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The barasingha, or swamp deer, in Suklaphanta Wildlife Reserve, Nepal

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Between 1988 and 1993 six periods of field study were undertaken to investigate the environmental impact of the construction of a main irrigation canal and other works in the proposed extension of Suklaphanta Wildlife Reserve and to recommend protective measures. Suklaphanta is administered by His Majesty's Government of Nepal through the Department of National Parks and Wildlife Conservation. Special emphasis was placed upon the barasingha Cervus duvauceli *population because it is the largest remaining group of this endangered deer species in the world. This paper presents recommendations for the management of the barasingha and its habitat.*

Suklaphanta Wildlife Reserve

The barasingha or swamp deer *Cervus duvauceli* is listed as Endangered by IUCN (1990). In 1976 Suklaphanta Wildlife Reserve in the terai zone of western Nepal was gazetted to provide protection for this species in the belief that the Suklaphanta population was the largest remaining in the world. The world population was estimated at 2700–4000 by Schaller (1967). Schaaf (1978) estimated the Suklaphanta population to represent about one-third of the world population. However, Bauer (1990) considered the overall population to have become restricted to even fewer localities and to have shown a continuing downward trend in numbers. Suklaphanta has the status of Category IV (Nature Conservation Reserve/Managed Reserve/Wildlife Sanctuary) in the United Nations List of National Parks and Protected Areas (IUCN, 1985).

The reserve covers approximately 15,500 ha with a proposed eastern extension of about the same area, through which a major irrigation canal is currently under construction to link two areas of agricultural development under a scheme financed by the World Bank for the Nepal Government (the Mahakali Irrigation Project).

The study of the barasingha population was undertaken during six study periods over a 5-year period from January 1988, as part of the canal-related wildlife environmental impact and protection work conducted by the author via ULG Consultants Ltd and Sir William Halcrow and Partners Ltd.

Suklaphanta Wildlife Reserve is mostly flat, with occasional rolling hills in the north, and varies in altitude from 190 to 270 m a.s.l. Most of the reserve lies in a broad alluvial floodplain, which slopes gently away from the foothills (Churia Range) of the Himalaya to the north. Soils tend to be slightly alkaline and vary in texture from sandy-loam to occasional clay.

The climate is monsoonal with over 90 per cent of the annual precipitation (1000–2000 mm) falling between June and September. Maximum temperatures average 40–42°C in summer and 10–12°C in winter.

A small river, the Bahuni, rises near the centre of the reserve, flowing south-east until entering the Mahakali River on the southern edge (Figure 1). The Chaudhar River, which forms part of the eastern boundary of Suklaphanta, but which would bisect the reserve if the proposed extension is gazetted, is a large river with extensive floodplain grasslands. The Chaudhar also flows south-east until it enters the Mahakali River.

Balson (1976) estimated that the vegetation cover of Suklaphanta was approximately two-

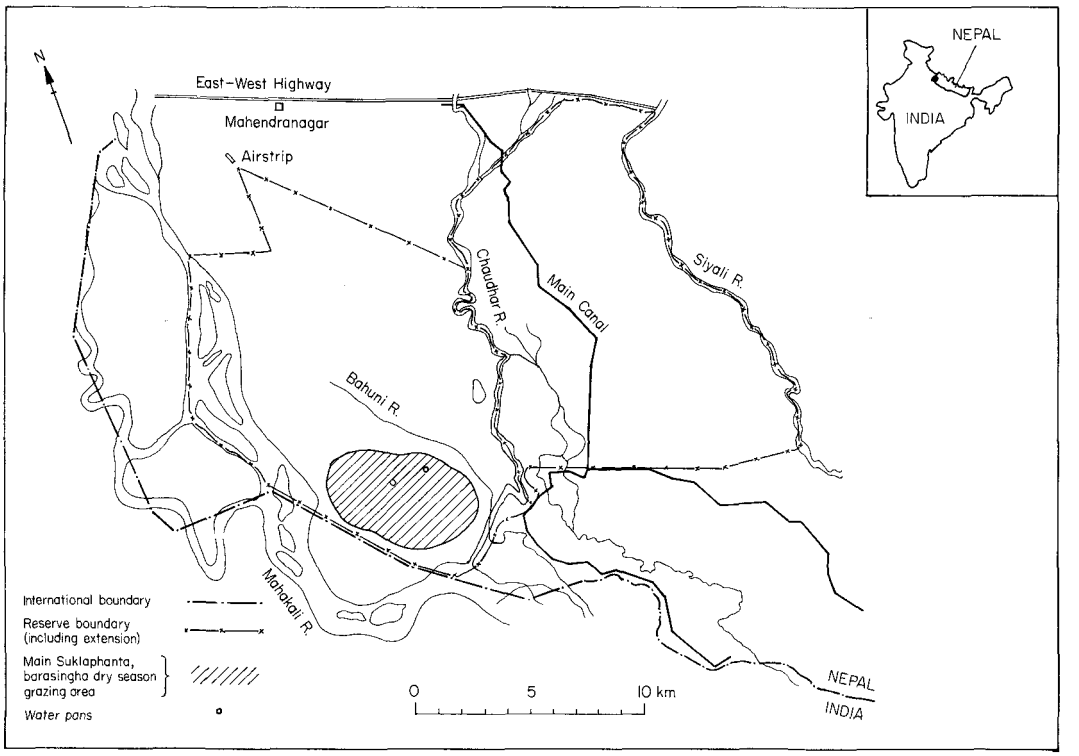

Figure 1. Suklaphanta Wildlife Reserve, Nepal.

thirds forest and one-third grassland and a generalized vegetation map was published by Schaaf in 1978. Bell (undated report) quoted Schaaf's (1978) classification and description of the vegetation cover and an FAO (1985) report confirmed the continuing validity of Schaaf's (1978) description – the better drained soils on the higher elevations in the north support moist deciduous forest and some savannah, with sal *Shorea robusta* as the dominant tree species. Mixed deciduous forest is patchily distributed among the more extensive grasslands in the south, where sal is largely absent. Khair-sissoo forest, dominated by *Acacia catechu* and *Dalbergia sissoo*, forms an early succession in riverine areas. Marsh habitats, in which tall dense grasses, such as *Saccharum spontaneum*, *Vetiveria zizanioides*, *Eulaliopsis binata* and *Heteropogon contortus*, predominate, also occur in the south. *Saccharum* spp. tend to predominate in the drier grasslands.

The principal grassland areas ('phantas') are moist only during the monsoon and for a short period afterwards. The largest of these, the Suklaphanta (approximately 32 sq km) is of critical significance to the barasingha population, especially during the long dry season. Although the sal-dominated and other forest areas contain a more or less continuous grass understorey, which is used by several ungulate species, the grass cover in the eastern extension area is less continuous and abundant due to over-use by domestic cattle, buffalo and goats.

Apart from the barasingha, the reserve is important for several other large mammal species. The spotted deer or chital *Cervus axis* is abundant, occupying a much wider variety of habitats than the barasingha. It is the most common species in the somewhat degraded habitat of the proposed extension area, occurring even in the sal forest sections. There are a few hog deer *C. porcinus*, which are found

singly or in small numbers in taller grass stands and other concealing habitats. The Indian muntjac *Muntiacus muntjak* is infrequent, although widely distributed, favouring dense habitat types. The sambar *Cervus unicolor* is rare, appearing to be restricted to mature forest with glades in the north-west part of Suklaphanta. The territorial nilgai *Boselaphus tragocamelus* is not common, but is found in sal and other forest types both in the reserve and the extension area. Wild boar *Sus scrofa* occur in most habitat types, even in the open grassland, where they feed on the rhizomes of perennial grasses. Only about 40 or so Asian elephants *Elaphus maximus* habitually use the reserve, also spending time elsewhere, especially the sugar-cane-growing areas. Apart from conflict arising from damage to agricultural crops, the danger from irrigation canals is a problem attended to in this project. Leopards *Panthera pardus* are widely dispersed even at the reserve/agricultural land interface, but it is impossible to provide a population estimate for tiger *P. tigris*, although evidence of its presence is found frequently and indicates dispersion throughout the forested sections of the Suklaphanta and to a lesser extent in the proposed extension.

Protection of the wildlife is efficient and effective due to the presence of sufficient rangers and the strategic siting of army personnel in several camps, who make night patrols on elephants. There are now no local people living in the reserve, the residents of the former villages having been resettled some years ago. Formation of the eastern extension will also require resettlement of people and, because they will occupy land that is not sustainable as it is, irrigation is being developed to increase the cropping capability.

Mahendranagar, near the north-west corner of the reserve, has no tourism infrastructure but can be reached by road from Delhi in 1 day and from Kathmandu in 2 days outside the monsoon. A weekly flight to the Mahendranagar strip is subject to cancellation due to weather conditions.

Although a local naturalist has camping facilities in the reserve and can offer a 'safari' service to visitors, it is unlikely that Suklaphanta receives as many as 30 tourists per annum. Its primary role, therefore, is for wildlife conservation *per se*, with particular emphasis on the barasingha population.

The barasingha – distribution and habitat use, together with implications

The barasingha is a social species of medium-sized deer, showing seasonality similar to more northerly living species, with the annual rut peaking in October and with calving mainly in June. Bhatt and Shrestha (1977) noted that for most of the year the total stock of the barasingha was found in one place – the main Suklaphanta and its forest margins. Schaaf (1978) noted the same situation and warned of the potential insecurity of the population, recommending habitat manipulation and population regulation, as well as the establishment of other herds.

Conservation and management problems for the barasingha arise because of its specialized habitat requirement for extensive open grassland and its aggregation in a single limited area throughout the long dry season.

The deer do not normally utilize the sal forest sections of the reserve, although small numbers are occasionally found in the more open sections of the mixed deciduous forest in the south close to the main Suklaphanta. They are seldom found in the marsh habitats because the grasses there remain dense and tall (2–3 m) all year round.

Corbet and Hill (1992) stated that the barasingha populations north of the Ganges occupy swampy habitats, but those south of the Ganges are found on drier grasslands. However, this is not a valid distinction because the grassland occupied by the Suklaphanta barasingha is dry for at least two-thirds of the year and cannot be classified as swamp, despite experiencing heavy rain during the monsoon.

In short grassland, barasingha form large groups. The individuals often spread out in a line 1 km or more in length and are in frequent vocal communication. This behaviour probably reflects adaptive strategies for

limiting predation and intraspecific conflict.

The reserve has populations of tiger and leopard but it can be assumed that neither of these predators have a significant effect upon the population dynamics of the barasingha. Both appear to prey largely upon chital, which are abundant in the reserve, although not indicated for Nepal in the distribution map of Corbet and Hill (1992). Chital form the common prey species probably because they are distributed in small groups throughout the forested areas of the reserve. Their behaviour and distribution patterns combine to provide easier hunting by large felids than is the case with barasingha in the open grassland.

The tall, post-monsoon grasses of the main Suklaphanta and other areas are burned in the November–January period to provide a green flush within days of the burn. This management provides the barasingha with optimum habitat conditions for feeding and predator avoidance and the expression of evolved social behaviours. Without this early dry-season burning, the carrying capacity of the reserve for barasingha would be greatly reduced, especially because tall, dense and rank dry grasses possess very little food value and also inhibit movement, social aggregation and predator avoidance. A further problem exists if early dry-season burning is not undertaken in that lightning fires, which can occur in very dry stands of grasses immediately before the first monsoon rains, are hotter than early dry-season fires and tend to destroy the rhizomes of perennials.

Grass-cutting is also practised in the reserve because local people consider the quality of the grass to be superior to grasses elsewhere in the region for thatching, wall and corral construction. Cutting is done under a permit system, which is available to people from an extensive area of the south-west corner of Nepal. The cut grass is hand-carried to the reserve boundaries and taken away in cattle and buffalo carts. During a 10-day period from 25 December 1992, 31,000 people entered the reserve to cut grass.

The main areas open to grass cutting are along the west side of the Chaudhar River up to the northern border of the reserve and along the northern half of the western border. Cutting is not permitted in the main Suklaphanta. The grass is cut to a height of about 15–20 cm and despite the (short) period of disturbance, the overall effect is beneficial to the grazings because it removes coarse and unpalatable material, whose tops are out of reach of the deer, and promotes new low growth.

A large, monsoon-fed water-pan in the main Suklaphanta, which lasted throughout the dry season in earlier years, provides the barasingha with drinking water. However, in 1991 the combination of a greatly increased barasingha population, plus the significant dry-season evaporation loss of water, caused the pan to dry out completely by 21 May – sometime before the first rains of the monsoon. However, instead of drinking in the marsh habitat on the eastern edge of the main Suklaphanta, the barasingha moved into a series of small phantas to the north-west, close to the Bahuni River.

If the proposed eastern extension of the reserve were to be gazetted and humans and their livestock moved from the Chaudhar River floodplain and resettled elsewhere, this habitat would revert to natural grassland similar to the phantas of the existing reserve. This would greatly increase the carrying capacity for the barasingha, which would undoubtedly expand into the new area of open grassland. However, for current conservation and management purposes, the existing limits of the habitat sections selected and occupied by the barasingha must be considered in deciding future management concepts and interventions.

Population size and trend

Opportunities and circumstances for counting entire deer populations with confidence are extremely rare. Wildlife biologists are normally required to adopt complex biometrical manipulations with extrapolations from often quite narrow sample counts and observation, especially for deer populations widely scattered in concealing habitats. Such procedures

The behaviour and habitat of the barasingha together offer a rare opportunity to census the entire population *(John Henshaw)*.

are often less convincing with reference to brain logic than computer-derived statistical tests imply. However, the barasingha population in Suklaphanta can be counted in its entirety when the deer congregate in the recently burned main Suklaphanta and when none can be found anywhere else.

The method adopted and refined was to locate all groups, manoeuvring to each in turn and counting from the roof of a four-wheel drive vehicle using 7×50 binoculars. This was always undertaken during the last 2–3 hours of daylight, the principal grazing period, when the deer are particularly calm and approachable and none remains lying down for long. Counts were repeated for up to seven or more evenings during each field-study period but were occasionally abandoned when a group or groups shifted around, creating the potential for duplications or omissions. On a few occasions it became clear that not all of the deer were out in the open phanta, but with repetition some remarkably consistent high counts were obtained for the period of censusing, for example: 1253 and 1279 in 1988, and 1731 and 1748 in 1992.

Table 1. Highest counts (approximate minimum population size) of barasingha in each census

Date	No.	Notes
January/February 1988	1279	All strung out along short grass sections of main phanta
May 1990	1380	All in main phanta in a large single aggregation; little movement
December 1990	900 (approx.)	Not a reflection of true numbers or trend: observability restricted because grass-burning had not been completed, the green flush was not well developed and the deer were more widely distributed
May 1991	400 (approx.)	Not a reflection of true numbers or trend because the water-pan was drying out and the barasingha were shifting to the small northern phantas close to the Bahuni River
January 1992	1748	All in the main phanta and static in several groups
January 1993	1854	All in main phanta in several groups; very little movement

The system demands that binoculars are not lowered until an entire group and any outliers are counted, and that the numbers are called to, and acknowledged by, a person recording in the vehicle. The numbers are called for each 100, followed by the remaining number of deer in the group.

In order to illustrate any trends in the population, all annual counts reflect the period from 6 months after calving to 1 month before the earliest time expected for the next calving. The highest evening count for each census period was noted as the approximate minimum population size for that time, an assumption made also by Schaaf (1978), who found 805 barasingha in 1975 and 908 in 1976. The highest counts obtained during the present study are give in in Table 1.

An endangered deer population with an increase averaging about 9 per cent per annum over a 5-year period would appear to reflect a more than satisfactory situation. However, a number of questions and factors combine to introduce a level of concern with regard to the future of this population, with special reference to its position as a major world reservoir of this species.

1. Do the Suklaphanta barasingha still represent one-third – or more – of the world population, with dependence upon a specialized habitat of only 32 sq km?

2. Has the population now reached the carrying capacity of the reserve, bearing in mind the factors listed below.

(a) The availability of fresh grazings in the main Suklaphanta appears to be at a critical level. Following 41 mm of rain in December 1991, fresh green perennial grass shoots were abundant and about 10–20 cm tall, whereas in December 1992 there was no rain and fresh green perennial grass shoots were less abundant and shorter.

(b) The reserve's chital population, considered to number around 5000 in 1992 (pers. obs.), puts increasing pressure on the grazings of the main Suklaphanta because up to 400 or more chital move into this habitat from the forest each evening to graze.

(c) Water availability in the preferred habitat is now critical towards the end of the dry season. The original water-pan is insufficient and in 1993 the level had shrunk significantly as early as January. A secondary water-pan, which was recommended and excavated in 1992, dried out in January 1993.

(d) When barasingha move from their preferred area they occupy areas to the north, which are less suitable in terms of overall habitat needs. Also, some barasingha have recently crossed the reserve boundary to the south on excursions to wheat fields, indicating possible food insufficiency in the main Suklaphanta.

Obviously, there is a limit to the safe carrying capacity for barasingha and the implication of the above factors suggest that this limit may be close, if it has not been reached already.

The dry-season grazings of the main Suklaphanta may not be able to sustain the barasingha and chital on an annual basis at a combined average density of about 70 deer per sq km. If habitat over-use and degradation occur, the physical condition of the deer will decline and this will be followed by the prospects of malnutrition, disease and mortality. Clearly, the extent of predation will not offset any such trend. In view of this, management should be planned and implemented as recommended by Schaaf (1978) and as discussed in the current author's internal project reports.

Schaaf (1978) recorded that discoloured, hairless patches had been observed on the sides of some barasingha and he wondered if this could have been a form of dermatitis or mange. The same phenomenon was observed in a limited number of animals during the current study, being most common in January 1993. The hairless patches were small in size and very similar to the bare patches that occur on red deer due to biting and fore-hoof kicking on subdominant animals by mature hinds in particular. Closely knit aggregations are formed by both species and their intraspecific behavioural patterns are very similar. Such behaviour will intensify with population increase.

Management – principles and practices

The basic and current management requirements are to retain the barasingha within the reserve as it now exists, and to prevent overpopulation and habitat degradation. It is assumed that further population increase will result in increased dispersal due to dry season shortages of fresh grass and water in the main Suklaphanta.

Dispersal to the east would bring the deer into conflict with the currently settled and farmed Chaudar River floodplain. There is then the problem posed by the main irrigation canal currently under construction. The profiles of the irrigation canals are such that deer drownings occur because it is easy for the animals to get into the canals, but difficult for them to get out (Rautensrauch and Krausman, 1989). The same applies to Indian elephants (Sukumar, 1989), which also occur in the reserve, and this threat extends to other large mammal species. Problems caused to African wildlife species by the Rahad and Jonglei canals in Sudan have been outlined by Cloudsley-Thompson (1992), where animal losses and obstructed migrations are the end result. Animal-escape structures have been designed for the main canal passing through the eastern extension area (Figure 1), which already has significant numbers of chital, together with lesser numbers of other large mammal species. The structures for the Suklaphanta extension area were designed to allow for exit from the water on both sides of the canal.

Dispersal to the north and south-east will bring deer into conflict with the new irrigation area farms, where rice and wheat will form the principal crops. Due south of the main Suklaphanta lies the Indian border on the other side of which are also small farms. Some distance due west of the principal grazing area of the barasingha is the reserve border and the Mahakali River, which forms a barrier to animal movements for the monsoon period and some months after. Drownings of barasingha in the Mahakali River were reported by Schaaf (1978).

Holding the deer to their current and preferred area will necessitate maintaining the annual burning policy to encourage a dry season green flush. Most importantly, it is necessary to extend the water-holding capacity of the two water-pans so that the barasingha are not forced to move from the main Suklaphanta by lack of drinking water towards the end of the dry season. Dew falls and the moisture content of the post-burn fresh shoots may assist the deer to some extent but it is doubtful that the barasingha can obtain their daily water requirements entirely from these sources.

Boreholes have already been sunk at both water-pans and a portable pump has been provided. Also, the new water-pan will be deepened so that it can hold more rain-water. This is important because renewal supplies from underground are not abundant.

Without the above interventions, the prospect of dispersal exists, even without further population increment, thereby jeopardizing not only the Suklaphanta barasingha *per se*, but also the population's potential use for restocking other areas to improve the prospect for the survival of the species as a whole. Major oscillations in the population's numbers in the reserve must be avoided. Because natural predation is unlikely to dampen the current rate of increase, the management interventions listed below should be considered.

1. Capture and translocation of appropriately composed and significantly sized units to restock areas where the species occurred formerly, or where its numbers are currently at a low and possibly critical level.

A first option in this regard would be the Bardia National Park, also in the terai zone of Nepal and some distance to the east of Suklaphanta Wildlife Reserve. Bardia contains the only other population remaining in Nepal, but during a survey in 1988 only 41 barasingha were recorded there (Bauer, 1990). In that paper, the author reported that cessation of grass burning had been 'handled rather successfully in Bardia.' However, it is probable that a carefully devised burning policy for the *Saccharum*-dominated phantas would markedly increase the carrying capacity for

barasingha in Bardia.

Although barasingha in the open grassland are relatively easy to approach for observation purposes when using a vehicle – more so than when on elephant back – approaching to within safe and accurate dart-gun range (considered by this author to be 50 m maximum) can only be achieved quite rarely. In any event, darting would be extremely time-consuming for the capture of groups for translocation. An alternative would be to construct a fixed-capture system incorporating a large entry funnel, corral and handling section. Translocations for large-enclosure captive breeding/farming might also be considered because barasingha share many of the characteristics of red deer *Cervus elaphus* that have made them suitable for parks and large farms: social, non-territorial behaviour, tolerance of humans in relatively close proximity, etc.

2. Selective culling to maintain the overall numbers at an apparent/observed safe level at which there is no degradation to the main Suklaphanta grassland. This was a recommendation for the future made by Schaaf (1978) in the event that the population increased significantly, which it has done, and it should be regarded as valid, despite the alternative philosophy to 'let nature take its course'.

Management for the conservation and survival of an endangered species is imbued with special demands and considerations, not the least of which is the imperative for not putting off until tomorrow what can be done today.

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