EX-SITU AND IN-SITU CONSERVATION OF WILDLIFE WITH REFERENCE TO ZOO GARDENS AND SUNDARBAN TIGER RESERVE IN WEST BENGAL

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ABSTRACT:

Conservation of Wildlife along with their natural habitats is the demand of the time and the only way to mitigate the self-destruction processes initiated by the mankind since the inception of human civilization. Among the two conservation measures in vogue, viz., ex-situ (outside natural habitat) and in-situ (within natural habitat), the first one is the older practice since ancient times. Due to huge hue and cry made by the naturalists and the scientists from various disciplines regarding the climate change accusing the gross outrage over the natural ecosystem for last five decades or so, the latter has got prominence and the outcome is the establishment / declaration of different conservation systems. Zoo is a common example of ex-situ conservation and Protected Areas (PA) like National Park, Sanctuary, Conservation Reserve, Biosphere Reserve, Community Reserve etc. are examples of in-situ conservation. West Bengal is by no way exception and in the year 1973, **Sundarban Tiger Reserve (STR)** was formed for conservation of Royal Bengal Tiger and its associate species in the natural habitat of Sundarban, a part of the greatest mangrove delta in the world. On the other hand, ex-situ conservation of Bengal Tiger and several other important species are being practiced in the **Zoological Garden, Alipore, Kolkata** since its establishment **in the year 1875**. The Zoo has already celebrated its **138th anniversary**. The current topic deals with the basic concept of ex-situ and in-situ conservation of some of the wildlife species in captivity and a few others in natural habitats.

KEY WORDS:

Conservation, ex-situ, in-situ, biodiversity, environment, gene pool, habitat, heterozygosity.

INTRODUCTION:

In-situ conservation means maintenance of biodiversity in natural habitat whereas Ex-situ conservation emphasises the conservation of biodiversity outside natural habitat. The first one is always preferable for conservation and preservation of biodiversity but sometimes situation demands for the second method having no other alternative. However, the biological diversity to be sustained which is the essence of life having variety and variability of life forms along with the ecological functions and processes interacting together as envisaged by Decker et al. 1991.

In-situ Conservation: Until recent times, human being tried to establish his own command over other animals to get food and shelter. There was indiscriminate felling of trees, hunting of

wildlife, encroachment on their natural habitat and also disturbing the ecosystem for own interest. In the last part of twentieth century, human being realized the necessity or in true sense, the essentiality to conserve the ecosystem, its components like plants and animals and to mitigate, as far as possible, the damages already done to the nature. It also felt necessary to conserve the habitat which is an outcome of evolutionary processes and susceptible to random environmental, demographic and genetic events. Among these, impacts caused by human activities are also to be considered. By that time many plant and animal species had become extinct or on the way of extinction. National Parks, Sanctuaries and other Protected Areas had been established to conserve the bio-diversity of the locality and even re-introduction of species either directly or through ex-situ conservation method. So many species had been declared as 'Endangered' or 'Rare', and ameliorating measures are being taken for successful rehabilitation, though mangrove forest of Sundarban is very dynamic and potential ecosystem in the earth (Alongi, 1996). In Indian Sundarban 31 major species of mammals are found (Chowdhuri and Chowdhury, 1994; Sanyal, 1999). The mammalian species that once existed in Sundarban and have become extinct today are: Javan Rhinoceros (*Rhinoceros sondaicus*), Wild Buffalo (*Bubalis arnee*), Swamp deer (*Cervus duvaucelii*), Barking deer (*Muntiacus muntjac*) and Hog deer (*Hyelaphus porcinus*) [Seidensticker and Hai, 1983]. The Royal Bengal Tiger (*Panthera tigris tigris*) had its uniqueness for adaptation in the mangrove habitat having distribution in the Gangetic delta of West Bengal and Bangladesh. But, due to indiscriminate hunting for its valuable body parts and regular encroachment into its natural habitat, there is continuous man-animal conflict which eventually resulted in declining of tiger population in Sundarban areas of both the countries. It is a flagship species also as an indicator of health of forests and ecosystems. It has be considered as globally endangered (IUCN, 2006) and a conservation dependent species listed under Schedule- I of Wildlife (Protection) Act, 1972 in India and Appendix- I of the CITES (Jimmy Borah et al., 2010). Considering the importance and impact, Sundarban Tiger Reserve had been established for in-situ conservation of Royal Bengal Tiger and other indigenous species of that locality in the year 1973. Protected Areas (PA) viz., National Park, Wildlife Sanctuary, Conservation Reserve, Community Reserve, Biosphere Reserve etc. have been declared since the last quarter of the last Century with the aim to conserve wildlife and its natural habitat.

Ex-situ Conservation: At prehistoric times human being acted as gatherer, hunter, farmer, conqueror and eventually on today modified his own environment as a consequence of his own misdeeds. From the beginning, his attitude towards the animals was contradictory; the animals were worshipped, domesticated, hunted and decimated. Human relations with animals date back more than ten thousand years. As back as 2500 BC in Egypt in zoo type collection the pet animals like monkeys, antelopes, mongooses etc. were found. At about 1100 BC Chinese Emperor Wen Wang built his "Garden of Intelligence" in an area of 1500 acres to house his animal collection including Giant

Panda. Several Emperors from Greek, Roman and Mughal dynasty established their Menagerie to house their animal collections. The first recognized Zoo in the world was established in 1759 in Schonbrunn near Vienna by the Emperor Francis I. The Zoo is still operating at the same site and more than 500 species have found their home at this Zoo.

In India, the first private Zoo was established in 1854 at Marble Palace of Kolkata by Raja Rajendra Mullick Bahadur. The Zoo is commonly known as **Marble Palace Zoo**. Like Schonbrunn zoo, the Marble Palace Zoo is still operating at the same site. Since then Madras Zoo (1855) which was shifted later on in 1980 at Vandalur, Chennai and presently known as Arignar Anna Zoological Park, Trivandrum Zoo (1857), Mumbai Zoo (1863), Alipore Zoo (1875) and other Zoos in India gradually came into being. Presently, there are 71 major Zoos which include 7 large, 16 medium, 48 small Zoos, 86 mini Zoos ,18 rescue centres and 23 circuses (According to the "Inventory of Animals in Indian Zoos" – 2010-2011 published by Central Zoo Authority).

Historically Zoos were established to meet the curiosity of the people in respect of animal and to entertain them as well. Conservation of wild animals did not get any attention to the managers of the Zoos in those days. Probably as animals were abundant at nature in those days and the threat of extinction of wild animals was not that acute as it is today, people were not serious about conservation of wild animals. With the establishment of Zoological Society of London in 1826, utility of Zoos was realized. In 1907, Carl Hegenback developed the concept of bar-less moated enclosures and this concept of display of animals influenced the managers of the Zoos around the world. In place of smaller cages, spacious enclosures came into being that also helped in maintaining biological and psychological need of the captive animals, but even then animals were continued to be kept in cages for part-time i.e., during night time and adverse climatic conditions.

With the tremendous growth of human population and development of infrastructure like roads, buildings etc. as a support system of growing human population, exploitation of natural resources started leading to depletion of forests. As a consequence, animal populations day by day became fragmented leading to loss of genetic variability and ultimately animal populations enter into extinction vortex. Species extinction caused primarily by indiscriminate poaching of animals and deforestation, may eliminate between 20% and 50% of wild species within the next decades. Under the circumstances, the role of Zoos has also dramatically changed. The Menagerie of 19th Century developed into Zoological Park in 20th Century and ultimately the same developed into Conservation Centre in 21st Century. Over the period of time, the objectives of establishing a Zoo have changed from mere exhibitionism, entertainment and amusement into research, education and ex-situ conservation to complement in-situ conservation.

METERIAL AND METHODS:

Material: As the current topic is restricted to brief sketch of the scenario of ex-situ and in-situ conservation in West Bengal, no material except the natural environment pertaining to the indigenous wildlife within their natural habitat is needed in case of in-situ conservation. In case of ex-situ conservation, wildlife in captivity requires the artificial environment prevailing in zoo condition like night shelter, paddock, food, medicine etc. as per requirement of the animals concerned.

Methods: Different methods are required for in-situ and ex-situ conservations as follows:

For ex-situ conservation establishment of a zoo is necessary and in case of already established zoo, its recognition by **Central Zoo Authority (CZA)** is mandatory. The CZA was established in the year 1992 by the Government of India through an amendment of Wildlife (Protection) Act, 1972. The main objective of the CZA is to oversee the functioning of Zoos in India and enforce minimum standards and norms for up-keep and maintenance of health care of animals in Indian Zoos and to provide them technical support & assistance to them for further improvement. The CZA formulated "Recognition of Zoo Rules, 1992" for fixing standards and norms for management of Zoo in India. To give proper direction and thrust to the management of Zoos in India, National Zoo Policy was framed and adopted by the Government of India in the year 1998. In the Policy, it has clearly been mentioned that the main objectives of the Zoos shall be to complement and strengthen the national efforts in conservation of the biodiversity of the country, particularly the wild fauna. For that purpose, CZA prepared the strategy for conservation breeding of endangered species in Indian Zoos. CZA has already indentified 61 endangered targeted species and also specified coordinating zoos and participating zoos for each targeted species to achieve desired results. Hence, the proper methodology for ex-situ conservation would be to follow the guidelines of the Central Zoo Authority formulated under "Recognition of Zoo Rules, 1992" with the latest amendments in the year 2009 in accordance to the National Zoo Policy, 1998. The **Master Layout Plan (MLP)** covering the total layout of the individual enclosures following the guideline of CZA and the **Master Plan (MP)** showing the plan for management of the zoo for a determined period are two essential criteria of methodology to manage a zoo for ex-situ conservation.

For in-situ conservation, the Wildlife (Protection) Act, 1972 would be of immense help which was formulated in the year 1972 in conserving wild heritage of India and was amended from time to time in the years 1982, 1986, 1991, 1993 and 2006 to make it more comprehensive towards protecting wild animals of the country. As per the Act, a natural habitat with its flora and fauna may be declared as a Protected Area (PA) viz., National Park, Sanctuary, Conservation Reserve, Biosphere Reserve etc. following the norms and procedure as required. Then a **Management Plan (MP)** for that PA is to be prepared which would cover all the aspects like boundary, topography, climate etc of that area as well as the revenue and budget for a determined period for planned management of the area including feeding, healthcare, protection, breeding etc. of the conserved animal populations. According to the

Management Plan, the activities in respect of in-situ conservation continue with regular monitoring and periodical assessment. According to the modern concept, not only the management of the demarcated area is good enough for conservation but the adjoining peripheral zone having human and domesticated animal population should also come under the zone of sanitization in order to keep the total system in proper place. The method of in-situ conservation should religiously observe and maintain all the above mentioned formalities with the restoration of natural habitat keeping the eventual goal of rehabilitation of the endangered species. India boasts of having huge and diversified stock of wildlife having various types of eco-climatic habitats and accordingly there are more than 300 big and small wildlife sanctuaries in the country to protect, preserve and nurture the widespread varieties of mammals, birds, reptiles, insects etc. without confining them in to cages or enclosures. The animals are free to roam in the natural to semi-artificial habitat free from commercial structures and activities.

RESULTS AND DISCUSSION:

A. Conservation studies in ex-situ condition produced excellent results in case of certain endangered species even before establishment of Central Zoo Authority in India involving the captive wildlife. Some of those success stories are depicted below:

1. Crocodile Conservation Project :

Intensive surveys on the status of crocodiles of India were carried out by Whitaker (1973) and FAO (1974). The survey determined the endangered status of gharial (*Gavialis gangeticus; Family: Gavialidae)*, salt water crocodile (*Crocodylus porosus; Family: Crocodylidae)* and depleted status of mugger (*Crocodylus palustris; Family: Crocodylidae*). The National Crocodile Conservation Project was launched in April, 1975 with the objectives of reintroducing the three Indian crocodilians in protected areas in their former distributional limits.

The project identified Nandankanan Zoological Park, Odisha as the location for pilot captive breeding project of crocodiles. The project decided to use only the available captive stock of various zoos in the programme. It was decided that any wild individuals would not be captured from an already depleted population for the purpose of captive breeding as the same will go against the ethics of conservation.

The first zoo held crocodiles to go into the wild were from the Hyderabad Zoo on February 7, 1972 to Ethipothalla Falls in Nagarjunsagar- Srisailam Sanctuary. This is the first wild location in the country where reintroduced crocodiles bred in 1980.

2. Conservation breeding of Asiatic Lion:

Asiatic Lion (*Panthera leo persica; Family:Felidae*) is highly endangered and restricted only in Gir National Park of Gujarat State and not a single specimen is found elsewhere. Considering

the highly sensitive and important issue as the top priority mission, Central Zoo Authority selected Junagarh Zoo, Gujarat as coordinating Zoo and Hyderabad, Bhopal, New Delhi & Rajkot Zoo as participating Zoos for the conservation breeding programme of Asiatic Lion.

From 1995 to 2003, 186 births of Asiatic Lions took place of which 143 births were taken place in Junagarh. Kuno Sanctuary, M.P. was proposed for reintroduction. But final result is yet to achieve.

3. Conservation breeding of Red Panda at Darjeeling Zoo :

In India, Red Panda (*Ailurus fulgens; Family: Ailuridae*) is available in natural condition in the Eastern Himalayan region in Darjeeling district of West Bengal and adjoining areas of Sikkim and Assam. It is also highly endangered and the habitat is also very highly restricted. The population continues to decline due to loss and fragmentation of habitat, poaching and inbreeding depression. To increase the gene pool and avoid inbreeding, a male specimen was brought from Rotterdam Zoo in 1983. Conservation breeding of Red Panda was initiated at Darjeeling Zoo in 1989 as a part of Global Captive Breeding Master Plan. First successful breeding of Red Panda at Darjeeling zoo took place in 1994 and as a result of which 2 cubs were born. Two males and one female came from Europe for infusion of new blood in the breeding population. Three more individuals were added between 1994 and 1996. Since then till 2008, 40 cubs were born at Darjeeling Zoo. A pair of Red Panda was sent to Gangtok Zoo and the same pair started to breed there. After successful breeding at Darjeeling Zoo, reintroduction of Red Panda to the wild started.

To continue successful conservation breeding of Red Panda, Central Zoo Authority identified Padmaja Naidu Himalayan Zoological Park, Darjeeling as coordinating Zoo while Gangtok & Itanagar as participating Zoos. The programme has been running very successfully at PNHZP, Darjeeling and the population of Red Panda has already reached to an sizable quantum with good heterozygosity required for sustained conservation breeding programme.

4. Conservation breeding of Snow Leopard at Darjeeling Zoo :

Snow Leopard (*Panthera uncia* or *Uncia uncial; Family: Felidae*) is listed on the IUCN Red List of Threatened Species as Globally Endangered. Darjeeling Zoo started breeding of Snow Leopard since 1983. To introduce new blood as well as for effective captive breeding programme in Darjeeling Zoo, a pair of unrelated Snow Leopards were brought from Zurich Zoo in 1986. Another pair of leopard came from U.S. in 1989 at Padmaja Naidu Himalayan zoological Park, Darjeeling. Two female cubs were born at this Zoo in 1989. Two wild females were rescued from J & K in 2000. Since 1983 till 2008, 40 births took place at Darjeeling Zoo. To establish at least 4 – 5 stable captive populations at different high altitude zoos in the country before any release, a pair each of Snow Leopards was sent from Darjeeling Zoo to Gangtok, Nainital and Shimla Zoo.

5. Conservation breeding of Pigmy Hog at Basistha, Guwahati :

Pigmy Hog (*Porcula salvania; Family: Suidae)*, the smallest and rarest member of the pig family, once thought extinct, was rediscovered in 1971. When the conservation breeding programme of pigmy hog started in the year 1995 at Basistha (Guwahati) by Forest Department, Assam, in collaboration with IUCN/SSC Pigs Picarius, Hippo Specialist Group, Durrel Wildlife Protection Trust, MOEF, it was observed that the species was reduced to a single declining wild population of few hundred pigmy hogs in the Manas National Park, with no individual in captivity anywhere in the world.

The main objective of the conservation breeding programme of pigmy hog is to maintain about 60 captive hogs at two places in Assam and out of those 60 captive hogs, after breeding 20 new selected hogs would be raised every year. From the captive bred population, 14 hogs will be prepared for eventual release in restored well managed and protected grasslands in Assam. The project continues with sustainability and desirable result is expected.

6. Conservation breeding of Brow-antlered Deer at Alipore Zoo :

For conservation breeding of Brow-antlered Deer (*Panolia eldii; Family: Cervinae; local name: Sangai*), one of the most critically endangered deer of the country, Central Zoo Authority selected Zoological Garden, Alipore as co-ordinating zoo while National Zoological Park, New Delhi, Manipur Zoological Garden, Imphal and Assam State Zoo-cum Botanical Garden, Guwahati as participating Zoos.

Their natural habitat is only at Keibul Lamjao National Park over the floating biomass (locally called *phumdi*) in the South-eastern part of *Loktak Lake*. The home range of the deer is confined to 15-20 Km. Sq. within the National Park. *Phumdi* forms the most important and unique part of the habitat which is a floating spongy mass of entangled vegetation with organic debris having few centimetres to two metres thickness, the 4/5 part of which remains under water. The natural population has been declining gradually with the loss of *phumdi*.

However, the captive populations of brow-antlered deer at Alipore Zoo have been thriving well with normal growth and reproduction. The genetic analysis based on scat samples of the captive populations of the Brow-antlered Deer of the aforesaid zoos were studied to find out heterozygosity. Some individual deer were selected to start with captive breeding programme in future under the project conceived by Central Zoo Authority.

B. Conservation of wildlife in-situ condition is more difficult because wild animals are to be conserved in their natural habitat or at least semi-natural ecosystem; that means, at first the natural habitat of the target animal is either to be restored or to be stabilized without any further disturbance,

particularly human interference. There are reports that most of the large mammal groups are threatened due to destruction of habitats and over-hunting of animals as a consequence of rapid increase in human population and economic development (Ceballos et al., 2005; Schipper et al., 2008). In West Bengal, in the year 1973, Sundarban Tiger Reserve was established with the aim to conserve Royal Bengal Tiger and its associated wildlife in situ through restoration and preservation of the natural habitat through stabilization of the natural mangrove eco-system. It was well known that man-animal conflict due to encroachment of human being in the natural habitat of tiger and tiger poaching were the main reasons for declination of tiger population in Sundarban mangrove forest. Other reasons are: regular tiger straying in the forest fringe areas, diminishing prey base inside forest, regular infiltration of NTFP collectors inside core areas and above all the changing character of the fragile eco-climatic condition of Sundarban.

Hence, multi-faceted strategies had been adopted for reclamation, stabilization and improvement of the natural ecosystem of Sundarban giving judicious importance to the comprehensive development of the socio-economic, socio-cultural and socio-climatic conditions of the infringing human population of the buffer area in following manner:

a) **Prevention of tiger straying to the forest-fringe villages** to save the lives of human and cattle population in order to take the local sentiment into confidence to get their support. For that, regular patrolling by boat and other mode, immediate rushing to the spot after receiving the information of tiger straying and **in extreme cases, shielding the most vulnerable areas through strong netting** were taken up in the management programme of Sundarban Tiger Reserve.

b) **Intensive patrolling inside the core as well as buffer areas** in form of stationary and floating camps along the tributaries and rivers through motor-boat, speed-boat and other means to combat the possibilities of poaching at the root and apprehend the trespassers without compassion.

c) **Making the process easy to avail the legitimate concessions/permits** to the fishermen, NTFP collectors etc. to earn their livelihood from the permissible areas but with strict vigil when they are inside so that no violation to the fragile ecosystem in that area can take place.

d) **Pragmatic and feasible approach to grass root level people through joint forest management (JFM) system** to minimize the man-animal conflict and to curb the hostility against the Forest Directorate and forest personnel by way of making roads in inaccessible areas, providing sweet water facilities, constructing community hall/school building/rescue centre for natural calamities, providing solar system for lighting/watching television which the Forest Department has been doing very successfully and almost 80% of the vulnerable areas have been covered with the formation of 24 nos. JFM Committees. Alternative source of livelihood are also being provided under various developmental schemes like MGNAREGA/ Forest Development Agency (FDA)/ Rural Integrated Development Fund (RIDF) etc. so that the pressure on the mangrove ecosystem is reduced to minimum level and optimum support of local population is achieved in the process of conservation.

e) **Appropriate measures for increasing the density of prey base** of tiger by way of conservation and even introduction of herbivore population in core and buffer areas so that the incidence of tiger straying at human locality in search of food is minimized.

Through the above-mentioned all-round approaches in the mangrove eco-system and the adjoining areas of Sundarban in West Bengal by the Forest Directorate, the incidence of poaching has gone down to almost nil and even in case of human casualty due to tiger straying no animosity is evidenced among the local people against the forest personnel and the wildlife. The general awareness regarding the role of mangrove eco-system and the essentiality of tiger existence has been percolated up to the grass-root level to such an extent that unexpected co-operation and co-ordination are extended by the public in rescue operation of wildlife without causing any harm to them. The camera trapping technique adopted jointly by Forest Directorate and WWF in recent time also indicates that the free movement and the number of tigers have been increased in comparison to previous occasions.

CONCLUSION: The results obtained so far in case of both ex-situ and in-situ conservation methods as adopted in the zoos and in Sundarban mangrove area respectively in West Bengal indicates that both the techniques are essential and complementary to each other for successful stabilization of the prestigious and flagship animal i.e., Royal Bengal Tiger along with harmonious co-existence of other indigenous species in the natural ecological background.

Sometimes, injured or ailing tiger from Sundarban is sent to Alipore zoo hospital for treatment and speedy recovery of the animal in ex-situ condition and there are repeated instances of rehabilitation of those recovered animals to their natural habitat.

Similarly, the healthy and quarantined deer population obtained as surplus from ex-situ condition is released in to natural forests to increase the prey base in the ecosystem. On the other hand, the genetic heterozygosity or the increment in gene pool to reduce the inbreeding mortality at ex-situ condition can be achieved only from the in-situ population. The research and nature interpretation studies for genetic activities and the study of animal behavior can be very elaborately and critically done in ex-situ population.

Another unique feature of ex-situ conservation is that it can provide the opportunity of observing the **exotic** wildlife in captivity before the general viewers to the researchers and their successful breeding give ample scope for further genetic studies which is not possible in-situ condition. In a State like West Bengal where the natural ecosystem and wildlife are very scanty in comparison to the ever-increasing human population, these two tools, viz., in-situ and ex-situ conservation methods should be considered as a boon of nature and science simultaneously.

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