habitat before final release.

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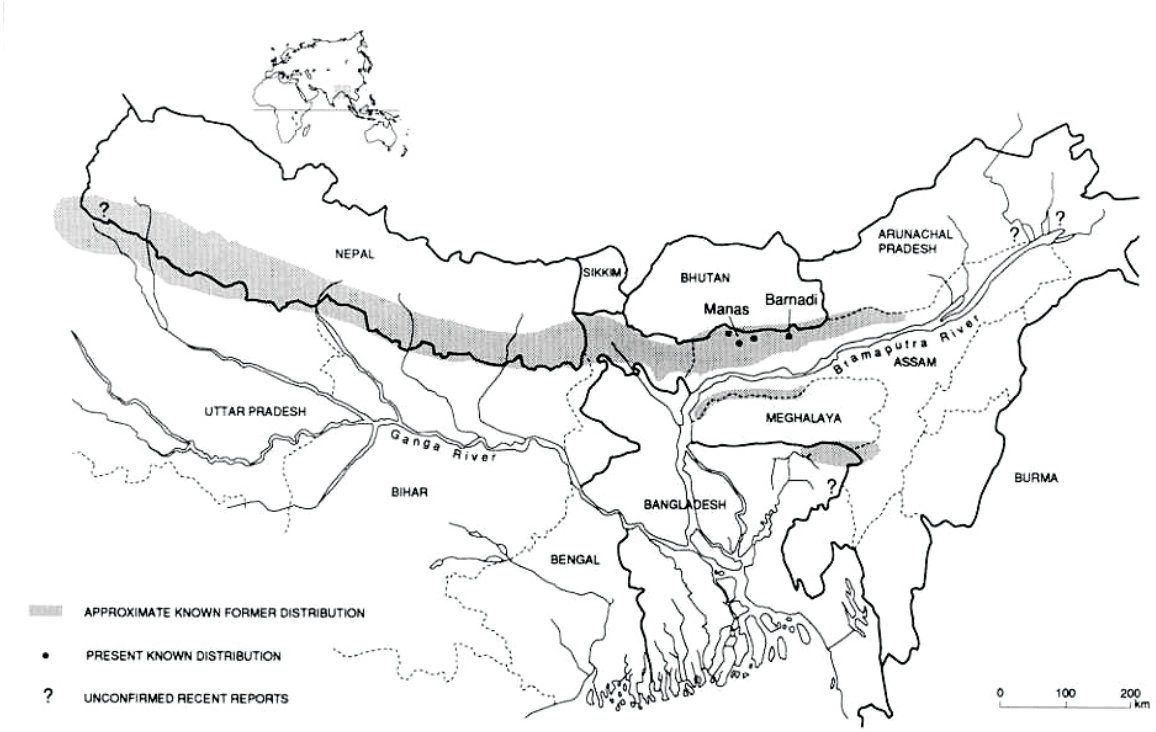

FIGURE 1: Map showing distribution of Pygmy Hog (Courtesy: IUCN/SSC PPHSG)

FIGURE 2: Female Pygmy Hog with piglets
(Courtesy : Pygmy Hog Conservation (Breeding) Centre (PHCC), Baistha, Assam

FIGURE 3: Solitary male Pygmy Hog
(Courtesy : Pygmy Hog Conservation (Breeding) Centre (PHCC), Baistha, Assam

FIGURE 4: Nest of Pygmy Hog
(Courtesy : Pygmy Hog Conservation (Breeding) Centre (PHCC), Baistha, Assam

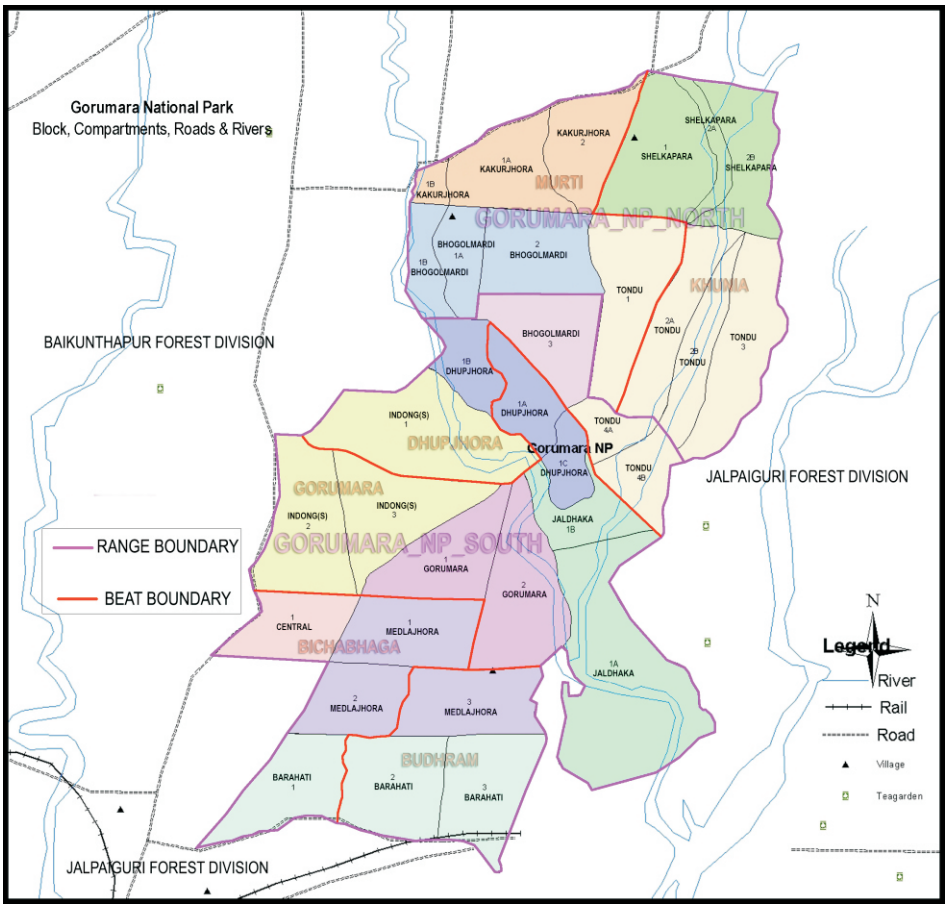

FIGURE 5: Map of Gorumara National Park (Range, Beat, Block, Compartments boundary, Rivers and Roads)

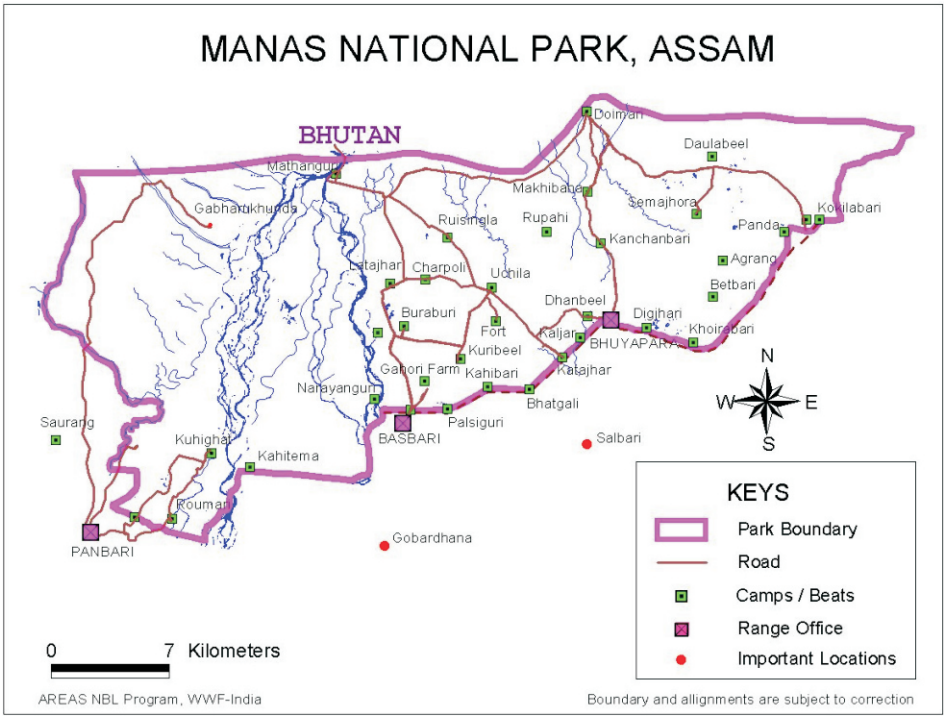

FIGURE 6: Map of Manas National Park, Assam (Courtesy: AREAS NBL Program, WWF-India)

FIGURE 7: Aerial view of the Pygmy Hog Conservation (Breeding) Centre (PHCC), Basistha, Assam

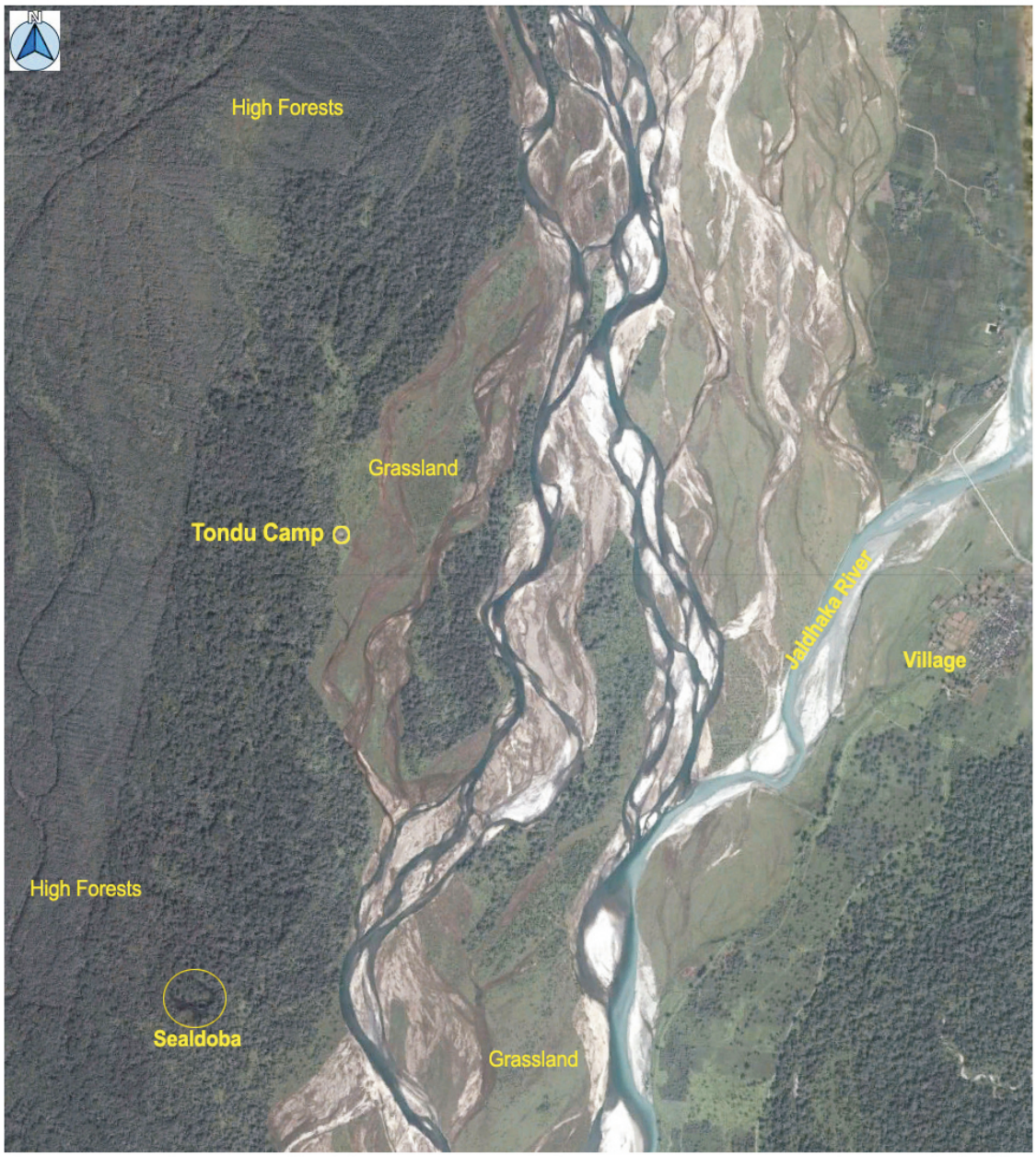

FIGURE 8: Aerial view of the grassland and forested areas near Tondu Camp (Map courtesy: Google Earth)

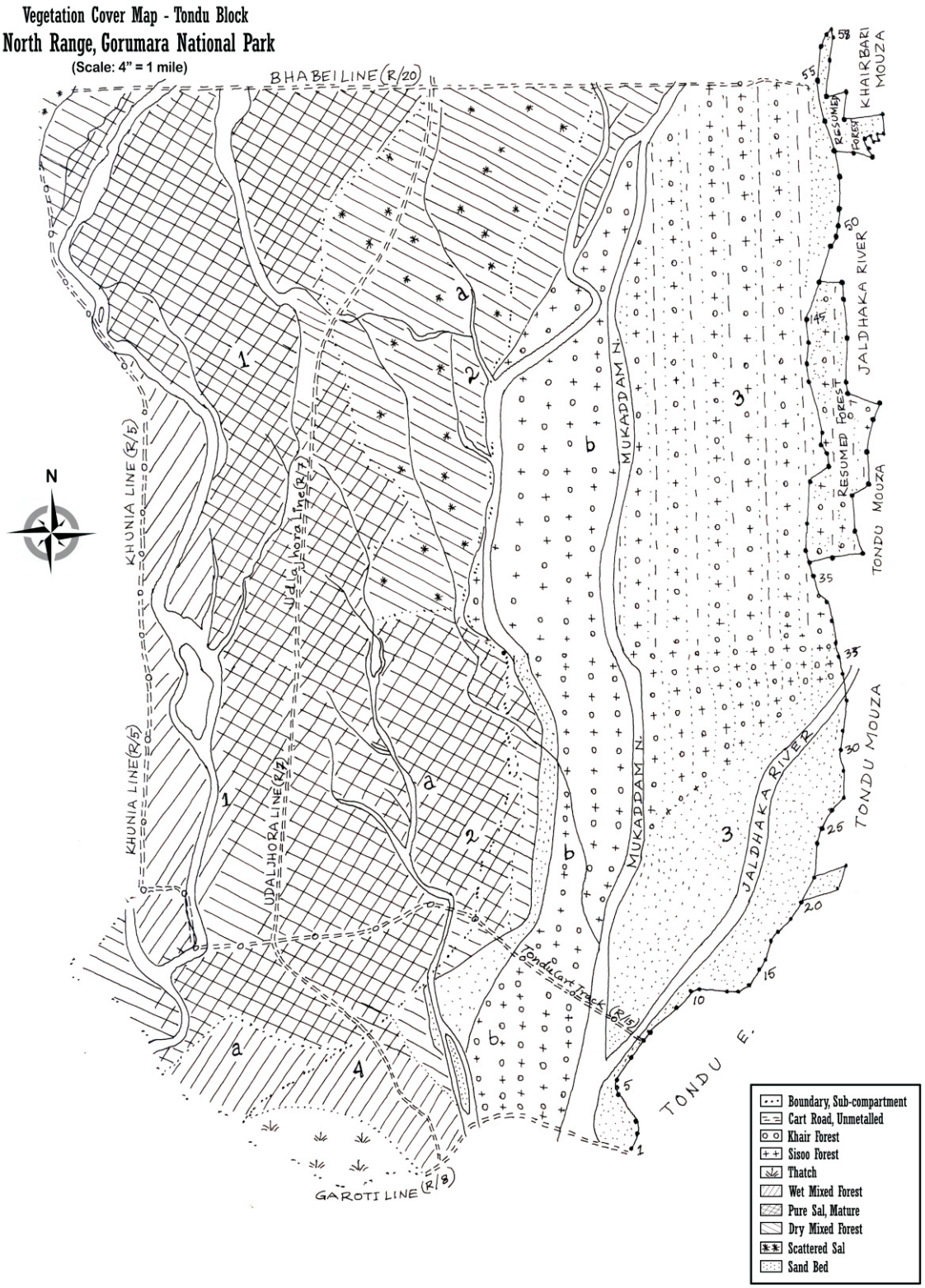

FIGURE 9: Vegetation cover map of Tondu Block (Gorumara National Park)

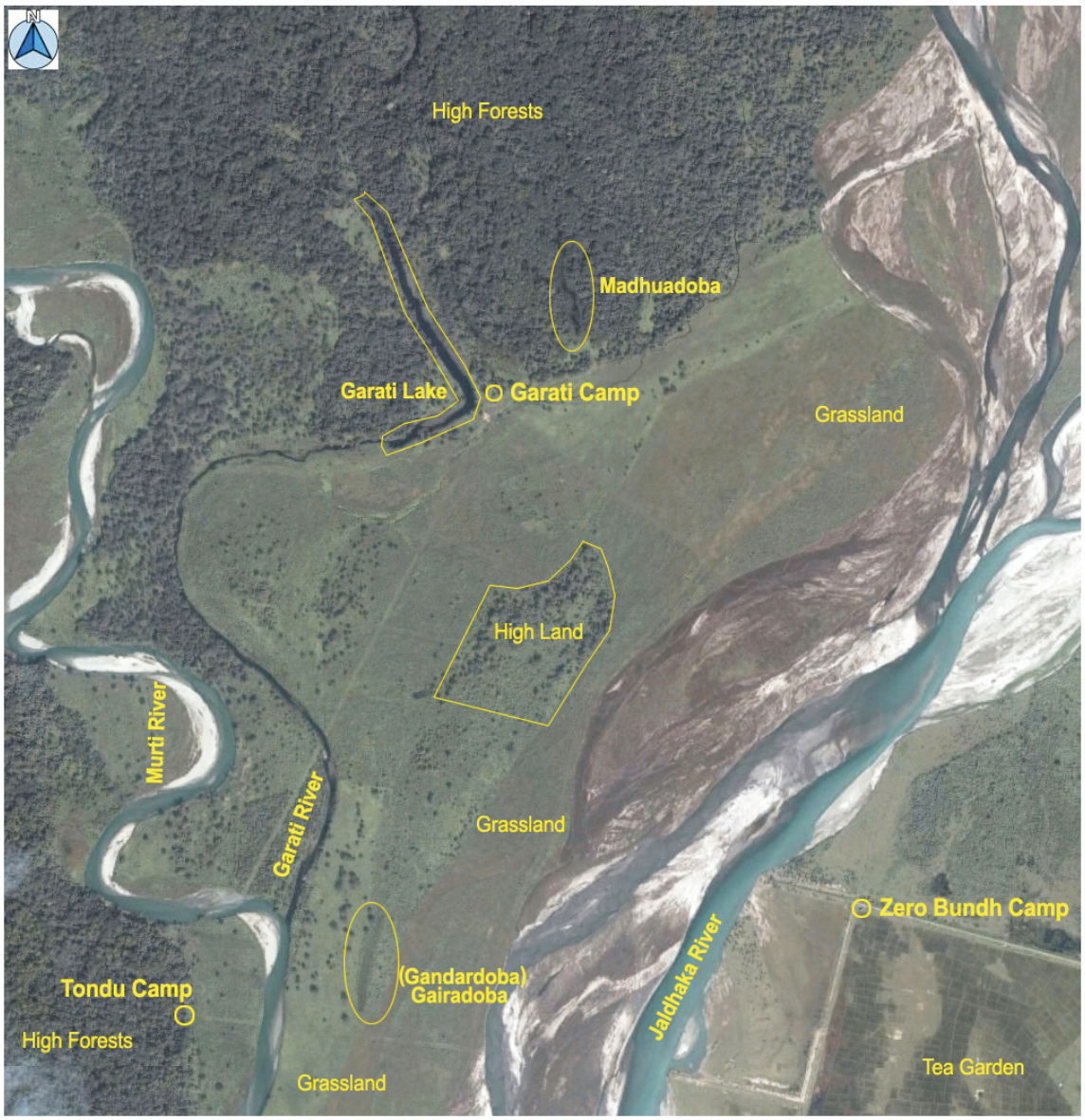

FIGURE 10: Aerial view of the grassland and forested areas near Garati Camp (Map courtesy: Google Earth)

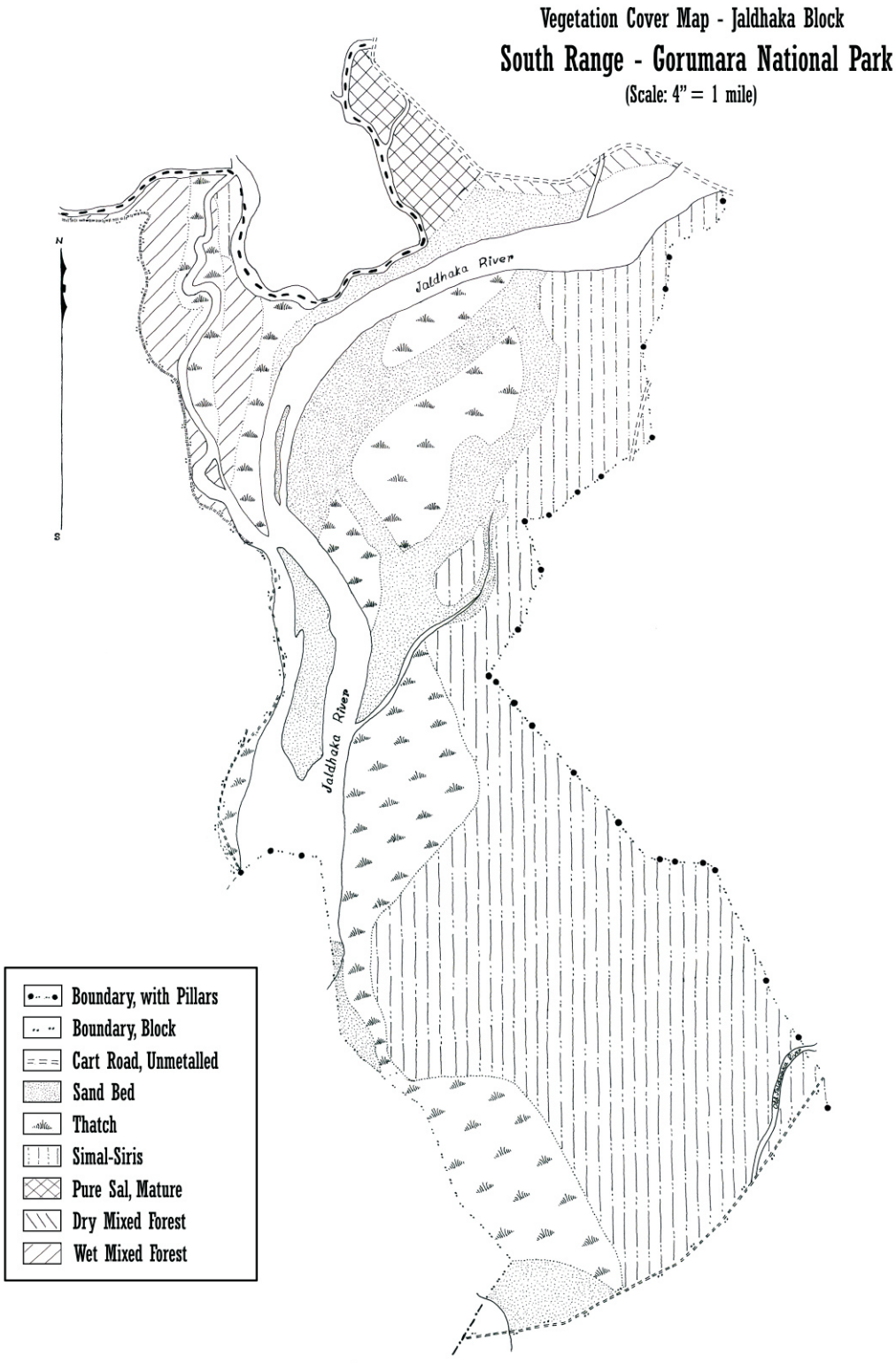

FIGURE 11: Vegetation cover map (old) of Jaldhaka Block (Gorumara National Park)

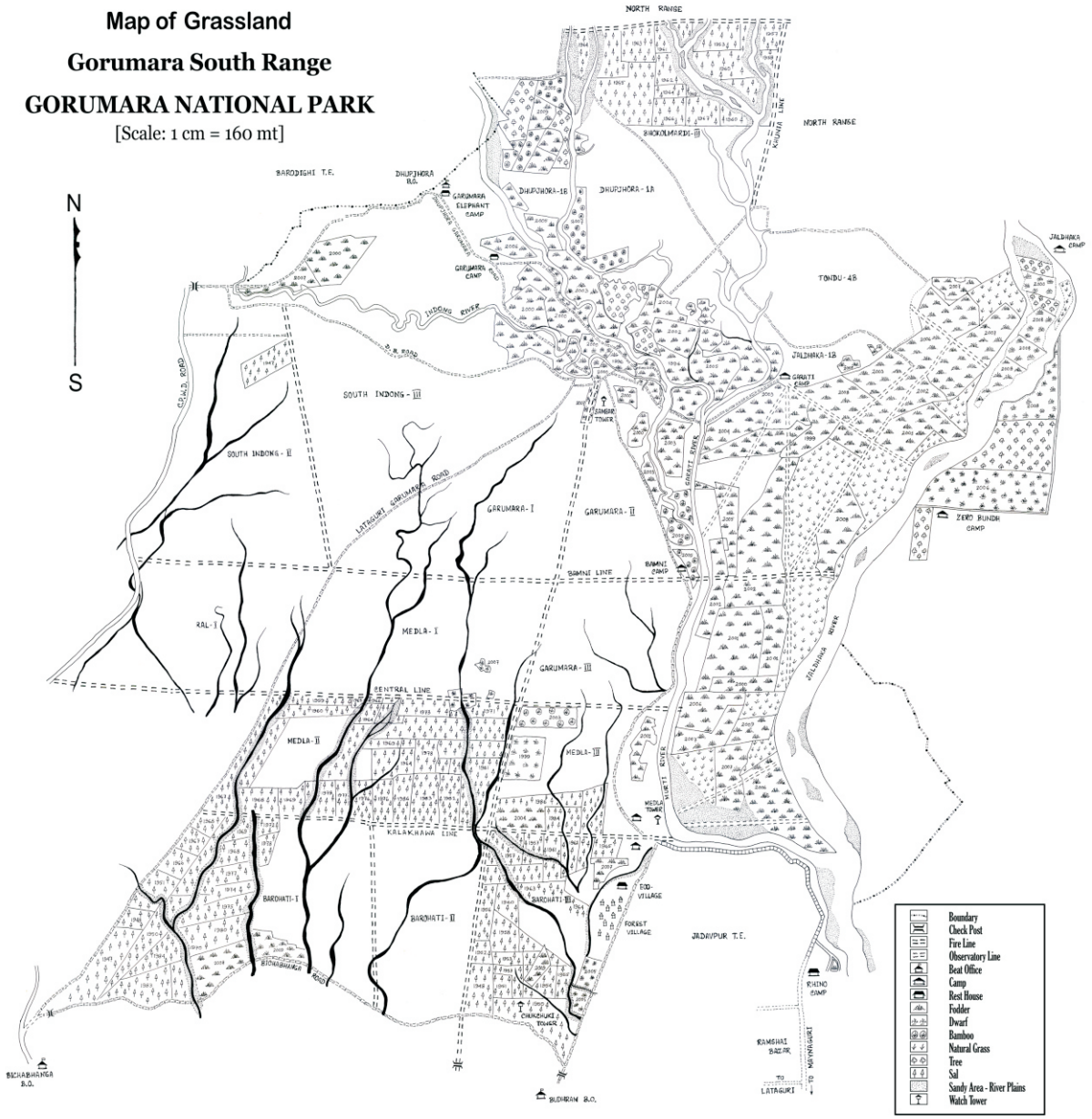

FIGURE 12: Vegetation cover map of South Range, Gorumara National Park

FIGURE 13: Aerial view of the grassland and forested areas near Medla Camp (Map courtesy: Google Earth.

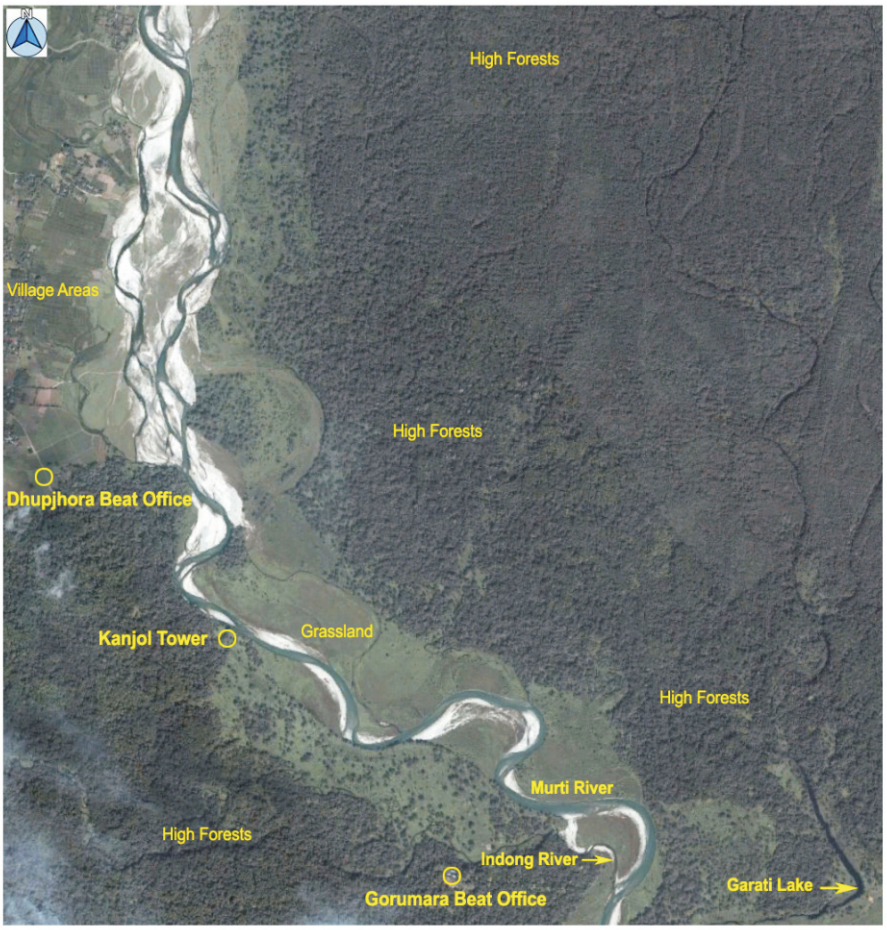

FIGURE 14: Aerial view of the grassland and forested areas near Kanjol Tower (Map courtesy: Google Earth)

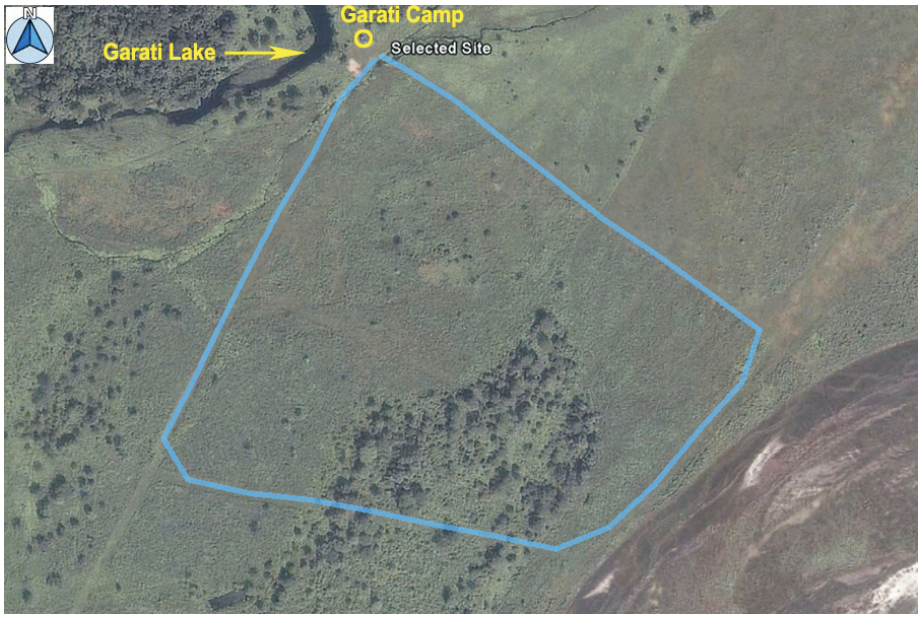

FIGURE 15: Aerial view of the area which is preferred for primary re-introduction (Map courtesy: Google Earth)