



VIDYASAGAR UNIVERSITY

**INDIAN JOURNAL
OF
BIOLOGICAL SCIENCES**

ISSN 0972-8503

VOLUME - 10

2004

CONTENTS

<i>Articles</i>	<i>Author(s)</i>	<i>Pages</i>
Y-linked trichosis auris in the gotras of Radi Brahmans	<i>D. P. Mukherjee</i>	1
Dermatoglyphic Variations in Oculocutaneous Albinism	<i>Sudip Datta Banik and D.P. Mukherjee</i>	9
Survey of nutritional status of college-going adolescents and young adults of Birbhum district of West Bengal with BMI-study method	<i>K Roy, N. Goswami and A.Pari</i>	15
Adult Bengalee Tuberculosis Patients and Controls : Comparison of anthropometric characteristics and nutritional status.	<i>Sujata Jana, Kaushik Bose, Ashish Mukhopadhyay and Mithu Bhadra</i>	21
Consanguinity effect on fertility and related phenomena among Telugu speaking population of Kharagpur, West Bengal	<i>Bidhan Kanti Das</i>	30
A Comparative Account on Aquatic Weeds Infestation in two Adjacent Districts of Orissa	<i>B. R. Dhal, R. N. Mandal, A. Mohapatra and J. K. Pradhan</i>	42
Studies on gastropod distribution in Indian Sunderban with special reference to the influence of habitat factors	<i>Sougata Roy and S.C. Santra</i>	49
Conservation of the Great Indian One Horned Rhino (<i>Rhinoceros unicornis L</i>) in Jaldapara Wildlife Sanctuary, West Bengal, India	<i>P. K. Pandit</i>	60
Roles of Probiotics in Aquaculture	<i>Partha Bandyopadhyay, Pradeep K. Das Mohapatra, Biplab K. Nandi and Bidhan C. Patra</i>	76

CONSERVATION OF THE GREAT INDIAN ONE HORNED RHINO (*RHINOCEROS UNICORNIS L*) IN JALDAPARA WILDLIFE SANCTUARY, WEST BENGAL, INDIA

*P.K. Pandit**

Introduction :

Jaldapara Wildlife Sanctuary (JWLS), renowned in the wildlife map of India and abroad as home of the great one horned Rhinoceros (*Rhinoceros unicornis*), is located in the foothills of Eastern Himalaya in the district of Jalpaiguri, West Bengal, India that is situated between the latitude 25°58" and 27°45" north and longitude 89°08" and 89°55" east. It lies in the flood plain of river Torsa and its tributaries like Sanjoy, Bhaluka, Sissamara, Chirakhawa, Gorumara, Hollong etc which support large tracts of grassland sustaining a small population of one horned rhinos. During rainy season, a number of seasonal water sources developed like TiTi, Howri, Purnekhola, Sanjoykhola, Kalikhola, Dayamara etc. All the river and rivulets are flowing from north to south direction of the sanctuary.

Configuration of the sanctuary is more or less flat and the elevation varies between 60-130 metre except Titi block which is hilly having elevation ranging from 152- 610 metre above mean sea level.

It was declared as a Game Sanctuary in 1941 comprising an area 99.5 sq.km. With two subsequent extensions in 1976 and 1990 the area was increased to 216.5 sq.km covering 12 forest blocks and 46 compartments (pandit, 1996). The sanctuary is trouser like in its southern part and width of the two legs varies from less than a km to 4.5 km (Pandit, 1996). There are 32 revenue villages, 4 forest villages and 9 tea gardens situated in and around the sanctuary having approximately 90,000 human and 1,00,000 cattle population.

The sanctuary is located near Madarihat town, 140 km away from Siliguri, which reached by air from Kolkata, Delhi and Guwahati. From Siliguri, Madarihat can be approached by rail (Meter Gauge) or by road. Alternatively the sanctuary can be approached by road (about 80 km) from Cooch-Behar town which is linked by train (in broad gauge) with Delhi, Kolkata and Guwahati. Nearest broad gauge railway station is Falakata which is 22 km away from JWLS.

JWLS harbours the one horned Rhinoceros - a threatened species included in Schedule - I of the Wildlife (Protection) Act, 1972 of India. Besides rhino, it harbours 15 wild animals which belong to same Schedule. These animals are tiger, gaur, elephant, sloth bear, leopard, hog badger, hispid hare, swamp deer, pangolin, Bengal florican, peacock, large

* Divisional Manager, Forest Corporation South Division, India, Kharagpur, West Midnapore, West Bengal

falcon, Indian pied hornbill, python, and Indian Soft-shelled Turtles.

The sanctuary contains 33 species of mammals, 230 species of birds, 24 species of reptiles (including 8 species of turtles), 30 species of fishes and huge number of micro fauna (Pandit 1996, Pandit & Yadav, 1996). Rhinoceros, hispid hare and hog deer are endemic to Jaldapara. Swamp deer (*Cervus duvauceli*) once existed in the sanctuary but become extinct sometimes in late sixties. Total Rhino population of the sanctuary constitutes 2% of total rhino population in the world.

The vegetation structure in this sanctuary is variable and within a stretch of few km. several types of vegetations are available. The entire forests of JWLS falls under North Indian Moist Tropical Forest according to Champion and Seth's recent classification (1968) However, from recent observation following type of vegetations are found in the sanctuary (Banerjee, 1993; Pandit, 1996; Anon, 1997; WII, 1997; Das *et al*, 2003; Pandit *et al*, 2004).

(i) Riverine Forests (ii) Sal Forests (iii) Wet mixed Forests (iv) Semi evergreen Forests (v) Evergreen Forests (vi) Savannah Grasslands (Moist sal savannah; Low Alluvium Savannah woodland; Eastern Alluvial Grassland; Primary Grassland) (vii) Hydrophytic Vegetations.

Savannah grassland covers a considerable part (18.24%) of the sanctuary (Pandit, 1996; Das *et al*, 2003; Pandit *et al*, 2004) mainly on flood plains, elevated riverbeds in pure forms or in association with khair - sissoo, simul - siris.

Savannah grassland dominated by few species of grasses like *Arundinella bengalensis*, *Saccharum narenga*, *S. longosetosum*, *S. arundinaceum*, *S. spontaneum*, *S. bengalense* and *Themeda* species. This tract of grassland support rhino (key species of JWLS) and other herbivores. The sanctuary contain 585 species of flowering plants (Banerjee, 1993), which belonging to 429 genera and 111 families out of which 71 are grass species, 19 orchid species and 47 endangered plant species (29 genera) that needs conservation. Recently Das *et al* (2003) have provided an additional list of 224 species (141 dicotyledonous, 51 monocotyledonous and 32 pteridophytes) to the flora of the sanctuary.

It is very rich in flora of Non Timber Forest Produces (NTFPs). Recently Pandit *et al* recorded that 116 species of dicotyledons (15 families and 93 genera), 14 species of monocotyledons (8 families and 13 genera) 2 pteridophytes (2 families and 2 genera) are collected and marketed by local fringe people as their livelihood. These are used for medicines, decorations, fodder, edible materials, thatching, religious purposes, detergent, snake repellent, bath sponge, spices, masticators, and construction purposes. It is needless to mention that these plants are collected most unscientifically and unsustainably.

JWLS provides an opportunity to study ecology, behaviour requirement, habitat analysis, food habit, demographics, genetic threat and reproduction biology of rhino. It offers excellent possibility for studying bio-diversity, as it is very rich in flora and fauna.

It belongs to the Bio-Geographical zone &B (Lower Gangetic Plain) according to Rodgers and Panwar (1988).

Totopara village, the home of the endangered Toto tribe situated in the north of the

sanctuary. The socio-economic practices, religion, culture and language of them is a matter of great anthropological interest. Currently this remote village has small population slightly greater than 1000 and till this day Totos have managed to keep and have preferred to be swamped by the inroads of the mainstream culture.

JWLS has tremendous potential of Eco-tourism and every year 12-15000 visitors come to the sanctuary through which local people get direct and indirect benefit (Pandit, 1996).

Key areas of the JWLS

As rhino is the key species so, the area where it concentrated more is considered as key areas. The three main rhino concentrating areas are Jaldapara and Malangi beat, Sissamara beat and Moiradanga beat area where food, cover and water sources are good. The areas of these consisting of approximately 24 sq.km. 8 sq .km and 19 sq. km respectively (Pandit, 1996). Maximum managerial intervention to be required to these key areas to conserve Rhino and other wild lives without much damaging natural habitat and eco-system.

Rhino Population in India :

The five species of Rhinoceros, which still exist on the earth, have been subjected to serious threat as a result of poaching, illegal trade and destruction of habitat. The world population of Rhinoceros, which was about 70,000 twenty years ago, has drastically dropped down to 11,000. The Asian population of the great Indian one horned Rhinoceros was 1900 in 1992 (Dey, 1994).

In India Rhino population is distributed in two major states viz., Assam and West Bengal (not considering the small number of Rhino introduced in Dudwa National Park in Uttar Pradesh) containing 1500 Rhinos (Dey, 1994) broadly over 7 areas (5 in Assam and 2 in West Bengal).

The killing of Rhino and trade with Rhino is a major problem throughout the world, as it is believed that Rhino horn has an aphrodisiac property. Fortunately it was banned in India for nearly 60 years and in other countries of Asia for a considerable period. For that reason Rhino population has got some momentum in Asian continent. Nepal and India showing a remarkable rise of Rhino population, the figure increasing in Nepal from about 60 to about 400 in 1992 during last 60 years. In India the figure has increased to from about 50 in 60 years ago to about 1600 in 1991 (Dey, 1994).

Asian Rhinos are more prone to poaching than their African counterpart because horns are much more valued and nearest to the consumer centre (Dey, 1994).

Rhino Conservation Strategies in National Level :

The conservation of Rhino has a two-way approach – one for conservation of habitat through different managerial intervention and other for conservation of species by controlling poaching and illegal trade through legislation. The first Act was first start in Assam and subsequent acts that were formulated and enacted are given chronologically :

- 1887 - Act for preservation of Wild birds and animals.
- 1891 - Assam Forest Regulation.
- 1912 - Wild Birds and Animals Protection Act.

1927 - Indian Forest Act.
 1932 - The Bengal Rhino Preservation Act.
 1954 - The Assam Rhino Conservation Act.
 1972 - The Wild Life (Protection) Act followed by its main amendments in 1986 & 1991.

India is a member of CITES since 1996 and also signatory to various conventions and protocols on environment and wildlife conservation.

Indian Action Plan for conservation of Rhino include :

- a) Habitat protection and restoration.
- b) Creation of corridors for migration.
- c) Proper communication network.
- d) Anti-poaching squad and strike force.
- e) Training of Wildlife personnel.
- f) Arms training to protective staff.
- g) Research and Monitoring.
- h) Eco-development activities.
- i) Education and public awareness programme.
- j) Relocation of enclaved villages through persuasion.
- k) Veterinary care.
- l) Translocation of animal for rehabilitation and captive breeding.
- m) Development of intelligence network.
- n) Reward for good work and case detection.

Past Distribution of Rhino in West Bengal :

Rhinos in India were distributed in Brahmaputra valley and Indo-Gangetic Plains centuries ago. It was stated to have extended from Burma in the east to Peswar in the west all along the foothills and alluvial plains. In West Bengal it was existed in the Sunderban (Gupta, 1966) and the district of Malda (Banerjee, 1966), till the second half of the last century. Another one species of Rhino, viz., *Rhinoceros sondaicus*, used to exist in North Bengal, which became extinct and last sighting was recorded in Chilapata Forests in 1900 (Bist, 1994). The Great Indian one horned Rhino has managed to survive in West Bengal, especially North Bengal despite of all threats.

Besides Jaldapara and Gorumara. Rhinos were previously reported from Bholka (Buxa Forest Division), Patlakhawa (Cooch Behar Forest Division) and Chapramari (Jalpaiguri Forest Division). As many as 10 Rhinos were reported each in Bholka and Patlakhawa in 1958 -59 (Bist, 1994).

Factors influencing the Rhino conservation strategies in JWLS :

Due to small area, large interface and typical shape the sanctuary has been subjected to tremendous pressure in different point of view, which directly or indirectly affect the rhino population. Following factors affect the Rhino conservation strategies from time to time.

1. Poaching : Poaching of Rhinos takes place primarily for tremendous demand of its

horn in the clandestine market, which believed to act as an aphrodisiac property through not based on facts. A well-connected international network of poachers operates from their base camp to the population site by utilizing middleman and exploiting poverty fringe people. Prior to 1968, records of Rhino poaching in JWLS were not maintained properly. A total of 34 Rhinos was shot dead by poachers during the period 1969 to 1972-73 but after 1973 to 1977 no rhino was poached. In the year 1978 one Rhino was killed and again 11 Rhinos were shot dead in between the period 1980-85. Some hopeful situation appeared between 1986 – 90 when no Rhino was killed. Since the year 1991 poaching was continuing but in lesser extent and in between 1991 to 2003 total 11 rhinos were kill by poachers. As a result of which population of rhino has been more or less in upward directions. Maximum Rhinos were poached in JWLS from 1968 – 1973 and as a result of which Rhino population was drastically reduced from 80 (1968-69) to 23 in 1975 (Bist, 1994; pandit, 1996). Besides Rhino, other animals like tiger, elephant, deer, wild boar, Jungle fowl etc. are also killed time to time by the poachers and local villagers.

In Jaldapara poaching is being done by long range Rifle but recently incidences of poaching by poisoning has also been recorded (Pandit, 1996). Due to lack of adequate infrastructures, national and inter national co-ordination, inter departmental co-ordination, public awareness and presence of unauthorized firearms in fringe villages, poaching has not totally stopped.

2. Hunting : Hunting was a factor to reduce the rhino population in earlier days prior to Bengal Rhino preservation Act, 1932 because at that time Maharaja of Cooch Behar had exclusive right to hunt rhino in his jurisdiction. According to Bist, 1994, a total of 132 rhinoceros shot dead by the hunters in between the period 1877 to 1904 in Jaldapara and Buxa region.

3. Destruction of Habitat : Degradation of habitat lead to inadequate grazing and foraging area of rhino and other herbivores. Following are the factor of causing degradation of habitat

(a) Illicit felling of timber and collection of firewood, Non Timber Forest Products (NTFPs) from the sanctuary

It was done because presence of large number of wood based industries, large gap between demand and supply, unemployment and poverty of the fringe population.

(b) Grazing of livestock of fringe villages

There are 32 revenue villages, 4 forest villages and 9 tea gardens are situated in and around the sanctuary having approximate one lakh livestock population and a fair percentage of it regularly grazed inside the sanctuary which causing depletion of fodder grasses of wild herbivores in one way and in other way transmitting diseases of Foot and Mouth Disease, Rinder Pest and Anthrax. Domestic livestock received least veterinary care and general appearance is dwarf size with poor health. An attempt was made by present author (1996) to ascertain the grazing intensity in JWLS by laying out 121 sample plot (100 X 100 m) in all forest block

and result proved that everyday nearly 11000 cattle grazed within the sanctuary. Intensity of grazing in block wise was Barodabri followed by Hasimara, Jaigaon, Dalsingpara, Jaldapara, Torsa, Chilapata, Salkumar, Titi and Malangi.

4. Infestation with weeds and climbers: Among weeds, *Leea* species, Lemon grass, *Eupatorium* sp., *Clerodendron* sp., *Cassia tora* and *Solanum nigrum* are predominant. *Mikania* sp. is serious weeds in JWLS which damaged many fodder grass plantation. All these weeds and climbers cause reduction of fodder grasses of wild animals.

5. Advancement of Woodland in grassland: As JWLS situated in the flood plains of river Torsa so as a natural process of succession species like khair-sissoo, simul-siris, simul-sidha which made conversion of grassland in to woodland i.e., reduced the suitable habitat of rhino. An attempt was made by present author (1996) by laying out sample (100 sq.m.) plot in some natural grassland areas of different compartment and it has been found that total 2992 plants per hectare counted. Out of which 1579 were in height (ht) class of 0.5m and less, 617 were 0.5 - 20 m ht. class, 517 in 2.0 m and above ht class and 282 were in tree class. The study revealed that 58.72% plants were belonged to age group 0 - 2 years (yrs), 16.81%, 3.64%, 20.22%, 0.60% belonged to 2 - 4 yrs, 4 - 6 yrs, 6 - 8 yrs and 8 - 10 yrs age group respectively. If it is roughly assumed that 40% of the total plants will reach tree category then approximately number will be nearly 1100 which is very high density.

6. Fire: Fire in grasslands of JWLS is quite common every year although not in great extent. Uncontrolled fire is mainly caused by poachers, illicit collectors of simul floss, thatch grass and other NTFPs. Judicious fire has important role to maintain grassland but unregulated man made fire cause damage to the vegetation, wildlife and changes composition of natural vegetation.

7. Past forestry practices: In the past, some of the natural forests of JWLS in Bania and Mendabari block were converted to monoculture for better production of timber that is unsuitable for wildlives. Due to change of policy on forest management and conservation of biodiversity in PA's monoculture in natural forests has been discouraged. Forest conservation Act, 1980 also have imposed severe restrictions on such conversion.

8. Natural Calamities: The only known natural calamity that affects the habitat of JWLS is flood of rivers which are very common in North Bengal. Flood in one hand washed out the habitat but in other hand its positive effect to conversion of tree land to grassland. Fortunately, no such severe death of wild life was done except few cases due to flood. Floods of severe nature occur during the year 1952, 1954, 1964, 1968 & 1993 (Bist, 1994; Pandit, 1996). Of these, 1968 flood is considered to be a physiographic landmark since this resulted in a total change in the course of river from western to eastern leg of the sanctuary.. This has caused heavy damaged to the forests of Bania, Chilapata and Barodabri blocks along the course of Siltorsa. Due to flood of 1954 three rhinos were died (Bist, 1994). Damage of crop and forests was done in second week of September 1984 due to flood of river Torsa. Heavy rain occurred on 19th July 1993 (992 mm) and as a result of which flood of Hollong, Siltorsa, Malangi, Titi and Howri river eroded forests of Titi, Jaldapara, Barodabri and Hasimara.

block (Pandit, 1996).

9. Disease: Wild animals of JWLS are very prone to cattle borne diseases like Anthrax, FMD, Rinderpest etc. but fortunately incidence of out break of diseases is very rare in past. One rhino was died due to Septicaemia in 1967-68. In 1986, one abandoned female Rhino calf was caught and reported to be suffered from pneumonia and corneal disease in the right eye. One calf was died due to unknown reason in the year 1987 (Bist, 1994). There was an outbreak of Rinder pest in the year 1968 which reduced the population of Gaur (Indian Bison) 31 number. During January-February, 1994, 3 wild tuskers were died (Pandit, 1994) due to out-break of anthrax in Torsa 2 and 3 compartment. All departmental elephants and 24 wild Rhinos were vaccinated with live anthrax spore vaccine (Pandit, 1994) to save them against anthrax in February 1994. After that there was no record of disease incidence in the sanctuary.

10. Intra & Inter specific struggle

(a) **Intra specific struggle:** Fighting of Male Rhino among others of their own species is very common probably due to mating and rivalry which sometime causing death and injury of Rhino. A total of 14 rhinos are killed by this factor since 1948-49 to 2003 [Bist, 1994; Office record of Assistant Wildlife Warden (AWLW), Madarihat] in the year 1948-49, 1950-51, 1983, 1986, 1992, 1993, 1994, 1999, 2001, 2002 and 2003.

(b) **Predation:** There was a report in JWLS that Tiger killed the Rhino Calf as their prey although incidences are rare. Till date there two cases has been recorded in the year 1981 and 1994 (Bist, 1994).

11. Accidents : Rhino sometime died due to accident like trapped in swamp and mud, neck injury etc in JWLS. Although no past record was not available but from recent records (Bist, 1994; Office record of AWLW) it is found that total 6 rhinos have been died due to accident in between the period 1984 to 1995.

12. Trans boundary Problems : Titi and Jaigaon block i.e. extreme northern boundary of the sanctuary forms the international boundary with Bhutan. People of Bhutan side are creating constant pressure on biotic resource. Smugglers and poachers generally take advantage of International borders and as there is no proper co-ordination between two countries so it becomes very difficult to stop international smuggling racket of Rhino horn, elephant tusks etc.

Other factors, which directly or indirectly affect the Rhino population, are insufficient infrastructure, man-animal-conflict, irregular shape of the sanctuary etc.

Past Management of Jaladapara Sanctuary :

The area of the sanctuary has remained under control of Forest Department since 1865, no records are available of its management till 1875 when for the first time a scheme for systematic management was prepared by Dr. William Schlich, the then Conservator of Forests. In the working Plan of Buxa Reserves (1905-06 to 1919-20) Mr. C.C. Halt prescribed selection felling to be followed by natural regeneration. But the area remained untouched as

it was poorly stocked.

Mr. C.K. Homfray first emphasized the need for maintenance and improvement of the 'Savannah' areas to provide habitat for the rich grassland fauna of this tract like Rhinoceros, swamp deer, hog deer etc. in Working Plan of Buxa Forest Division (1929-30 to 1948-49).

Titi block (northern part of the sanctuary) came to Hill working circle under Shebbere's Plan (1919-20 to 1924-25) and prescription were of clear felling and artificial regeneration on a rotation of 80 years and trees over the exploitable girth might be removed from anywhere.

Ultimately the Bengal Rhinoceros Preservation Act came into force in 1932 to ensure the protection of the one horned Rhinoceros. The area, however, declared as a game sanctuary in the year 1941 only consisting of 99.5 sq. km. area.

A separate game sanctuary-working circle was created in the 5th working plan of the Buxa Division virtually covering the present area of the sanctuary with the exception of Salkumar block (Southern most isolated block) which continued to be worked under sal conservation working circle. The main objective of constituting a separate game sanctuary working circle was to preserve and improved the existing stock of indigenous fauna. All types of extractions including thatch were prohibited except limited felling of timber trees by departmental agency. Control burning in alternate years and removal of evergreen crop invading the grassland were carried out in 'Savannah' areas.

In the year 1951, the entire area of the sanctuary came under the control of newly created Couch-Behar Division for better management. The first working plan was prepared in the year 1962-63 for 10 years. An area of 99.5 sq.km. was kept under sanctuary working circle. The same area was managed under same working circle in second working plan for the period 1972-73 to 1981-82. Special emphasis ware given in this plan to create and maintain glades, saltlicks and periodic removal of trees invading the grasslands.

The game sanctuary was re-notified as Jaldapara Wildlife Sanctuary in the 1976 vide Govt. notification no. 5404 – For, dated 24.06.1976 and the area has been increased to 115.53 sq. km. The sanctuary area came under control of newly created Wild Life Division – 11 on 10.02.1982 for effective management and another 100.98 sq.km. area has been added to with the inclusion of valuable forests of Titi, Bania, Mendabari, Jaigaon and Dalsingpara blocks to the sanctuary from Cooch Behar Division vide Govt notification no. 7245 – For, dated 31.08.1990. Total area of the sanctuary stands at present is 216.51 sq. km. However, management of the extended area was lying with Cooch-Behar Forest Division. Again in the year 1995, whole area (216.51 sq. km.) of the sanctuary transferred to administrative control of Cooch-Behar Division vide Govt. notification no. 4983 – For dated 25.09.1995 and till date it is managed by this Division.

Present Management of the Sanctuary:

To manage each sanctuary it needs a approved realistic management plan for its efficient management with specific goals, objectives and strategies considering biodiversity conservation, socio- economic and socio-cultural condition, resource dependency of local people, man –animal conflicts, nature based tourism and other factors. Management plan is

a document, prepared by Management Plan Officer, which sets out of the values and objectives of management of Protected areas (Sawarkar, 1995). It guides and controls the management of protected areas resources, the uses of the area and development facilities needed to support that management and use.

First Management plan of the sanctuary was prepared for the period 1981-82 to 1985-86. The management plan prescribed for raising fodder plantation including fruit species to supplement food resources of herbivores, providing saltlicks and wallow pools, eradicating Mikania and cutting back of trees to arrest the successional development of the grassland areas, maintenance of fire line and patrolling track and creation of boundary trenches. Commercial felling was prohibited during the plan period. During the period infrastructure of the sanctuary had improved a lot with the induction of large number of Casual Daily Labour and with the supply of more firearms, R.T. net works and vehicles.

However, two important targets of the plan viz., translocation of Rhinoceros, reintroducing of swamp deer (*Cervus duvaucelii*) and wild buffalos (*Bubalus bubalis*) and relocation of habitations (11 villages) between the two legs of the sanctuary could not be met. Chetal (*Anis axis*) was successfully released in the sanctuary during the year 1982 – 83 and their population showing upward trend. The first Management plan expired in March 1986 but its prescription have been followed more or less during the following years.

One important development after first management plan period was the launching of “Fringe” area development scheme in 1991 in the fringe villages of Jaidapara to reduce their dependency on the forest based resources by providing some alternatives. Work was undertaken under this scheme in the fringe villages to raised fuel wood plantations, distribution of seedlings for farm forestry, improvement of village road, construction of culverts and bridges, provision of drinking water and irrigation facilities, community pond, duckery and piggery unit etc.

In the mean time a project “Strengthening Management Planning and Eco -development Planning Capabilities” was sponsored under United Nations Development Project (UNDP) and Wildlife Institute of India (WII). The main theme of the project was to train some selected Forest officers in the country and abroad to write Management Plan of some Protected Areas (PA) and to provide funds for better management of the PAs. Accordingly the present author was selected from West Bengal for training and writing Management Plan of JWLS.

Second management Plan of JWLS

In this plan sanctuary has been delineated in four zones for efficient management viz., (i) Wilderness zone consisting of 37.69 sq. km. area where limited management intervention should only be allowed and habitat should be protected as it was. (ii) Intensive development zone comprising of 71.53 sq.km.area where maximum managerial input should give. (iii) Tourism zone having overlapping jurisdiction over 46.29 sq. km areas and in this zone both wild life management as well as tourist-oriented work to be undertaken. (iv) Conflict management zone comprising of an area 61.03 sq km This area should be used to reduce conflicts between Sanctuary and people.

The main strategies (Pandit, 1996; Anon, 1997) of second Management Plan were as follows.

- i) Conservation of Biodiversity.
- ii) Control of Poaching of rhino and other species as well as illicit felling of timber by
 - (a) extensive patrolling, (b) induction of Lady force, (c) strengthening forest protection force, (d) reorganization of Ranges, Beats and Camps, (e) strengthening communication network, (f) providing more arms and ammunition including sophisticated firearms and small arms for undercover operation, (g) strengthening wireless network, (h) establishment of legal cell, (i) improvement of intelligence network, (j) co-ordination amongst various law enforcement agencies, (k) providing incentive and rewards to staff, (l) publicity, nature education and awareness regeneration.
- iii) Sustainable growth of rhino and other wildlife population by –
 - (a) Improvement of habitat without much affecting the eco-system.
 - (b) Over wood removal followed by indigenous fodder plantation including fruit species and bamboo.
 - (c) Eradication of weeds and climbers like *Leea* sp., *Cymbopogon* sp., *Eupatorium* sp, *Mikania* sp. etc. in some strategic locations.
 - (d) Control burning of older unpalatable grassland as well as planted area in a staggered manner to supplement new palatable and nutritious fodder grasses.
 - (e) Control of wild fire.
 - (f) Maintenance of special habitat by protecting riparian areas, caves, burrows, breeding sites of animals, retaining older trees, hollow, top drying, partially dead or fully dead (snag) standing trees, fallen trees etc.
- iv) Control of grazing of domestic livestock of fringe villages and departmental elephants by (a) extensive patrolling (b) imposing fine (c) raising fodder plantation in vested or Panchayat land (d) Castration of bulls (e) providing hybrid cow (f) Raising fodder plantation inside the sanctuary only for departmental elephant.
- v) Reforestation of degraded forestland along the boundaries of the sanctuary by raising indigenous timber species.
- vi) Heavy 'D' grade thinning of older monoculture plantation and converting them into mixed culture by raising wild animals user-friendly species.
- vii) Conservation of soil and moisture by embankment protection work, constructing water-harvesting structure in strategic location.
- viii) Control of illegal wood based industries and furniture shop by strict vigilance and enforcement of laws.
- ix) Control of illicit removal of timber, fuel wood, medicinal plants, non-timber forest produces and other wildlife by enforcing appropriate law and constant strict vigilance.

- x) Reduction of Man – animal conflicts by raising awareness generation, public support, strengthening wildlife squad, speedy distribution of compensation.
- xi) Veterinary care of wild animals, departmental elephants.
- xii) Management of departmental elephants
- xiii) Veterinary care of rescued animals.
- xiv) To reduce trans bound any problem with Royal Government of Bhutan regular co-ordination meeting, strengthening intelligence networks, joint patrolling work etc. to be done.
- xv) Creating nature awareness, erection of power fencing, need based priority basic Eco-development activity is needed to get local support to save JWLS.
- xvi) To depress in breeding among rhino introduction of rhinos from other areas a wild born zoo reared male sub adult Rhino from Assam was introduced in a fenced area but it was not successful as that rhino could not survived due to repeated attack of other male wild Rhino.
- xvii) Re introduction of Barasingha, Gharial and Sambar.

Presently sanctuary is being managed as per above cited prescription and getting UNDP fund. In the mean time midterm review is necessary to ascertain strategies to be remained same or some to be changed, any improvement has been made or not.

Other than these management strategies, some activities has been proscribed – in plan which will be helpful directly or indirectly to manage the sanctuary. These are as follows :

(1) Site specific need based, resource oriented, priority basis eco-development activities such as (i) production of fuel wood and fodder grasses in panchayat, private and vested land (ii) Provision of collection of certain NTFP, s such as simul flows of thatch grass etc. (iii) provision of drinking water by digging ring well and tube well, (iv) provision of irrigation in agriculture field by digging irrigation channel, pond, dug well etc., (v) provision of agricultural extension service, (vi) cattle improvement programme, (vii) health care services, (viii) development of employment regeneration to the fringe people by raising farm forestry, vocational training on apiary, piggery, duckery, knitting, weaving, tailoring etc; fruit species plantation (ix) Educational and allied services, (viii) raising of interdepartmental co-ordination.

(2) Research, Monitoring and Training :

JWLS act as a storehouse of research information but till date no such work was done form any agencies. So present plan prescribed to establish a field laboratory and research oriented basic infrastructure at Madarihat to regenerate scientific information. Research work should be done in collaboration with Wildlife Institute of India, Zoological survey of India, Botanical survey of India, Universities and Research Institutes. Current plan prescribed establishment of data storage and retrieval system, study on floral and faunal survey, fire regime, visitors impact, resource dependency, straying of wild animal, attitudinal changes of people etc. As monitoring is an important component so monitoring on animal sighting, elephant movement,

diseases, fire regime, socio-economic changes etc to be done.

Training should be given on protection and extension, monitoring, resource management, tranquillization, rescue, veterinary care and cattle improvement, application of law and regulation, health care of wildlife, post mortems etc. Training should be imparted within the sanctuary or at other recognised institutes.

(3) Tourism, Interpretation of conversation education :

Tourism, Interpretation facilities should be improved by (i) Developing Madarihat Nature interposition centre. (ii) Interpretative talk, (iii) audiovisual programme, (iv) signages (v) establishment of nature camp and Nature trail (vi) proper utilization of existing staying arrangements, (vii) development of interagency co-ordination (viii) guided tour etc.

Population dynamics of rhino in JWLS :

Rhino were reported to be reasonable in the West Bengal towards the end of 19th century and approximately 240 Rhinos were existed (Bist, 1994). The Fawcus committee (Fawcus, 1943) has estimated that Rhinos population of Jaldapara and Patlakhawa was about 200 in 1920 s.

Due to killing, poaching and hunting Rhino population of Jaldapara show very unstable trend up to nineties of last century and after that due to undertaken of appropriate management strategies, constant increasing trend of population was reported. Variation of population of Rhino is given in the following table.

Table – 1 : Population dynamic of rhinos in Jaldapara

Year	Population	Year	Population	Year	Population	Year	Population
1920	200 approx. including Patlakhawa	1953-54	30-56	1975	23	1992	33
1932	40-50	1957	50 approx.	1978	19	1994	35
1936-37	56 Including Panbari of Buxa Tiger Reserve	1964	72	1980	22	1996	42
1940-41	Increased in number	1965-66	75	1986	14	1998	56
1948	60 approx.	1968-69	75	1988	24	2002	76
1949-50	Increasing	1973-74	21	1989	27		

Source : Bist, 1994 and Office record of AWLW, Madaarihat

Age & Sex wise population structure of rhino: Records of age and sex wise classification of rhino in Jaldapara were not maintained properly in earlier days. However, Bist, 1994 had taken an attempt to recorded it on the basis of available information from the year 1968-1992 only. Present author updated it up to 2002 on the basis of available record in the office of the AWLW at Madarihat which is given in the following table.

Table -2: Age and sex wise Population structure of rhino

Year	Adult			Calves	Total
	Male	Female	Unsexed		
1968	-	-	70	5	75
1975	7	7	4	5	23
1978	5	7	4	3	19
1980	9	11	-	4	24
1989	9	13	-	5	27
1992	8	12	-	13	33
1996	9	18	2	8	42 (including one sub adult female & sub adult unknown sex 4 no.)
1998	16	25	-	14	55
2002	33	28	-	17	84

Source: Bist, 1994 and Office record of AWLW, Madarihat

Reproduction Trend of rhino: Earlier no record was maintained to ascertain the reproduction trend of Rhino in JWLS. However, Bits, 1994 has taken an initiation and recorded the information in between the year 1988-1992. Present author then had been updated it from the available records of the office of AWLW, Madarihat upto 2002 which is given in the following table.

Table – 3: Birth and Death of Rhino in JWLS

Year	Birth	Death	Year	Birth	Death	Year	Birth	Death
1988	3	-	1993	3	1	1999	5	-
1989	2	-	1994	3	2	2000	2	-
1990	2	-	1995	5	3	2001	4	-
1991	3	-	1997	1	-	2002	5	-
1992	2	1	1998	3	-	2003	4	-

Source: Bist, 1994 and Office record of AWLW, Madarihat

Mortality of rhino in JWLS:

Causes of death of Rhino in JWLS are may be old age, injuries, poaching, hunting, accident, predation, natural calamities etc. Bist, 1994 first recorded it from the available information from the year 1930 to 1992 and then present author updated the information up to 2002 which is given the following table.

Table – 4 : Mortality of rhino in Jaldapara

Year	Population Status	Year	Population Status	Year	Population Status	Year	Population Status
1930-31	50 approx	1957-58	2	1984-87	10	1998	2
1932	40-50	1967-68	1	1991	1	1999	2
1936-37	1	1968-72	30	1992	2	2000	3
1940-41	2	1972-73	6	1993	1	2001	4
1948-49	2	1973-80	9 (2 in Patlakhawa)	1994	1	2002	5
1949-51	5	1981	2	1995	3	2003	2
1954	3	1982	3	1996	1		
1955-56	4	1983	4	1997	3		

Source: Bist, 1994 and Office record of AWLW, Madarihat

Conclusion :

In JWLS, history of rhino conservation is very old. Throughout the world rhino population subjected to several natural as well as human pressure. But fortunately the great one horned Rhinoceros till survived despite several threats in the world as well as JWLS. One species *Rhinoceros sondaicus* reported to exist earlier in the North Bengal but it became extinct by 1900. The population of one horned Rhino in JWLS has been fluctuated due to poaching, hunting, biotic interferences, habitat degradation, natural calamity, mortality, depletion of forest resources and other factors. But due to timely taken of proper steps by Forest Department of Government of West Bengal, conservationist rhinos still exist in the 21st century in a small pocket like Jaldapara. Number of rhinos is steadily increasing since 1990 as a result of taking appropriate management strategies however, till the population is not up to the mark and there is no scope of satisfaction. Different Laws and action plan according to situation has been prepared by state and national level to boost the population. Appropriate efforts should be taken by Forest Department and other agencies to enter the Rhino population in the 22nd century despite of all odds.

Acknowledgements

The author would like to express his deep sense of gratitude to Sri A. Ghosh, IFS, Managing Director and Sri P. Shukla, IFS, General Manager, Head Quarter, West Bengal Forest Development Corporation Limited, Kolkata for facilities. I am also grateful to Conservator of Forest, Wildlife Circle, Divisional Forest Officer, Wildlife Division – II, and Cooch-Behar Division and Sri Kumar Vimal WBFS, present Assistant Wild Life Warden, Madarihat for their co-operation.

Reference :

1. Anon (1997). Management Plan of Jaldapara Wildlife Sanctuary, West Bengal . Wildlife Circle, Department of Forests, Government of West Bengal
2. Banerjee, Ajit, (1966). Rhinoceros – A Historical Treatment, West Bengal Forests (Centenary Commemoration Volume – 1964), Forests Directorate, Govt. of West Bengal.
3. Banerjee, L.K., 1993. Plant Resources of Jaldapara Rhino Sanctuary, Botanical Survey of India.
4. Bist, S.S., (1994). Population History of Great Indian Rhinoceros in North Bengal and major factors influencing the same, Zoos Print, Vol – IX, No. 3.4, P. 42 – 52.
5. Champion, H.G., Seth, S.K., 1968. A Revised Survey of the Forest types in India, Govt. of India.
6. Das, A.P., C. Ghosh and D. Bhowmick (2003). Project report on estimation of palatable biomass in Jaldapara Wildlife Sanctuary with special reference to *Rhinoceros unicornis* L. Department of Botany, University of North Bengal, India
7. Dey, S.C., 1994. Overview of Rhinoceros, Zoos Print, Vol – IX, No. 3.4, P. 4 – 5.
8. Dey, S.C., 1994. Indian approach to Rhino conservation, Zoos Print, Vol – IX, No. 3.4, P. 6.
9. Fawcett, L.R. , (1943). Report of the game and game fish preservation committee on existing species of game in Bengal, Govt. of Bengal, Calcutta, PP 15-19.
10. Fifth working plan of Buxa Division (1945-46 to 1964-65), Directorate of Forests, Govt. of West Bengal.
11. First Management of Plan of Jaldapara Sanctuary (1981-82 to 1985-86). Directorate of Forests, Govt. of West Bengal
12. First Working Plan of Cooch Behar Division (1960 – 63 to 1971 – 72), Directorate of Forests, Govt. of West Bengal.
13. Gupta, A.C., 1966. Wildlife of Lower Bengal with particular reference to the Sunderbans, West Bengal Forests (Centenary Commemoration Volume – 1964), Forests Directorate, Govt. of West Bengal
14. Pandit, P.K., 1996. Management Plan of Jaldapara Wildlife Sanctuary, West Bengal for the period 1996 – 97 to 2006 – 07. Directorate of Forests, Government of West Bengal.
15. Pandit, P.K. & Yadav, V.K. 1996 Management of Jaldapara Wildlife Sanctuary, West Bengal, India, Tiger paper, 4: 1-5.
16. Pandit, P.K. (1994). Vaccinating Wild Rhino (*Rhinoceros unicornis*) against Anthrax of Jaldapara Wildlife Sanctuary, Zoos Print, Vol.-IX, No. 9.
17. P.K.Pandit,C.Ghosh and A.P.das (2004). Non Timber Forest Products of Jaldapara Wildlife Sanctuary: An Asessment. Indian Forester 130:10, pp 1169-1185.
18. Records in the office of the Assistant Wild Life Warden, Madarihat.
19. Rodgers, W.A. and Panwar, H.S. (1990). Planning a Protected Area Network in India, Vol. I & II. Wildlife Institute of India, Dehradun ,India.

20. Sawarker.V.B. (1995). A manual for planning wildlife management in Protected Areas and Managed Forests. Wildlife Institute of India, Dehradun, India.
21. Second Management Plan of Jaldapara Wildlife Sanctuary (1997 – 98 to 2006 – 07), Wildlife Circle, Directorate of Forests, Govt. of West Bengal.
22. Wildlife (Protection) Act, 1972. 1994. Nataraj Publishers, Dehradun.
23. Working Plan of Buxa Forest Division (1905 – 06 to 1919 – 20), Directorate of Forests, Govt. of West Bengal.
24. Working Plan of Buxa Forest Division (1929 –30 to 1948 – 49), Directorate of Forests, Govt. of West Bengal.
25. WII (1997). West Bengal World Bank Aides Forestry Project: A study on the management of Rhinoceros (Final report). Wildlife Institute of India, Dehradun, India

—O—