ASIAN WILD BUFFALO

(*Bubalus bubalis* Linnaeus, 1758)

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Order	:	Artiodactyla
Family	:	Bovidae
Sub-Family	:	Ruminantia
Tribe	:	Bovini
Genus	:	*Bubalus*
Species	:	*B. bubalis*
Common name	:	Wild buffalo, Asian Wild buffalo, Indian Wild buffalo

Conservation Status		
WPA (1972)	:	Schedule I
IUCN RED DATA BOOK	:	Endangered
CITES	:	Appendix III

INTRODUCTION

Asian wild buffalo (*Bubalus bubalis* Linn.) in the Indian Sub-continent is also called as water buffalo or 'Arni'. It is one of the four wild oxen species found in India (Prater 1965). Three others are: the Gaur or Indian Bison (*Bos gaurus* H. Smith), the Banteng or Tsaine (*Bos banteng* Wagner), and the Yak (*Bos grunniens* Linn.). The mammalian tribe Bovini (family Bovidae, subfamily Bovinae) contains all the most important of the world's larger domestic species. Wild oxen are easily recognizable by their massive build and their general similarity in form to domestic cattle. The wild buffalo is the third largest land mammal in the Indian Sub-continent, after the elephant and the rhinoceros (Ranjitsinh *et al.* 2000). In the rest of Asia, it is now in all likelihood extinct.

The wild water buffalo is the ancestor of the domestic water buffalo, which is now found in most tropical and subtropical regions as the buffalo was domesticated very early during the ancient human civilization, but exactly

when and where, is uncertain. Representations of tame and hence possibly domesticated buffaloes appear on seals both in the Indus valley (Mohenjodaro) and in Mesopotamia from about the middle of the third millennium B.C. (Mason 1974, Mathur *et al.* 1995, Lenstra and Bradley 1999, Massicot 2004).

In Bovini, there are four genera and twelve species. *Bubalus* (Asian buffalo), *Syncerus* (African bufffalo), *Bison* (American bison), and *Bos* (Gaur and cattle), between them no interbreeding appears possible. On morphological basis, the closet relative of *Bubalus* is the African buffalo *Syncerus*. Both have horn cores which tend to be triangular in cross section (Mathur *et al.* 1995, Muley 2001). In wild bovids, *Bubalus* has four species (IUCN/SSC 1988). These are: (i) *Bubalus bubalis* (Asian wild buffalo) – truly wild populations occur in India and Nepal while domesticated or feral form are very widely distributed in Asia, South America, North Africa, Europe, and Australia; (ii) *Bubalus mindorensis* (The Tamarau) – closely related to Asian wild buffalo and is endemic to the Philippine island of Mindoro; (iii) *Bubalus depresicornis* (Lowland Anoa) – a dwarf race, 60-100 cm at shoulder, related to water buffalo and native of dense forests of Sulawesi in eastern Indonesia; and (iv) *Bubalus quarlesi* (Mountain Anoa) – like Lowland Anoa, it is also endemic to Sulawesi, but is found in mountain forests up to 2000 m. Some authorities, including Groves (1969), use the name *B. arnee* in place of *B. bubalis*. Likewise, 1996 IUCN Red List on Threatened Animals listed the Asian water buffalo as *Bubalus arnee* and later changed to *Bubalus bubalis* in 2000 Red List (Massicot 2004).

The wild buffalo in most of its existing range in Assam is interbreeding with domestic buffalo. Initially, the gene flow is from wild bulls to domestic cows, but when hybrids turn feral join the wild herd, the flow reverses and, due to sheer out numbering of wild by domestic and hybrid, the gene introgression leads to "swamping" of the wild gene pool (Muley 2001).

Two types of water-buffalo have been discerned; the 'swamp type' in South East Asia and 'river type' on the Indian sub continent and farther west. The swamp type resembles the Arni progenitor most closely. The two types differ in karyotype (swamp type has 2n=48 chromosomes while the river type buffalo has 2n=50). In contrast, African buffalo has 2n=52 chromosomes (Lenstra and Bradley 1999). The two types of water buffalo crossbreed to produce fertile progeny with 2n=49 chromosomes.

SURVEYS AND ECOLOGICAL STUDIES

With the advent of British rule in the Indian sub-continent, and particularly after the consolidation of the whole country following the mutiny of 1857, many hunters penetrated all parts of the country. Earlier available books and references on natural history by several hunters and naturalists refer about the wild buffalo in the jungles. Prominent references on wild buffalo have been made by Forsyth (1889), Brander (1923), Mooney (1930), Pocock (1939), Gee (1953) and Noronha (1954a and b). They gave a vivid picture of the great herds of hoofed animals and the numerous large predators that occurred in extensive and dense grassy jungles. Surveys on wild buffaloes in Northeast India and Central India have been documented (Mooney 1930, Daniel and Grubh 1966, Spillett 1966, Divekar 1976, Divekar *et al.* 1979, Divekar and Bhusan 1988, Mathur *et al.* 1995, Ranjitsinh *et al.* 2000). There are only a few studies on wild buffalo those have focused on the morphological features, behavioural characteristics and ecology of the species (Inverarity 1895, Gee 1953, Ashby and Santiapillai 1987, Pandey 1988, Mathur *et al.* 1995, Muley 2001, Kotwal *et al.* 2003, Kotwal and Mishra 2004). The only study available on population genetics of wild buffalo is by Muley (2001).

MORPHOLOGICAL FEATURES

Wild buffaloes in Kaziranga National Park, Assam have been categorized based on horn size and shape, body coat colour and chevron markings into three categories: (i) wild inside the park, (ii) hybrid feral inside the park, and (iii) hybrid domestic in cattle camps on the adjacent islands in river Brahmaputra (Mathur *et al.* 1995). Wild buffalos can be sexed and aged into adult male, adult female, sub-adult, and calf. The sub adult male and female are difficult to identify in field conditions as they have the same morphology and the distinguishing characters develop only at the later phase of this stage. The genitals of the sub- adult males are not fully developed and thus this character does not help in identification. The sub- adult buffaloes have a smaller body size when compared to adult buffalo. Hair on the body is more, body coat colour is brownish red and the under parts are reddish. Horns are much smaller and semi-lunar in shape. Adult male and female buffaloes can be easily distinguished in field mainly based on horn shape and body coat colour. Adult males have crescent shaped horns, which are very thick at the base. These horns are highly curved, thus the tip to tip distance between them is small. The body coat colour varies from dark grey to black, with light reddish ear pinnae and under parts of the body. The adult males have more hairs on

the body compared to the female. The bones above the eye form pronounced ridges, which have supra-orbital flecks (patch of light coloured hair). They also have supra-labial and infra-labial flecks, which tend to be obscured with age. The adult females have comparatively thin and less crescentic horns. Tip to tip distance between the horns is larger than that the male. Body coat colour is grey to brownish, more like mud colour. Hair on the body is very scanty. They lack supra-orbital flecks and have supra-labial and infra-labial flecks present. In the case of the calves, the body coat at birth is golden colour and the body is covered with thick hairs. At about six months of age, calves develop reddish brown coat and horns start appearing. Chevrons are the characteristics features of wild buffalo and helps, not only in age classification, but also in differentiation from domestic buffalo in which chevrons are absent. Chevrons are light and pale cream coloured markings, present on the neck region at two places; below the lower jaw and above the chest. These markings are due to the presence of light colored hairs and the skin. Chevrons become very distinguished in calves after the age of six month and stay so till the sub-adult stage. It becomes obscured and indistinct in older animals.

In wild *B. bubalis*, head and body length is 2,400 – 3,000 mm, tail length is 600 – 1,000 mm, shoulder height is 1,500 – 1,900 mm and weight is 700 – 1,200 kg (Massicot 2004).

Mathur *et al.* (1995) carried out the morphometric study using skulls of wild buffalo collected in Udanti sanctuary, Central India (n=2) and North-eastern India (n=30) and the comparison resulted into higher distance from tip to tip of the horn in the case of Central Indian population (965 mm) in comparison to North-eastern buffaloes – NEB (869 mm). However, the maximum distance of horns and outer curved distance was much higher in the case of NEB. No sex differences were made based on horns. Lundrigan (1996) recognized that the paired frontal horns are most distinctive characteristic of bovids. Accordingly, Muley (2001) used headshot (photographs) of the individual buffalo taken in KNP using a 35 mm camera fitted with zoom lens (70-210 mm and 70-300 mm) and 35 mm slides were projected on a white paper so as to make linear measurements of the horn using a standard millimeter ruler. The Principal Component Analysis revealed that the samples of domestic buffaloes collected in the surrounds of KNP were separated from the domestic hybrid buffaloes maintained in cattle camps on the northern periphery of KNP and wild buffaloes inside the parks. The hybrid and wild buffaloes showed some overlap in their scores as hybrid populations contains some

backcrosses. Further, the factor analysis indicated that all three groups have very tight distributions i.e. three types of buffaloes (domestic, hybrid and wild) were distinctly segregated. The results indicated that the wild are distinct groups with hybrid buffaloes being the intermediate. The dendrogram generated using pair-wise linearized square distances indicated that wild and hybrid are in one clade and the domestic buffaloes are separate from these two. The overall results indicated that it is possible to construct a classification scheme to decipher three categories of buffaloes found in around KNP.

GEOGRAPHICAL AND ECOLOGICAL DISTRIBUTION

Distribution and Status

The grassy jungles and swampy areas are the ideal habitat for the wild buffaloes where they can get food and shelter, and pools of water and mud for wallow. They occasionally use woodland. They prefer areas of short grass adjacent to water bodies (swamps, river, streams etc.) with scattered trees.

The Asian wild buffalo (*B. bubalis*) is now designated as endangered by the IUCN. Wild members of this species have disappeared from most of the original range because of usurpation of habitat by agriculture, hunting by people, and competition from and diseases transmitted by domestic livestock. A few herds, presumably to be descended from original native stock are still scattered in India and Nepal.

The wild buffalo was the once widely distributed over the tracts of tall grasslands and riverine forests in India and Nepal. Its range extended from eastern Assam in floodplains of river Brahmaputra to *Terai* grasslands and flood plains of the Ganges in Uttar Pradesh and Uttranchal and going southwards to coastal plains to the south of Godavari River in Peninsular India (Mathur *et al.* 1995). As late as of nineteenth century, wild buffalo was plentiful in Assam, Bengal, Bihar, Orissa and Madhya Pradesh (Fahimuddin 1975). There is no mention of the wild buffalo in old Tamil literature, although domestic ones are frequently mentioned. As regards wild buffaloes in Sri Lanka, they are thought to be feral and not truly wild (Cockrill 1974, Ashby and Santiapillai 1987). There is substantial free living population in south-east Asian countries (such as Burma, Malaysia and Indonesia) and Australia which was derived from domestic swamp buffaloes (Cockrill 1974).

By the middle of twentieth century, wild buffaloes were present in few surviving grasslands of Brahmaputra valley (Kaziranga, Dibru-Sakowa, Laokhowa and Pabha) and Manas in Assam; in riverine forests of Indravati in Bastar district and Udanti, Sitanadi areas in Raipur district of Madhya Pradesh; Koraput district in Orissa and in Kosi Tappu in Nepal (Daniel and Grubh 1966). A large-horn variety *Macroceros* was found in Manas and on the foot hills of Arunachal Pradesh till the turn of twentieth century. But this variety was lost completely due to extensive hunting.

Today, wild buffaloes in India are found in only two states and that to in a few scattered wildlife protected areas, namely Kaziranga and Manas National Parks in Assam; and Indravati NP, and Udanti, Sitanadi, Bhairamgarh and Pamed Sanctuaries in Chattisgarh. In the last bastion of the wild buffalo, Assam, the population is almost confined to Kaziranga NP. In other PAs of Assam, the few surviving animals are all affected by genetic swamping through interbreeding with the domestic buffaloes and this has also overtaken the population in Kaziranga. A marked deterioration in size of the wild buffaloes in the PAs in Assam has been observed (Ranjitsinh 1997). In Manas, the laxity of control due to the insurgency during the past decade has resulted both in the reduction of numbers and probably genetic swamping in the much more numerous southern populations which will inevitably have effect on the rest of the herds in the adjacent central part of the reserve – the Uchila range and along the Manas – Beki River (Ranjitsinh *et al.* 2000). The main hope with regard to the genetic purity of the wild buffaloes lies in the Peninsular population, confined in the last two decades to the four protected areas specially set up for them in the erstwhile Madhya Pradesh (Bastar region in the present Chattisgarh state).

Probably, Kosi Tappu Wildlife Reserve is the only remaining habitat for wild buffaloes in Nepal, wherein the population is estimated around 160 buffaloes.

Population

In contrast to the huge population (more than 130 million) of domestic water buffalo (*B.bubalis*), the present population of wild water buffalo in its entire range is estimated to be lower than 2,000 individuals that to in widely scattered protected areas across Assam and Chattisgarh states in India and Kosi Tappu reserve in Nepal.

Presently, Kaziranga National Park (KNP) is the main strong hold of wild

buffalo as it harbours almost 80-90% of its estimated population. Present population in and around Kaziranga is about 1,600 individuals (Vasu 2003). The population in KNP has shown a steady increase from 1966 onwards. The first systematic and extensive census of wildlife in KNP was conducted in 1966 (Spillett 1966). A total of 471 buffaloes were tallied during the two days census across eight blocks covering 33 compartments and using 18 census parties (four persons on elephant). The census was a total count of compartment and blocks. Since 1966, the Assam Forest Department has carried out census every six years. The population has shown a gradual increase from 471 in 1966 to 1192 in 1999. An exclusive census of wild buffaloes was also carried out by the park authorities in March 2001 in which 1,670 animals were counted including 228 feral buffaloes (Vasu 2003). In 1999, wild buffaloes were found in all the census blocks of KNP with heaviest concentration in the Baguri block on the western side of the park. Interestingly, in almost all the past census conducted so far, the Baguri has the maximum concentration of all the wild animals (elephant, rhino, swamp deer, sambar, hog deer, barking deer) and according to the 1991 census figures, about 50.6% of the buffalo population was recorded from this block only. This block represents about 17.1% area of the original park or roughly one fifth of the total area of the park (429.9 km^2). The density of wild buffalo in Baguri block works out to seven buffaloes per 100 ha while density in rest area of the park covering 4/5th of the total area was just one buffalo per 100 ha. Thus, Baguri block provides the most favoured and preferred habitat to wild buffaloes in KNP.

Populations of wild buffalo in other PAs of Assam including Manas Tiger Reserve have definitely dwindled in the recent past. There is a hope for recovery of population in Manas with now effective protection and improved management provided. Population surveys on wild buffaloes in Peninsular India have been undertaken from time to time right from the year 1930. Almost all earlier surveys by Mooney (1930) in Orissa, Daniel and Grubh (1966) in Peninsular India, Divekar (1976) in west Bastar, Divekar *et al.* (1979) in Raipur and Bastar districts, Divekar and Bhusan (1988), Mathur *et al.* (1995) in Udanti sanctuary, and Ranjitsinh *et al.* (2000) in Udanti and Indravati protected areas have indicated the rapid decline trends in the population and concluded that the species appears to be moving towards local extinction, primarily due to poaching, habitat loss, low population size and probably resultant genetic disorders. Daniel and Grubh (1966) have estimated a population of less than 250 animals in Bastar and Raipur dustricts while this has further declined to 150 individuals (Divekar and Bhusan 1988). It was feared that this 100 odd individuals were facing the inbreeding problem.

A joint survey carried out by the Madhya Pradesh Forest Department, Wildlife Institute of India, Bombay Natural History Society, and Bastar Society for Nature in May 2000 assessed 42- 44 animals in Udanti and about 25-30 buffaloes in Indravati, the total number thus less than 75 (Ranjitsinh *et al.* 2000). Subsequent to this last survey, the Chattisgarh state was carved out of larger erstwhile Madhya Pradesh almost four years ago. On the one hand, the problem of insurgency in the Bastar region has gone out of control while on the other hand the newly created state recognizes the significance in protecting and conservation of wild buffalo being the state animal. Accordingly, the current estimated population of wild buffalo in different pockets/PAs in the region by the Chattisgarh Forest Department is around 200-250 individuals. As stated earlier, the estimated population in Kosi Tappu, Nepal is around 160 individuals.

Hence, from the above stated figures (Assam, Chattisgarh and Nepal) it is amply clear that the species of wild buffalo has greatly suffered in its entire range of distribution and moreover there are hardly any promising signs of its improvement/recovery in majority of the locations of its present distribution. The only favourable site for this species is Kaziranga NP wherein the population has shown a steady growth during the past 40 years or so and the population is further expected to grow with better protection and improved habitat management. A constant vigil and annual monitoring of wild buffalo population is required as there are evidences that populations of other sympatric wild herbivores (rhino, swamp deer, hog deer) in KNP are also on constant increase during last two or three decades and there is an apprehension that these species may compete for resources. Nevertheless, the park management has been successful in extending the park area by adding six additional areas and presently efforts are on to get the entire park area free from cattle camps maintaining domestic 'hybrid' buffaloes.

ECOLOGY

Spillett (1966) has provided some insight on the sex and adult to young ratio based on the extensive census carried out in Kaziranga NP. Accordingly, 82% counted individuals were adults, of which almost 30% were 'non-sexed'. Out of 271 sexed adults, 80% (217) were females and 39% of these were reported to the accompanied by young. Thus, for every 2.6 sexed females there was one young. The analysis of census figures obtained for the year 2001 revealed that almost 73% of sexed

adults were females (Vasu 2003). Nearly 11% of the total population was represented by calf category. For every 3.8 sexed adult females there was one calf. It appears that female to calf ratio has improved in the recent time in comparison to the earlier census.

Study on the ecology and population genetics of the Asian wild buffalo in KNP during 1988-1992 by Mathur *et al.* (1995) revealed that out of the total 25 sightings, 68% sightings were made in short grasslands. Buffaloes avoided the woodland. Herd size ranged from solitary bull to a total of 45 individuals, 48% of the sighting was in the category of 10-20 individuals. The average herd size comes out to be 13 individuals/herd. Adult solitary bulls comprise 24% of the total sighting records whereas, they formed 40% of the total adult males recorded. The solitary bull is commonly encountered unit, all (100%) of the isolated individuals were adult males. In terms of total abundance, adult females out numbered adult males by eight times. The adult male to female ratio was 1:8 or 12 adult males: 100 females. Breeding herds forms 50% of the total sightings. Herds with adult males constituted 35% of total sighting records while herds without adult males were recorded for 41% times of total sightings. For every 100 adult females there were 34 calves, and for every 100 adult buffaloes there were 62 sub adults.

Before Kaziranga was declared as a national park in 1974, there were several '*Khuties*' (cattle camps) on the northern periphery and these *Khuties* had domestic swamp buffaloes. During the peak breeding season (November – January), wild bulls thronged the cattle camp to mate with female domestic buffaloes. The livestock owners encouraged interbreeding with wild bulls as the calves thus produced fetched higher prices in the village market. Moreover, domestic bulls could not be maintained in cattle camps as they were invariably chased out by the wild bulls. The husbandry practices were such that the animals were handled minimally, making them very aggressive and strangers. These cattle camps were rehabilitated in 1973-74, several livestock herders could not translocate their buffaloes and they were left inside the park to form a distinct 'feral' population. The rehabilitated cattle camps were settled on the river islands in river Brahmaputra, north of newly created Kaziranga NP. Mathur *et al.* (1995) carried out a survey on the domestic buffaloes in cattle camps. Eight camps (Laharni, Murkhowa, Bhawani, West Lumsali, East Lumsali, West Janeki, East Janeki, and Debashari) had a population of more than 2,800 domestic buffaloes. The park management has made efforts in recent years to once again relocate

these cattle camps on river islands as the entire stretch of river Brahmaputra along the northern boundry of KNP has been added as the sixth addition and the wildlife law requires relocation of villages, cattle camps, etc. It seems that considerable population of domestic buffaloes in cattle camps has declined over the years because of strict regulations. However, there is regular interaction of domestic buffaloes with wild buffalo bulls. Cattle herders leave their herds to graze in the park area. Invariably, wild bulls will follow the domestic buffaloes while they return to the cattle camps in the evening. This way, despite cattle camps being relocated outside the National Park area, wild bulls continued to mate with domestic buffaloes. The domestic buffalo females are therefore sired by these visiting solitary bulls. Cattle owners dispose the male hybrid progeny before they attain the age of one year in far flung areas for drought purpose.

The genetic exchange between domestic and wild buffaloes was therefore studied and clearly established (Mathur *et al.* 1995). Based on the data on hybrid domestics, it is assumed that calves are born on equal sex ratios in wild buffaloes . Mortality in case of hybrid domestic calves was slightly biased towards male calves i.e., for every 100 female calves, 140 male calves died. If this is assumed in case of wild buffaloes it would explain partly as to why only 12 adult males were present for 100 adult females. This revealation can be argued and supported by the fact that males are solitary on account being thrown out of the herd during the breeding season by the dominant males and they suffer higher mortality due to predation when compared to females who remain in herds. Also since during the rut the dominant bulls spend more time and energy defending their harem and territory, they become weak and emaciated at the end of the season which makes them vulnerable to predation and disease.

Wild buffaloes used short grassland more than its availability whereas woodland was avoided. Wetlands (*beels*) were used significantly in proportion to its availability, where as tall grasslands were used less than their availability. After the monsoon season, when water starts drying, short grasslands surrounding the lakes are exposed. These short grasslands around numerous reduced *beels* offer the best grazing grounds for all the wild herbivores in KNP including wild buffaloes. Wild buffaloes are predominantly grazers and they find very little grassland in woodland areas to feed. However, during the monsoon season when all short grasslands and most of the tall grasslands are submerged under

several feet of water, buffaloes are known to use the woodland. *Beels* (lakes and swampy areas) are used by wild buffaloes for feeding and wallowing. Buffaloes were also observed to feed on water hyacinth and other aquatic vegetation. Wetland habitats in KNP were classified based on depth of water body, extent of bank area and extent of adjacent short grasslands. Twenty *beels* were classified into eight wetland type. Wild buffaloes used all the eight habitat types indicating that wetlands play an important role in determining the habitat suitability for wild buffaloes while there was a decreasing order in the case of elephant and rhino, swamp deer and hog deer. Wild buffalo preferred medium depth of wetlands and large extent of short grasslands. The study also indicated that probably there is no direct competition between the five wild herbivores (elephant, rhino, buffalo, swamp deer, and hog deer).

Unfortunately, till date there is no radio-telemetry study carried out on wild buffaloes in India or even in Nepal so as to provide authentic information on the habitat use, movement and dispersal pattern, home range, etc.

BEHAVIOUR

The wild buffalo is usually diurnal and lives in herds of females and their young. The males gather in separate bachelor herds outside the breeding season or remain solitary. Only the dominant bull mates with a large number of female buffaloes. Thus, usually during the peak breeding season (November-January) only one bull can be seen in a herd of buffaloes. This bull spends entire breeding period and avails opportunity to breed with as many females in estrous as possible. According to Massicot (2004), calves are usually born in March-May, but have been observed in other months of the year also. Gestation period is assumed to be about 300-340 days. Puberty is reached about 18 months and usually one calf is born. The birth interval is usually about two years. Weaning occurs after 6-9 months. Maximum age of at least 25 years in the wild and 29 years in captivity has been documented.

Despite wild buffalo remaining in a herd; they usually maintain a safe distance of about 50-75 m. Often they get alarmed or even start running on seeing the human or otherwise being disturbed. They continue to graze on short grasslands around *beels* or remain in wallow if the safe distance is maintained and they are not being disturbed. They are true social animal. This was evident when one of the herd members was chemically

immobilized for collection of blood sample in KNP during the study carried out on this species. Till the buffalo was revived by the research team and could join other members of its herd, the entire herd remained present at a distance.

Wild buffalo is definitely ferocious and aggressive in its behaviour, particularly wild solitary bulls and buffaloes with calves are dangerous and they often charge. Wild buffalo seems to have a good power of hearing. As to sounds, members of a herd grunt to each other when moving along. Adult wild bulls often fight during the breeding season in order to show their dominance.

CONSERVATION

Once widely distributed in its former range, wild buffalo is one of the worst affected mammalian species in the recent times. In past, the species was hunted for its meat, hide, and trophy while during recent past 40-50 years; habitat loss on the account of agriculture expansion and other developmental works has severely impacted this species. Domestication of the species and continuous interbreeding with domestic buffalo in majority of field sites has led to genetic swamping, competition and mortality due to disease. Extremely small populations of wild buffalo that too in widely scattered locations probably also results in inbreeding and related genetic disorders. Habitat fragmentation, habitat degradation, and poaching are the main threats to the conservation of this globally important species. Frequent and increasing level of floods in Brahmaputra in recent years is one potential causes of worry to wild buffalo population in KNP. Flood is a normal phenomenon in river floodplains and essential for maintaining the diversity of habitats particularly grasslands and wetlands in the area by annual inundation. Brahmaputra is prone to flooding and river migration. However, increased level of disturbance by way of deforestation in the up-stream/catchment, construction of lateral embankments, diversion of river flow, construction of reservoir and other developmental activities can have cascading effect on the hydrology of the area and river channel changes ultimately impacting the wildlife habitat and threatened species.

Despite wild buffalo as a species has greatly benefited the human society by its early domestication and subsistence support for livelihood to masses, the species has suffered severely in living memory and dismally never received recognition and attention which it deserves. In present

time, it is now difficult to ascertain the purity of wild buffalo population in the absence of a well known reference/control population. The study on population genetics on wild and domestic buffaloes in KNP has revealed that the wild buffaloes in the national park area are still a distinct group fully worthy of conservation efforts (Muley 2001). Hence, urgent and concerted efforts are needed to rehabilitate cattle camps and domestic buffaloes from the northern side of the original KNP (429.9 km^2) as the entire Brahmaputra river stretch along the initial KNP has been added as the sixth addition (376.5 km^2 river area upto its northern bank including enclave river islands) to KNP. Once the biotic pressure due to existing cattle camps and ongoing genetic exchange between domestic buffaloes and wild bulls are discontinued in the larger area of KNP, chances are that habitat will recover rapidly and the wild buffalo population will increase in its size and the current level of genetic divergence *vis-a-vis* hybrid and domestic buffaloes will be maintained.

In the case of Manas Tiger Reserve, efforts for effective protection of wild buffalo population and habitat improvement are desirable on priority so as to safe guard the species from local extinction.

The central Indian population of wild buffalo in the Bastar region and Raipur district has dwindled to precariously low level. Despite the species having been declared as the State animal by Chattisgarh, the scattered populations are under constant risk due to increasing biotic pressure and hunting. The protection of species and its habitat has become much more complex due to growing threat of local insurgency. However, the significance of these population(s) from the genetic purity and variability point of view can not be over emphasized. Efforts on the highest priority firstly, to protect the population(s) through awareness campaign and community involvement while strengthening the protection infrastructure and adoption of anti-poaching strategies are urgently required. Secondly, concurrent actions for habitat restoration, preservation of the germplasm using appropriate technology are also necessary. This would be possible if the species is not only given its much desired national and international recognition but also wanted vital support for its conservation. Further, research studies carried out so far on both populations (North-eastern and Central Indian) are now quite old, inadequate and need updation in view of the changed scenario. Thus, there is an urgency to encourage and support research and monitoring activities on the species in its present distribution range.

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