ANTHRAX INCIDENCE AND ITS CONTROL BY VACCINATING GREATER ONE HORNED RHINO (*RHINOCEROS UNICORNIS*) AGAINST ANTHRAX IN JALDAPARA WILDLIFE SANCTUARY, WEST BENGAL, INDIA

P.K. PANDIT* AND S.P. SINHA**

Introduction

Jaldapara Wildlife Sanctuary (JWLS), renowned in the wildlife map of India as also of the world as the home of the great one horned Rhinoceros (*Rhinoceros unicornis*), is located in the foothills of Eastern Himalayas and lies in the flood plains of the river Torsa and some other small rivers that support large tracts of grassland sustaining a small population of one-horned rhinos. JWLS lies in Jalpaiguri District, West Bengal, India (latitudes 25°58' and 27°45' North and longitudes 89°08' and 89°55' East).

It was declared as a game sanctuary in 1941 comprising an area of 99.5 km². With two subsequent extensions in 1976 and 1990, the area was increased to 216.5 km², covering 12 forest blocks and 46 compartments. The sanctuary is trouser shaped in the southern part with 32 revenue villages all around having human population 90,000 and about 70,000 cattle.

JWLS harbours the One-horned Rhinoceros, a threatened species included in Schedule-I of the Wildlife (Protection) Act, 1972 It belongs to the Bio-Geographical zone 7B (Lower Gangetic plain) according to Rodgers and Panwar (1988). Importance of JWLS in the national context lies in the fact that besides the Rhino, it supports at least 15 species in Schedule-I of the Wildlife (Protection) Act, 1972 and is given maximum protection at national level. These animals are tiger, gaur, elephant, sloth bear, leopard, hogbadger, hispid hare, Bengal florican, python, pangolin, peafowl, Indian pied hornbill, large falcons, swamp deer and Indian soft-shelled turtles.

The sanctuary has 33 species of mammals, 230 species of birds, 24 species of reptiles, 30 species of fishes and huge numbers of micro fauna (Pandit, 1996; Pandit and Yadav, 1996). It contains 585 species of flowering plants (Banerjee, 1993), which belong to 429 genera and 111 families, out of which 71 are grasses, 19 orchids and 47 endangered plant species (29 genera) that needs conservation. Moreover, it contains many Pteridophytes, Bryophytes, Algae, Fungi and Lichens. Total number of One-horned Rhino population was 34 (during 1994), which constitutes 2% of the total rhino population in the world.

Totopara village, the home of the Toto tribes is situated in the North of the sanctuary. The socio-economic practices,

* Addl. DFO and Management Plan Officer, JWLS.
Presently : Divisional Manager, Forest Corporation South Division, Kharagpur (West Bengal).
**Project Coordinator and Consultant, SOS Rhino Project, Dudhwa NP, Lakhimpur Kheri (Uttar Pradesh).

Zoo's Print 21(1)

religion, culture and language of the Toto tribe are a matter of great anthropological interest. Currently this remote village has small population of about 1,000 (in 1996) and till this day Totos have managed to keep away from the inroads of the mainstream culture. Bania ruins, the remains of an old fort and a big lake in Bania Block, speak for existence of an ancient settlement and culture

JWLS has tremendous potential of tourism and attracts a good number of visitors to the sanctuary through which local people get direct and indirect benefit.

Elephants are not permanently resident in JWLS, but herds consisting of 30-35 numbers frequently visit the sanctuary in full herd or split form as the food and cover is suitable for them (Pandit, 1996).

Although there are plenty of records of attack by anthrax in herbivores and carnivores in several parts of the world including many wildlife preserves in India, but in India is not taken very seriously may be due to other important diseases like Rinderpest, Foot and mouth disease and hemorrhagic septicemia.

During the winter of 1998-99, a major outbreak of anthrax extended over an area of 6,000 km² in the Kruger National Park and neighbouring nature reserves in South Africa. More than 160 cases amongst animal species were confirmed, 68% of which affected Kudu and Buffalo (Anon., 2000). A large number of lions were infected by consuming infected carcasses. In Namibia, 76 cases of Anthrax were reported is wild animals, most of them in Etosha National Park where the disease is enzootic. Eleven wild species were affected including elephant, zebra, etc. (Anon., 2000).

Elephants have been affected by Anthrax in 1987 and 1988 in Luangwa valley, Zambia (Turnbell, *et al.*, 1991). It also occurs in Buffalo, Zebra, Kudu, Giraffe in the same NP in between 1987-91 (Tuehili, *et al*, 1993).

Elephants (*Laxodonta africana*) died of Anthrax in Etosha NP in Namibia in the year 1996 (Berry, 1993), Lindeque *et al.* (1994) observed that a greater number of adult males die due to Anthrax among elephants in Etosha NP. Anthrax has been studied externally in Etosha NP since 1960; in addition, since 1995 mortality due to rabies and all other causes has been recorded, totalling 6,190 deaths out of which 811 (13%) were due to Anthrax. Out of total deaths by Anthrax, maximum occurred in elephant, zebra and springbok.

Very little work has been done on the detection, prophylaxis and treatment of wildlife diseases in India. Several communicable diseases of bacterial, viral, protozoan and reckettisied origin occur among Indian wildlife. Rinderpest outbreak in South India during 1965 and 1975 and Kaziranga NP in 1981 resulted in large scale mortality in Indian Bison. Diseases like tuberculosis, anthrax, salmonellosis and coccidioisis occur in the captive primates (Rathore and Khera, 1981). Foot & Mouth Disease has depleted more than 15,620 gaur in the past (Morris, 1952). Anthrax coupled with other unidentified one was responsible for large scale mortality of rhinos in Kaziranga (Lahan and Sonewal, 1973).

Pandit (1994) first recorded Anthrax

in elephant in Jaldapara Wildlife Sanctuary and three tuskers died due to that disease in the last week of January to first week of February, 1994.

Detection of Anthrax in JWLS

In January-February, 1994 carcasses of three wild tuskers were detected in Torsa Comptts. 2 and 3 (Torsa Block) of Bengdaki Beat of JWLS. Details of detection of carcass are given in Table 1.

The first and third carcasses were detected at a distance approximately 300 m apart having forest of mixed dry deciduous type. All those locations were plain with alluvial soil and very near the fringe villages (approximately 400 m, 1500 m and 700 m, respectively). Tusks of these dead animals were collected, processed and kept in safe custody of Range Forest Officer after weighing, measuring and labeling etc. Those elephants were part of a male herd

Table 1

Detection of carcasses and detail body measurement of three dead tuskers

Body measurement and other details	Tusker no. 1	Tusker no. 2	Tusker no. 3
Detection of Carcasses :			
Date of detection	29.01.1994	03.02.1994	04.02.1994
Age (yrs)	22-25	22-25	22-25
Sex	Male (Tusker)	Male (Tusker)	Male (Tusker)
Compartment	Torsa-2	Torsa-3	Torsa-2
Beat	Bengdaki	Bengdaki	Bengdaki
Range	Jaldapara West	Jaldapara West	Jaldapara West
Body measurement :			
Length Head to Tail (m)	2.80	2.50	2.80
Shoulder height (m)	2.60	2.30	2.40
Circumference of right foreleg (m)	1.25	1.07	1.15
Trunk length (m)	2.50	2.05	2.00
Tail length (m)	1.55	1.20	1.25
Left tusk :			
Length (m)	0.93	0.69	1.15
Mid girth (m)	0.22	0.20	0.25
Weight (kg)	3.50	2.33	4.31
Right tusk :			
Length (m)	0.93	0.61	1.12
Mid girth (m)	0.23	-	0.25
Weight (kg)	3.50	2.18	4.25

Source: Office Record of Assistant Wildlife Warden, Jaldapara Wildlife Sanctuary, Madarihat

consisting of 5 tuskers (Maljuria group) and frequently raided villages.

Post-mortem of those dead tuskers was done by Shri Kuldeep Dey, Government Veterinary Surgeon, Falakata, Jalpaiguri and blood samples were sent to District Veterinary Laboratory, Jalpaiguri for testing. After through examination it was confirmed as Anthrax on 07.02.1994, caused by bacteria *Bacillus anthracis*. According to the post-mortem report it transpired that first, second and third elephants were died 5-7 days, 70 hrs. and 10-15 days respectively before detection of carcasses.

After thorough observations at the spot by the author, it were understood that before death elephants roam extensively about one hectare area, stamped and threw soil, broke branches of trees, defaecated repeatedly.

External symptoms and post-mortem report of three dead tuskers

Tusker No. 1 : Cascass was detected on 29.01.1994 and post-mortem done by following day at 1.00 pm with the observation that both tusks were intact, no detectable injury on the body, 70% decomposition of the body and extensive maggot formation had started. Internal findings showed that no part of the internal organ were in detectable condition and almost pulpy.

Tusker No. 2 : Carcass was detected on 03.02.1994 and post-mortem was completed on the following day at 9.00 am. External study of the carcass showed signs and symptoms like highly distanded abdomen, swollen body, oozing out of blood from natural aurifices, starting of decomposition, no external injury, both tasks were intact. Internal study revealed that respiratory system affected, no abnormality on heart, partially decomposition of spleen, abnormal decompostion of liver, abnormal decomposition of some part of intestine, unclotted blood.

Tusker No. 3 : Carcass was detected on 04.02.1994 and post-mortem was done on the same day having external symtoms of 90% decomposition of the body, intact tusks and no external injury. Internal findings revealed that almost all the internal organs were decomposed completely.

External symptoms of Tusker No. 2 showed close similarity with the syptoms of Anthrax.

After post-mortem and detailed measurement of the body, it was buried on the spot with proper care and fence (barbed wire) so that bacteria could not be transmitted to other animals grazing at that spot.

Vaccination of captive elephant and fringe cattle with live anthrax spore vaccine

Elephants are very susceptible to Anthrax, so when it was confirmed that those three elephants died due to *Baccillus anthracis*, all the captive elephants of JWLS (adult 20 and calf 9) were vaccinated with Anthrax spore vaccine from 5th February, 1994 onwards and same was completed by 7th morning. 3 ml dose for adult and 1 ml dose for calf was given cutaneously by injection. Only Damayanti (female in advanced stage of pregnency) and two small calves were not vaccinated. Age class and sex wise details of

vaccination of captive elephants with anthrax spore vaccine (as on February, 1994), are given in Table 2.

Table 2

Age class and sex wise captive elephant vaccinated with Anthrax spore vaccine

Age class	Sex			
	Adult		Calf	
	Male	Female	Male	Female
0 – 5	-	-	3	5
6 –10	-	1	-	1
11 –15	1	-	-	-
16 –20	-	4	-	-
21 –25	2	2	-	-
26 –30	1	1	-	-
31 –35	-	2	-	-
36 –40	-	-	-	-
41 –45	-	5	-	-
46 –50	-	-	-	-
51 –55	1	-	-	-
56 -60	-	-	-	-
Total	5	15	3	6

Source: Record of the Office of Assistant Wildlife Warden, Jaldapara Wildlife Sanctuary, Madarihat

It is well known that Anthrax transmitted from cattle so livestock population of nearby villages (upto 5 km from sanctuary) were vaccinated from 9th February, 1994 onward. As JWLS had no veterinary surgeon, Government veterinary officers and staff of nearby blocks namely Falakata, Kalchini, Hasimara, Jateswar were engaged to operate this programme as per guideline given by the District Veterinary Officer. In the first phase, livestock situated within 3 km of sanctuary boundary and in second phase within 5 km of boundary were vaccinated and ultimately approx. 17,000 cattle were vaccinated with the active co-operation of fringe people, sanctuary staff and veterinary officers. One ml dose was used per livestock.

Vaccination of Wild Rhino with Anthrax spore vaccine

To save the Rhino – the key species of JWLS – vaccination programme started on the morning of 10 February, 1994 under the strict guidance of Chief Wildlife Warden, West Bengal. One week schedule (10.02.1994 to 16.02.1994) was chalked out and both morning (6.30 am to 10.30 am) and afternoon sessions (3 pm to 5 pm) were utilized. On each day, 3-4 captive elephants were used and the whole operation was carried out under supervision of a senior forest officer. Six trained officers and technical experts used the dart gun to vaccinate wild rhinos by darting process under following guidelines :

(i) Compartment-wise covering was done as per sequence like Torsa-2, Torsa-3, Torsa-1, Jaldapara (JP)-5, JP-4, JP-1, JP-2, JP-3, Malangi-1, Malangi-2, Malangi-3, Chilapata (CP)-2, CP-1, CP-3b and CP-4b. Other compartments where rhino concentration was negligible not put under this vaccination operation.

(ii) No calf below 2 years age and female in advanced stage of pregnancy was darted.

(iii) Minimum 3 and maximum 4 elephants were used per drive. Each elephant carried 2 persons (one darter and one spotter/identifier/gunman/ photographer). At least two indetifiers were used in each drive.

(iv) Supervisor's duty was to ensure that no rhino was darted twice. To ensure it, each rhino after being sighted was closely checked to establish identify by sex, age (approx.), distinguishing characteristics of cut marks, injury, shape and size of horn, age of accompanying calf if any, etc.

(v) A register was maintained.to describe each rhino that had been darted, mentioning location, time and date of darting, name of darter, distinguishing characteristics etc.

(vi) Recognised dose of live anthrax spore vaccine was 1.5 ml for each rhino.

(vii) A suitable rhino was located with the help of captive elephant in a habitat where vegetation was not too dense to reduce the chance of missing the animal by deflection of the dart when fired and easy location after recumbancy.

(viii) Location and watch over the rhino was conducted with minimum disturbance and as far as possible the animal was kept from being aware of human disturbance.

(ix) Targeted rhino was encircled with 3-4 elephants having darter to check its running and one elephant would approach near the rhino for darting.

(x) Dart was loaded with 1.5 ml anthrax spore vaccine previously and more than one dart was ready in a small metal box on elephant back to ensure that if the first dart missed, then second dart could be used.

(xi) First aid box was always carried with the team.

(xii) The dart was ideally fired fairly high into the hind quarters from a distance of 30-40 m, ensuring that the target area was perpendicular to the line of flight of the dart.

(xiii) After darting, rhino would run away so 5 minutes watching over was ensured to see if darting was successful and if possible the syringe could be collected from field for use the next day.

There was no record of vaccination of wild rhino with anthrax spore vaccine in JWLS as well as in other protected areas in West Bengal.

Identification marks of each rhino, date and time of vaccination, compartment number, location, sex, age, behaviour, horn size, identifying characteristics, etc. of rhino are given in Table 3.

In this vaccination process 24 rhinos out of total 34 were vaccinated. Of the total 34 rhinos, 17 and 15 were concentrated in JP East and West Range jurisdiction, respectively. In JP East Range the maximum concentration was found in JP-3 compartment (13 nos. including 2 calves) of Jaldapara Beat and remaining 4 (including 1 calf) were found and vaccinated in CP-2 (one) and CP-3 (two), respectively under Sissamara Beat; whereas in JP West Range maximum concentration was found in Torsa-2 and 3 Comptts. of Moiradanga and Bengdaki Beats (12) and remaining 3 were found in JP-5 (two) and JP-4 (one), respectively.

Remaining 10 (34-24) were not vaccinated; of them 8 were calves, one female was in an advanced stage of pregnancy and one sub-adult was found but could not be vaccinated due to his rapid movement.

Thereafter, no incidence of Anthrax was noticed in case of rhino and other animals in JWLS.

Table

Total count of rhinos with other features during vaccination period

Sl. No.	Local Name	Sex	Approx. Age (yrs)	Time	Range	Beat	Comptt.
1	2	3	4	5	6	7	8
10.02.1994 :							
1.	Kankata	M	40-45	8.10am	JP West	Moiradanga	Torsa-3
2.		F	15-20	9.25am	JP West	Moiradanga	Torsa-3
3.		F	30-35	4.30pm	JP West	Moiradanga	Torsa-3
4.	Barabacchauli	F	30-35	4.45pm	JP West	Moiradanga	Torsa-3
5.	Chhotabacchauli	F	15-20	5.00pm	JP West	Moiradanga	Torsa-3
11.02.1994 :							
6.		F	25 to30	8.30am	JP West	Moiradanga	Torsa-3
7.		F	20 to25	3.55pm	JPEast	Jaldapara	JP-3
8.		M	05 to 10	4.20pm	JPEast	Jaldapara	JP-3
9.		M	35 to 40	4.30am	JPEast	Jaldapara	JP-3
12.02.1994							
10.	Baraghutka	M	25 to 30	7.15am	JPWest	Hollong	Torsa-3
11.	Chhotoghutka	M	10am	8.05am	JP West	NWC	JP-5
12.		M	35 to 40	9.50am	JP West	Hollong	JP-4
13.	Barabacchauli of JP-3	F	20 to 25	4.30pm	JPEast	Jaldapara	JP-3
13.02.1994							
14.		M	25 to 30	8.00am	JPEast	Jaldapara	JP-3
15.		F	20 to 25	8.05am	JPEast	Jaldapara	JP-3

3

from 10.02.1994 to 17.02.1994 and 25.02.1994.

Horn size	Behaviour	With calf or not	Identifying features
9	10	11	12
7"-8"	Charging	-	Right ear torn.
3"-4"	Grazing.	-	Cut mark in right tail fold.
4"-5"	Running away.	With calf of approx. 1yr. 1 yr. age; sex unknown.	Cut tail.
4"-5"	Running away.	With calf of approx. 2 yrs. age; sex unknown.	Base of horn circular; shape pointed sharp and bent.
3"-4"	Normal.	Calf of 6-8 months age, sex unknown.	Horn straight; no pointed tip.
3"-4"	Running away.	Calf of 14-15 months age, sex unknown.	Base of horn circular, tip not pointed.
4"-5"	Grazing.	-	V-shaped cut marks on left tail fold.
2"-3"	Normal.	-	Horn not pointed, just like an outgrowth.
8"-9"	Charging.	-	Lacerated wound under left tail fold.
6"-7"	Normal.	-	Horn slightly bent, pointed tip.
3"-4"	Feeding.	-	Horn oval shaped, just like a protuberance.
6" - 7"	Bold.	-	Cut marks on right tail fold, injury in rear left fold, ring mark on horn, slightly bent.
4" - 5"	Normal.	Calf of 6 months age, sex unknown.	Slightly pointed horn.
6" - 7"	Grazing.	-	Horn tip sharply pointed and straight.
4" - 5"	Normal.	-	Tip of horn very smooth and not pointed, base not circular.

Contd...

1	2	3	4	5	6	7	8
16.	Chhotabacchauli of JP-3	F	25-30	8.45am	JPEast	Jaldapara	JP-3
14.10.1994 :							
17.		Un.	10-15	3.35pm	JPEast	Jaldapara	JP-3
18.		M	40-45	4.45pm	JPEast	Jaldapara	JP-3
15.02.05							
19.	Padamara	M	35-40	3.00pm	JPEast	Sissamara	CP-3
20.	Sissamara	F	30-35	3.25pm	JPEast	Sissamara	CP-2
21.		F	10-15	4.45pm	JPEast	Sissamara	CP-3
16.02.1994							
22.		M	25-30	7.50am	JPEast	Jaldapara	JP-3
23.		M	3-0	8.55am	JPEast	Jaldapara	JP-3
25.02.1994							
24.		F	20-25	5.05pm	JP West	Bengdaki	Torsa-3

JP = Jaldapara, NWC = North West Corner, M = Male, F = Female, CP = Chilapata. Un. = Unknown
Source: Office record of Assistant Wildlife Warden, Jaldapara Wildlife Sanctuary, Madarihat.

Age classes, sex and productive age-wise Rhinos vaccinated with anthrax spore vaccine

Of the total 24 rhinos vaccinated, 11 were male and 12 were female (ratio of male and female is 46 : 50) and sex of remaining could not be identified. Rhinos of JWLS achieve sexual maturity at the age of 15-20 years and end in the 40-45 years age class approximately (Ghosh, 1991), hence total number of productive males and females would be 9 and 11 respectively, which is quite a good sex ratio. Of the total rhino population in JWLS of 34, sex of 9 could not be identified (8 calves and one adult).

Details of age class, sex etc are given in Table 4.

JWLS contains 34 Rhinos in 216.51 km² i.e. concentration of Rhino is only 0.16 nos./km², which is quite high in other rhino bearing areas of India. It is clear from the Table 4 that all females and males ere belonged to the 10-35 years and 15-45 years age groups, respectively. All the Rhinos were within the productive age group. As the number of females was more and within the productive age group 10-35 years, there is a fair possibility to increase the population in the future if proper protection and other managerial input is given adequately.

9	10	11	12
5"-6"	Running away.	Calf of 2 months age, sex unknown.	Horn slightly pointed.
2"-3"	Grazing.	-	Horn almost oval shaped.
4"-5"	Bold.	-	Top portion of horn broken due to fighting.
8"-9"	Bold extremely.	-	Horn shape curved & tip pointed.
6"-7"	Normal.	Calf of 8-10 months, sex unknown.	Horn pointed and shightly curved. Straight ridges from the top of horn.
2" - 3"	Normal.	-	Horn tip flat.
3"-4"	Feeding.	-	Distinct rings on the horn, blunt.
1"	Childish nature.	-	Horn like small protuberance, no shape yet to come up.
3"-4"	Normal.	Calf of 6-7 months, sex unknown.	Left ear hanging, horn base oval shaped.

Table 4

Age classes, sex, productive ages of rhino and their percentage vaccinated in JWLS

Age Class	Total Nos.	No. of males	No. of females	Sex unknown	No. of productive males (15-45 yrs) and %	No. of productive females (15-45 yrs.) and %
0 – 5	1	1	-	-	-	-
5 – 10	1	1	-	-	-	-
10 – 15	3	1	1	1	1 (4.17)	2
15 – 20	2	-	2	-	-	2 (8.33)
20 – 25	4	-	4	-	-	4 (16.7)
25 – 30	5	3	2	-	3 (12.5)	2 (8.35)
30 – 35	3	-	3	-	-	3 (12.5)
35 – 40	3	3	0	-	3 (12.5)	-
40 – 45	2	2	0	-	2 (8.35)	-
45 – 50	-	-	-	-	-	-
50 – 55	-	-	-	-	-	-
Total	24	11	12	1	9	11

Acknowledgements

The authors are thankful to Conservator of Forests, Wildlife Circle, West Bengal and Shri A. Ghosh, IFS, Managing Director, West Bengal Forest Development Corporation Limited, Kolkata for facilities.

SUMMARY

Jaldapara Wildlife Sanctuary (JWLS) harbours 34 rhinos. In India several incidences were noticed where death occurred in elephant and rhino due to anthrax attack. The first incidence of anthrax attack in wild elephant was reported in January and early February, 1994. Symptoms of carcass and blood testing report confirmed it was anthrax. To save the captive elephants in JWLS total 29 elephants (20 adult and 9 calves) were vaccinated with anthrax spore vaccine cutaneously by injection. As anthrax is a cattle borne disease so approximately 17,000 cattle of nearby villages were also similarly vaccinated. To save the most endangered species *Rhinoceros unicornis* in JWLS vaccination programme was carried out in which a total 24 of wild rhinos (out of 34) were vaccinated- the first record of Wild rhino vaccination with anthrax spore vaccine in West Bengal. Later on no death of rhino due to anthrax attack was noticed. Full details of the procedure are given in this paper. Out of total 24 rhinos 9 males and 11 females were in productive age groups (15 - 45 yrs) which indicates the possibility to increase the number in future if adequate protection measures are ensured.

जलदपाड़ा वन्यप्राणि अभयारण्य, पश्चिम बंगाल, भारत में एन्थैक्स आपात तथा वृहद एक श्रृंगी गैण्डे (*रहाइनोसेरोस युनिकार्निस*) को टीका लगाकर उसका एन्थैक्स से बचाव करना

पी०के० पण्डित व एस०पी० सिन्हा

सारांश

जलदापाड़ा वन्यप्राणि अभयारण्य में 34 गैण्डे रहते हैं । भारत में एन्थ्रैक्स रोग हो जाने से हाथियों और गैण्डों की मृत्यु हुई । जलदापाड़ा अभयारण्य में जंगली हाथियों में एन्थ्रैक्स रोग होने का यह पहला आपात है और इससे तीन दन्तल जनवरी के दूसरे भाग, फरवरी के प्रथम भाग, 1994 में मर गए । कंकाल के लक्षणों और रक्त परीक्षण की रिपोर्टों से एन्थ्रैक्स रोग की पुष्टि हुई । जलदापाड़ा अभयारण्य के सभी 29 बन्दी हाथियों (20 पौढ़ और 9 बच्चे) को बचाने के लिए उन्हें अन्त: क्षेपण द्वारा त्वचा में एन्थ्रैक्स बीजाणुलसी क़े टीके लगाए गए । एन्थ्रैक्स मवेशियों द्वारा वाहित रोग है इसलिए आसपास के गाँवों के लगभग 17,000 मवेशियों को भी एन्थ्रैक्स बीजाणुलसी के टीके लगाए गए । सर्वाधिक संकटापन्न, जलदापाड़ा अभयारण्य की जाति, *रहायनोसेरोस युनिकार्निस* को इस रोग से बचाने के लिए एक टीकाकरण कार्यक्रम चलाया गया । एक सप्ताह चले कार्यक्रम में कुल 24 गैण्डे (34 गैण्डों में से) को प्रत्येक को टीके लगाए गए । यह पहला अवसर है जब पश्चिम वंगाल में जंगली गैण्डे को एन्थ्रैक्स की बीजाणुलसी टीका लगाया गया है । बाद में ऐन्थ्रैक्स होने से किसी गेण्डे के मरने की सूचना नहीं मिली । उम्र, लिंग, प्रत्येक गैण्डे के अभिज्ञान चिह्न और उसका व्यवहार, स्थान, तारीख और समय सींग का आकार आदि का ब्यौरा ठीक तरह से पंजी में लिख लिया गया । कुल 24 गैण्डों में से 9 नर और 11 मादा सन्तानोत्पत्ति आयु वर्ग (15 - 45 वर्ष) में आते हैं जो भविष्य में संख्या वृद्धि होने का संकेतक है क्योंकि उत्पादक मादाएं अधिक हैं, यदि सुरक्षा उपाय सुनिश्चित करके रखे जाएं ।

References

Anon. (2000). Bull. World Veterinary Assoc., 17 (2).

Banerjee, L.K. (1993). *Plant Resources of Jaldapara Rhino Sanctuary*. Botanical Survey of India.

Berry, H.H. (1993). Surveillance and control of anthrax and rabies in wild herbivores and carnivores in Namibia, *Reveu scientifique et Technique* (Office International des Epizooties), **12** : (11) 137-146

Ghosh, Deepak Kumar (1991). Studies on the Eco status of the Indian Rhinoceros. Rhinoceros unicornis with special reference to it altered habitat due to human interference in Jaldapara Wildlife Sanctuary, West Bengal. *Ph.D. Thesis*.

Lahan, P. and R.N. Sonewal (1973). Kaziranga Wildlife Sanctuary, Assam. *J. BNHS*, **70** (2) : 245-78.

Lindeque, P.M. and P.C. Turnbell (1994). Ecology and Epidemiology of anthrax in the Etosha National Park, Namibia, onder stepoort. *J. Vet. Res.*, **61** : 7-83.

Morris, R.C. (1952). *The preservation of Wildlife in India – A compilation*, Bangalore Press. p. 11.

Pandit, P.K. (1994). Vaccinating wild Rhino (*Rhinoceros unicornis*) against Anthrax at Jaldapara Wildlife Sanctuary, *Zoos Print*, **9** (9) : 3-5.

Pandit, P.K. (1996). *Draft Management Plan of Jaldapara Wildlife Sanctuary for the year 1996-97 to 2006 - 2007*.

Pandit, P.K. and V.K. Yadav (1996). Management of Jaldapara Wildlife Sanctuary, West Bengal, India. *Tigerpaper*, **4** : 1-5.

Rodgers, W.A. and H.S. Panwar (1988). *Planning a Wildlife Protected Area Network in India*. Vol. I &II. Wildlife Institute of India, Dehra Dun.

Rathore, B.S. and S.S. Khera (1981). Causes of mortality in Felines in free living state and capacity in India. *Ind. Vet. J.*, **58** : 271-76.

Tuehili, L.M., G.S. Pandey, P.G. Sinyangwe and T. Kaji (1993). Anthrax in cattle, wild life and human in Zambia. *Veterinary Records*, **132** (19) : 487

Turnbell, P.C, R.H. Bell, K. Saigawa, C.K. Mulenga and L.H. Makala (1991). Anthrax in Wildlife in the Luangwa valley, Zambia. *Veterinary Records*, **178** : 399-403.