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CHAPTER 18

ECOLOGICAL IMPACT OF CONSERVATION MEASURES ON SWAMP DEER AND ITS HABITAT IN KANHA NATIONAL PARK: A CASE STUDY

By

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ABSTRACT

Though the Kanha National Park was brought under Project Tiger for the conservation of swamp deer (*Cervus duvaceli branderi*) in 1974, it is well known worldwide for its tigers (*Panthera tigris*). It has gained a global acclaim for its scientific management and played a remarkable role in saving the rare and endangered endemic swamp deer from the brink of extinction. The park is comprised of a mosaic of meadows and forests in the plain, extensive grasslands on the plateaus, forests in the rolling hills, and numerous perennial streams and ponds in the valley. The Kanha is kept free from all kinds of external biotic interference from human, except strictly regulated eco-tourism. Forests are not exploited for timber and non timber forest produce. Ecological succession in the forest and grassland ecosystem is taking place; the woodland is taking over the grasslands. The unpalatable invasive alien species weed *Lantana camara* is also invading over the grasslands. With strict conservation measures the ecological conditions of the habitat have been greatly changed. This paper reviews the ecological impact of conservation measures on swamp deer, its habitat, and management strategies of the Kanha National Park.

INTRODUCTION

Though the Kanha National Park was brought under Project Tiger for the conservation of Swamp Deer in the year 1974, is well known worldwide for its tigers. It has gained global acclaim for its scientific management and has played a remarkable role in saving the rare and endangered endemic species of the hard ground swamp deer *Cervus duvaceli branderi* from the brink of extinction.

Several ecological studies on Kanha National Park have been carried out. Forsyth (1889) and Brander (1923) published a classic account of the flora and fauna of this region that now includes Kanha National Park. Schaller (1967) pioneered in the ecological study of some large mammals before the Project Tiger was launched. Thereafter Binny *et al.* (1969) presented a proposal for the rehabilitation of the Swamp Deer. Martin (1976, 1977, 1987), Panwar (1977), Kotwal (1993), Kotwal & Parihar (1990), Rajesh Gopal (1995, 1997), Rai (1998), and Kanoje (2004 b) studied the ecology of Swamp Deer. Ali *et al.* (1998) analysed the genome of the Swamp Deer. Chandiramani (1983), Newton (1984, 1985) and Ranjitsinh (1982, 1989), described ecology of Indian bison, langur and black buck, respectively. Panwar (1979a, 1979b, 1979c, 1979d, 1990), and Kotwal & Rajesh Gopal (1993), have presented many details of the food habits, population dynamics and land tenure of tiger.

Maheshwari (1964) and Lal *et al.* (1986) described the flora of the Kanha National Park and Kanha Tiger Reserve. Newton *et al.* (1986) and Eric D' Cunha (2001) updated the checklist of birds. Kanoje (1995, 96, 97, 99 and 2005) studied the ecology of waterbirds and their wetland habitats. Kanoje (1994) Kotwal & Pande (1980), Kotwal (1987, 1989,), Mishra & Kotwal (1990), Pandey (1982), Panwar (1983, 1988), Panwar & Negi (1991), Sinha (1979) and Mathur (1991) made general ecological studies about the wildlife and its habitat. Chakraborti (1986), Dutt *et al.* (1986), Parihar *et al.* (1986), Roy & Jurgan (1986), Roy *et al.* (1986), and Singh (1986) evaluated the habitats of Kanha National Park through remote sensing techniques. Kanoje (2004 a) studied the taxonomy of mammals and methods used for population estimation of wild ungulates of Kanha National Park. Kanoje (1999, 2004 b) drafted the management plan of wetlands of Kanha Tiger Reserve, and dealt with the distribution and management of wild ungulates of Kanha National Park. Panwar (n. d.), Kotwal & Parihar (n. d.), and Rajesh Gopal & Shukla (n. d.), prepared the management plan of the Kanha National Park and Kanha Tiger Reserve.

Most of the researches carried out are either on habitats or on some specific species. With conservation measures strictly enforced, the ecological conditions of the habitat have been greatly changed. Comprehensive research on the ecological relationship between the Swamp Deer and its habitat has not been done done. The object of this paper is to review the ecological impact of conservation measures on the swamp deer, its habitat, and management strategies of the Kanha National Park.

STUDY SITE

The Kanha Tiger Reserve is cradled in the Maikal Hills in the Eastern segment of Satpura Hill Range in the Narmada River basin in the central India. It stretches from 22°¸ 02´ to 22º, 27´ North latitude and 80º, 26´ to 81º, 03´ East longitude (Kanoje, 1999). Floristically Kanha National Park lies in the Indus-Ganges Monsoon Forest of the Indo-Malayan Biogeographical Realm and Zoo-geographically in the Oriental Region (Kanoje, 1999). According to the biogeographic classification of the Wildlife Institute of India it lies in zone 6E-Deccan Peninsula-Central Highlands (Rodgers & Panwar, cited by Kotwal & Parihar, n. d).

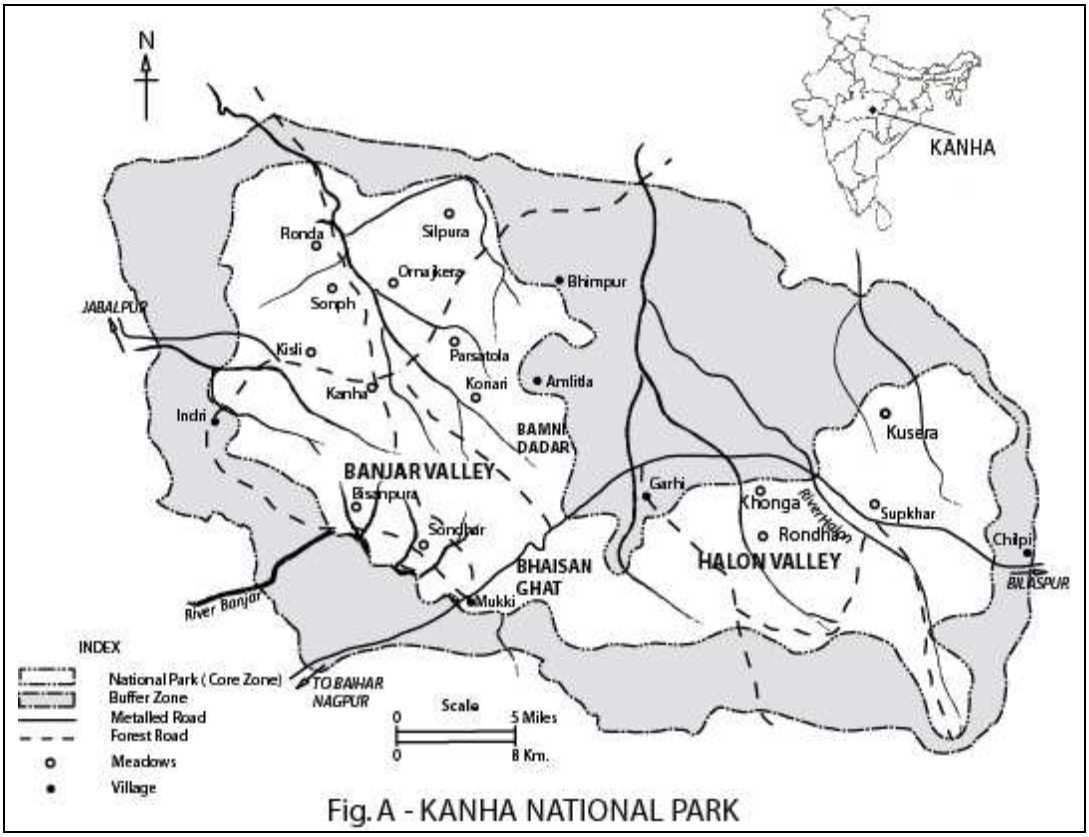

Fig. A - KANHA NATIONAL PARK

Kanha is free from all kinds of biotic interference from humans, except strictly regulated eco-tourism. The park area comprises of mosaic of meadows and forests in the plain, extensive grasslands on the plateaus, and forests in the rolling hills, and numerous perennial streams and ponds in the valley. The unique ecosystem of Kanha harbours high biodiversity, including 626 species of plants (Maheshwari, 1964, Lal, *et al.*, 1986), 268 species of birds (Newton *et al.*, 1986, Kanoje, 1997, D'Cunha, 2001), 42 species of mammals (Kotwal & Parihar, n .d., Panwar & Negi, 1991), and 11 species of reptiles (Panwar & Negi, 1991).

METHODOLOGY

General observations were made from August 1973 to December 1977 during the tenure of the author as a Forest Ranger in the Kanha Tiger Reserve, and again fresh observations were made in May-June 2004. The biomass of Banjar Valley and Halon valley were estimated by multiplying the number of individuals in each ungulate species per unit area with the average body weight. The biomass was plotted with the time. Carrying capacities were estimated from the population curve. The distribution of ungulates, population dynamics, and carrying capacities were compared for the Banjar Valley and Halon Valley of the Kanha National Park**.** Management plans reviewed, and results of relevant research papers were analysed; implications and strategies for management were discussed.

CONSERVATION HISTORY

In 1933, 253 sq km of forests in the Banjar valley, and in 1935, 300 sq km of forests in the Halon valley were declared as Kanha and Supkhar Sanctuary respectively (Panwar 1983, Kanoje 1999). In 1942 the Supkhar Sanctuary was abandoned and in 1943 the Kanha Sanctuary was reduced to just 134 sq km (Panwar & Negi 1991). That was the era of the British regime, and the Second World War had broken out. The main objective of forest management was to exploit the forests to cater to the war needs of the British Empire (Bebarta 2002). Moreover, a great amount of damage was done by the

army personnel by hunting and shooting during the Second World War (Schaller 1967). Despite this, the area received considerable protection until 1947 when India became an independent nation; a hunting permit was required for tigers within the sanctuary (Norman n. d.). As the prince of the Vijainagaram, the Maharajkumar had a special shooting privilege (Schaller 1967). Between 1949 and 1951 the Prince shot 30 tigers in and around the Kanha Sanctuary. This caused a great uproar at the national level, persuading the authorities to initially restore sanctuary status to the earlier area of 253 sq km in 1952 (Panwar 1983; Panwar & Negi 1991). In 1955 the sanctuary was upgraded to the status of a national park (Kotwal & Parihar n. d.; Panwar & Negi 1991). Exploitation of forest in the National Park was stopped from 1959. In 1964 and 1970 the park was subsequently expanded to 446 sq km. (Kanoje 1999; Kotwal & Parihar, n. d.).

Kanha was brought under Project Tiger in 1974. The forests of 489 sq km of the Halon Valley and a corridor connecting with the Banjar Valley was notified as a sanctuary and merged with the administration of Kanha National Park. In 1976 another 5 sq km forests area was added to the sanctuary with some peripheral adjustment and the status of the sanctuary was upgraded to the status of national park. The buffer zone of 487 sq km was constituted in 1974 and subsequently expanded in 1976, 1977 and 1995, when the area of buffer zone was expanded to 1009 sq km and its administration was vested with the park management (Rajesh Gopal & Shuka, n. d.)

Thus today's Kanha Tiger Reserve consists of 940 sq km as core zone and 1009 sq km as buffer zone. The legal status of the core zone is as National Park under the Wildlife (Protection) Act 1972. The buffer zone contains 40% area as reserved forests under Indian Forest Act 1927, and 60% as revenue land. The buffer zone contains 145 villages with 64,000 people and 50,000 cattle. The buffer zone is a multiple use conservation area (Kotwal & Parihar, n. d.).

With the launching of the Project Tiger in 1974 the exploitation of wildlife and forests, collection of non-timber forest produce, and cattle grazing were totally banned in the entire areas of the National Park. Consequently the residents became unemployed and lost their income. They were already suffering from the recurring incidence of human-wild animal conflict, including human injury and loss of life, crop raiding, cattle lifting. The residents were ready to be rehabilitated outside the Park boundary. Twenty six villages consisting of 64.3 sq km including 1,205 families of 4,980 people and 8,232 cattle were shifted from the heart of the Park from the year 1974 to 1978 (Jain 2001).

RESULTS

The grasslands in the valleys are of anthropogenic origin (Kanoje 1999). Primitive human settlements since time immemorial had the practices of shifting cultivation, cyclic desertion and reoccupation of villages thereby perpetuating the grasslands (Kotwal & Parihar, n. d.). Grasslands had been long subject to annual burning in summer by local people, but the first planned burning for habitat improvement in the Kanha meadows was carried out in the cool season of 1902-1903 by Brander (1923). Since then the Forest Department adopted this practice of setting fire in patches of the meadows from December to January until practically the entire meadows were subject to burning (Martin 1977). In 1973, the practice of annual winter burning was given up and meadows were protected from fire and grazing (Panwar & Negi 1991). After evacuation of the villages the farmland turned into lush green grassland in the valleys. Ecological succession in the forest and grassland ecosystem continued, tree species started appearing in the grasslands. In 1990 the practice of annual burning was against resumed to arrest the succession in the grassland. One third of the area of grassland in the plateau and the half the area of grassland in the valley is burned every year (Kotwal & Parihar n .d.), Rajesh Gopal & Shukla n. d.).

The coppices and root suckers of fire resistant and unpalatable tree species of Landia (*Lagerstromia parviflora* Roxb.*),* Palas (*Butea monosperma* Lamk. Taub.*) and* Tendu (*Diospyros melanoxylon* Roxb.*)* continued to encroach on grasslands (Kotwal & Parihar, n. d.; Roy *et al.* 1986; Kanoje 1999). Seedlings of these species emerge amidst the grassland as small patches and gradually grow in size and area, thus creating favourable conditions for other woody species which also follow the suite.

Colonisation by pioneer species as well as peripheral advance of Sal *Shorea robusta* can be noticed in various stages in the meadows of Kopedabri, Banada Bahara, Urna Khero, Parsa Tola, Masna Dabra, Soph, Singarpur and Bisanpura (Kotwal & Parihar n. d.). The largest meadows however lay within the Sal forest areas. Sal forest is considered to be the climatic climax forest. The northern part of the Park, which was subject to lower impact by herbivores and less rigid burning practices than the southern part, has more Sal regeneration, taller cover, and younger and denser tree stands in the meadows including more typical forest trees. Some clearings at the edge of the Sal area in the north i.e. Jamuntola or Ornakhera, have been so densely overgrown with trees that locally it is difficult to draw a line between forest and meadows. There are signs of reoccupation of meadows by forest (Martin 1977).

Lantana camera an alien invasive weed, also emerges in clusters in the open areas. The groves of young trees and *Lantana camera* are uprooted in small patches in certain areas for restoration of grassland (Kotwal & Parihar n.d.; Rajesh Gopal and Shulka n. d.). The forests in the hill slopes and valleys are growing denser, grasses as undergrowth are disappearing, and woodland is taking over the grasslands. As the extent of grassland has been reduced, the growing population of ungulates has congregated in the Kanha and Kisli meadows in the Banjar Valley in such a concentration that they overgraze the remaining grassland to bring it to the threshold of soil erosion and degradation.

Kanha National Park has 10 species of wild ungulates, Table- 1 (Kotwal & Parihar n. d.; Kanoje 1999). The forest department has conducted annual censuses of wild animals in Kanha Park since 1953, the only such sustained effort in India. Since 1958 the census technique has been relatively standardized (Schaller 1967). The Forest Department's census gives a fair idea of the population size of the large gregarious herbivores (Martin 1977, 1987). The Indian chevrotain or mouse-deer (*Ttragulus meminna*) is like all mouse-deer, a tiny little creature. Because of its small size, shy habits, and very protective colouring it is easily escapes observation (Prater 1980). Its population size could not be estimated.

Table- 1 Wild Ungulates of Kanha National Park

S No	Common Name	Scientific Name	Average Body Weight * (Kg.)
1	Indian bison	*Bos gaurus* (H. Smith)	561
2	Black buck	*Antilope cervicapra* (Linnaeus)	23
3	Four-horned antelope	*Tetracerus quadricornis* (Blainville)	18
4	Blue bull	*Boselaphus tragocamelus* (Pallas)	182
5	Sambar	*Cervus unicolor* (Kerr)	136
6	Swamp deer	*Cervus duvauceli branderi* (Pocock)	159
7	Spotted deer	Axix axix (Erxleben)	47
8	Barking deer	*Muntiacus muntjak* (Zimmermann)	18
9	Mouse deer	*Tragulus meminna* (Erxleben)	-
10	Indian wild boar	Sus scrofa (Linnaeus)	27

*(Schaller; 1967 & Mathur; 1991)

The number of individuals in each ungulate species per unit area multiplied by their average body weight provides an estimate of the biomass supported by a certain habitat (Schaller 1967). The estimation of biomass of ungulates is based on the average body weight of all ungulates except mouse-deer (Table-1) and the annual census data of Kanha National Park.

The Bhaisan Ghat Ridge with steep slopes running north – south divides the park into two halves, the

Banjar Valley in the west and Halon Valley in the east. The forests of Banjar Valley have a longer period of conservation history than that of the Halon Valley. The tourist zone lies in the Banjar Valley, with adequate infrastructures. Much more attention is given to the management, conservation, supervision and research in the Banjar Valley than the Halon Valley. The steepness of Bhaisan Ghat and heavy traffic passing through the highway is a barrier for the movement of the wild animals on either side. Therefore Banjar and Halon valleys are treated as two separate ecological units and their biomass and carrying capacity is calculated separately and compared.

When animal density is plotted with time, a curve of growth form is obtained. The "S" shaped or sigmoid growth pattern may occur. Such a symmetrical sigmoid is obtained where the limitation is linearly proportional to density. The density levels off so as to approach an upper asymptote level, " K" commonly called the "Carrying Capacity Level" because it represents the maximum sustainable density (Odum1975).

In the Banjar Valley the abnormal rise in the biomass of wild ungulates in 1994 may be due to some errors in the estimation of animal population, so it may be ignored and given an average figure as the trend line shows (Fig-1). After reaching a biomass of 3369 kg/sq km in 1998, it declined and again continued to increase and reached to its maximum value of 3637 kg/sq km in 2003. The trend line showed a slight rising tendency. This maximum value is close to the theoretical carrying capacity of 3693 kg/sq km as Schaller (1967) estimated for the Kanha National Park in the Banjar Valley. It may rise to reach this value and thereafter may stabilize about this value. This value of carrying capacity of wild ungulates as Schaller (1967) estimated still holds good.

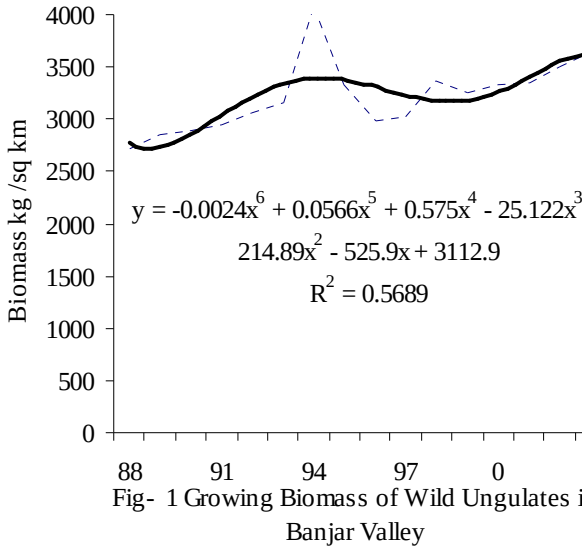

Fig- 1 Growing Biomass of Wild Ungulates i Banjar Valley

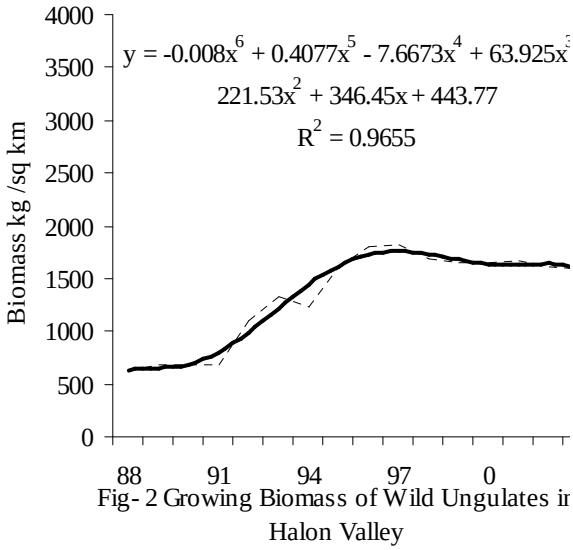

Fig- 2 Growing Biomass of Wild Ungulates ir Halon Valley

In the Halon Valley the average biomass of wild ungulates was 616 kg/sq km in 1988, increasing to the peak value of 1812 kg/sq km in 1998 (Fig-2). Thus it increased three-fold in just 10 years, before declining gradually to 1595 kg/sq km in 2003.

Table-2 Carrying Capacity and Standing Biomass of wild Ungulates

	Carrying Capacity	Standing Biomass	% Biomass
Banjar Valley	3693 kg/sq km	3637	98.48
Halon Valley	1812 Kg / Sq. Km.	1595	88.08

The trend line showed a tendency toward stabilizing. The shape of a trend line resembled a sigmoid

curve. In this sigmoid curve the limitation may be linearly proportional to density. As the density levels off and approaches an upper asymptote level, "K", the "carrying capacity level" represents the maximum sustainable density (Odum 1975). The maximum value of biomass ever attained is 1812 kg/sq km, and thereafter its population density is almost stable. Therefore at the present environmental conditions it can be concluded that the carrying capacity of wild ungulates for Halon Valley is about 1812 kg/sq km. If the environmental condition remains same the biomass may remain at this value.

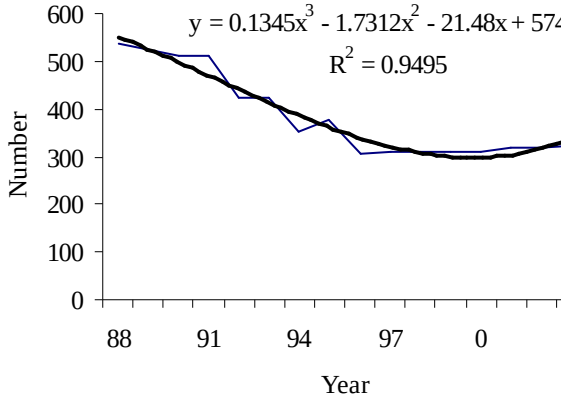

Fig. - 3 Population Curve of swamp deer in Banjar Valley

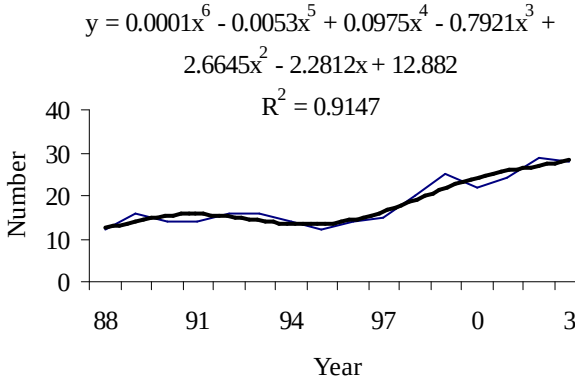

Fig. - 4 Population Curve of swamp deer in Halon Valley

This analysis indicates that the carrying capacity of Banjar valley was about double that of the Halon Valley. In 2003, the biomass of Banjar Valley was 3637 kg / sq km whereas in the Halon Valley it was just 1596 kg /sq km, so the biomass of Banjar valley was 2.28 times the biomass of the Halon Valley. The biomass of Banjar and Halon valleys were 98.48% and 88.08% of their respective carrying capacity (Table-2). Cmparisin of average biomass and relative abundance of wild ungulates of the entire area of Kanha National Park for the years 1974 and 2003 are given in the Table-3.

Table-3

Relative Abundance of Biomass of Wild Ungulates and Habitat Requirements

Species of Wild Ungulates	Abundance of Biomass				Habitat Requirements of Wild Ungulates (Prater, 1980).
	1974		2003		
	Kg /Sq. Km.	%	Kg /Sq. Km.	%	
1. Indian bison	310.937	30.59	846.2745	30.94	Hilly forests
2. Black buck	2.276	0.22	0.024468	0.00	Open plain covered with scrub or cultivation
3. Four-horned antelope	3.485	0.34	16.07021	0.59	Undulating or hilly country with tall grass and open jungle
4. Blue bull	0.479	0.05	2.144681	0.08	Hills sparsely dotted with trees, undulating plains covered with patches of scrub
5. Sambar	141.932	13.96	516.2213	18.87	Hill forest
7. Swamp deer	23.343	2.30	59.03298	2.16	Plain grasslands

8. Spotted deer	491.850	48.39	1040.4	38.03	Plain grasslands & shaded streams
8. Barking deer	5.151	0.51	21.81064	0.80	Hills, thickly wooded
9. Indian wild boar	36.967	3.64	233.4638	8.53	Grassy or scanty bush jungle, and forests

Biomass of all the ungulates increased to a sizable extent except black buck (*Antilope cervicapra*), which declined from 2.276 kg. / sq. km in 1974 to 0.024468 kg. / sq. km in 2003. The blackbuck is an animal of open plain with scrub or cultivation (Prater 1980), a habitat once confined to the Kanha Meadow in the Banjar Valley that has now disappeared all together. The last single individual male black buck died recently (personal communication from Rakesh Shukla Research Officer Kanha Tiger Reserve). Four- horned antelope (*Tetracerus quadricornis*), an animal of tall grass and open jungle, (Prater 1980), which contributed as little as 0.05% to the Park's biomass increased to 0.08%. The blue bull (*Boselaphus tragocamelus*), requiring a similar habitat jungle but with dotted trees (Prater 1980) increased from 0.34 % to 0.59 %. Average biomass of Indian bison (*Bos gaurus* H. Smith) whose habitat is hilly forests (Prater 1980) increased but its relative abundance of biomass remained unchanged. The sambar (*Cervus unicolor*), an animal of hill forest (Prater 1980) increased 4.91%. The swamp deer (*Cervus duvauceli branderi*) and Spotted Deer (*Axi axi*), animals of grasslands (Prater 1980), declined 0.14% and 10.36 % respectively, and barking deer (*Muntiacus muntjak*), which prefers thickly wooded hills (Prater 1980), increased 0.29 %. The Indian wild boar (*Sus scrofa*) (Prater 1980) also prefers forests and increased to 4.89 %.

Thus in general changes in species composition occurred in such a way that the relative abundance of animals which prefer forested habitat increased whereas the grassland species of Swamp Deer and Spotted Deer declined.

The four large species of ungulates Indian bison, sambar, spotted deer and wild boar, continued to contribute a major part of the total biomass 96.38 % in 1974 and 96.58 % in 2003. Four-horned antelope and barking deer are comparatively smaller in size, secretive in nature and spend solitary lives so their population may not be estimated accurately and remain underrepresented. Their contributions to the total biomass were 3.62% and 3.42% in 1974 and 2003 respectively. The blue bull, an animal of the semiarid zone, is not thriving and the blackbuck, an animal of arid zone, has been extirpated.

The Banjar Valley supported 535 swamp deer in 1988, declining to its minimum of 308 by 1996. Its population slightly increased to 321 in 2003 and is now stable around 320 (Fig.-3). The Swamp Deer found in the Supkhar grass land in the Halon Valley are the result of trans-location from the Kanha Meadow. Five Swamp Deer were reintroduced in 1976 and 8 in 1981 (Rajesh Gopal & Shukla n. d.). The population continued to grow up to 25 in 1999 and 28 in 2003. Its population has a tendency to stabilize around 28 (Fig.-4). In 1988 the entire park had a maximum number of 547 Swamp deer, declining to 349 in 2003. This small isolated population of Swamp Deer may be declining as a consequence of inbreeding, competition with Spotted Deer, degradation and loss of its habitat.

DISCUSSION

Experience from various parts of world suggests that dense high forest provides little food for wild herbivores and often relatively poor cover (Anon 1972).Therefore the Task Force of the Indian Board for Wildlife Government of India suggested in the Planning Proposal for Preservation of Tiger that "Forage and cover can be increased by opening the forest canopy and manipulating in such way that the opening is maintained at an ecologically advantageous position for wildlife". Though the vegetative mapping of the park area has been done, no information about how much of its area is infested with *Lantana* weeds and grasslands have been encroached by woodlands are available. Grasslands are not monitored regularly as the Sal and mixed forests are monitored. Moreover the management plans do not include measures to clear Lantana or woodland species from the meadows.

The management plan should have an operational objective specifying how much area of habitat will be restored and what population of key species will be achieved in the plan period.

High level of genetic homogeneity between them may be a prime reason for the decline of this sub-species. The genetic similarity due to inbreeding could contribute ultimately to the extinction of the swamp deer. Genetic analysis on swamp deer from other habitats using a greater number of samples would provide a clue as to whether the species is declining due to inbreeding, and whether the resultant loss of hybrid vigour or some other yet elusive factors are responsible. Appropriate strategies may be adopted, including ex-situ conservation and breeding programme, infusion of captive genes and exchange of males-female from one herd to another for maintaining the hybrid vigour (Ali *et al.* 1998). No such genetic analysis has been undertaken so far. The swamp deer that were reared in semi-captive condition in a large predator-proof enclosure in the meadows of Supkhar was without any consideration of genetic characters.

The broad objective of maintenance of overall species diversity and prevention of their extinction is has been included for the first time in the management plan of Rajesh Gopal & Shukla (n. d.). Every species has a specific habit and habitat; therefore the management should be species specific as well as site specific. Their habitat should be managed according to the individual ecological requirements of each species. Some area may be designated for the specific requirements of that particular species and managed accordingly. Every species should be given equal importance. In this regard Moulton & Hulsey (1999) commented "Ironically, the decline of the Black Buck has been closely related to the Park's efforts in behalf of the Swamp Deer." There should be a time-bound programme for restoration of habitat and ex-situ conservation breeding of the swamp deer of different genetic origin in captivity. The population of Swamp deer to be a viable there should be at least 600 individuals of swamp deer in separately. Management intervention is required to achieve the desired objectives of the management. It is recommended that 15% of the area of the Park must be kept under open grasslands, and 10% under grassland with sparse trees.

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