Indian Zoo Year Book

Volume-III, 2000

INDIAN ZOO DIRECTORS' ASSOCIATION
&
CENTRAL ZOO AUTHORITY

INDIAN ZOO YEAR BOOK

VOLUME - III, 2000

Editors

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PREFACE

In recent times zoo animal keeping and management have attracted the attention of the scientific community and many wildlife conservationists world wide. Dissemination of knowledge and information on various aspects like management, breeding, disease and health problems emanating from different zoos and individuals has been one of the major achievements of zoo movement in India. The nodal bodies of Indian Zoo Directors' Association and Central Zoo Authority have played pivotal role in this direction. The publication of Indian Zoo Year Book, containing scientific articles and information on the general welfare of the captive animals and improvement of their abode, in 1996 was the first step. Enthusiastic response to the first volume prompted us to make the publication an annual feature. But unfortunately due to some unavoidable circumstances there has been a breach of two years since the last volume in 1997.

However, we hope to make a good beginning in the new millennium with the publication of the third volume of Indian Zoo Year Book, 2000.

We will be happy if the current volume too is appreciated and found useful and imformative to all concerned.

We are also grateful to all the contributors in their effort to enrich this issue.

We record our gratitude to the Central Zoo Authority for the financial support throughout our endeavour without which this could not have been possible.

We record our sincere appreciation of the assistance rendered by Dr. A.T. Rao and Dr. D.N. Mohanty for editing some of the articles and for their valuable suggestions.

Any suggestion for the qualitative improvement of the subsequent issues will be gratefully received.

Editors

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REUBEN DAVID : 1912 - 1989

The Gentle Animal Keeper of Ahmedabad - Reuben David's love for animals had created one of the most remarkable zoos in India and Asia. He was also known as a miracle man who could walk into the cages of ferocious animals like tigers with ease and the amazing part of this was that he was never mauled by the creatures he protected - instead he was loved in return, by both the inmates of the zoo and the people of Ahmedabad - who visited the zoo to see birds and animals and also have "darshan" of Reuben David with his animal friends.

This self taught zoo-man was born in a Bene-Israel Jewish family of Ahmedabad on 19 September 1912, where his father Dr. David Joseph had instilled in him a love for wildlife. His father had been a physician at the Yervada jail in Poona (now Pune), where he had treated Lokmanya Tilak and then under his influence had left his job to set up a philanthropic clinic at Kalupur gate in Ahmedabad. He was also a municipal councillor when Sardar Patel was the president.

But, somehow in his twenties, the young Reuben with his expertise in the matter of dogs and their problems, was very popular with the royal princes

of Saurashtra and Banaskantha with whom he became an expert shikari. But later, he laid down his guns when he had seen a wounded deer in the forest.

With this incident, Reuben David dedicated his life for the preservation of wildlife. In his thirties, he had set up his own kennel and this had earned him such a good name that in 1951, when the Ahmedabad Municipal Corporation decided to set up a zoo on a small hillock near the Kankaria lake, Reuben was the obvious choice. Nobody was aware at that time that Reuben David would put so much soul in his work that the Ahmedabad zoo complex would have a pride of place on the world map. No dignitary passed through Ahmedabad without seeing the zoo, so much so that John Kenneth Galbraith has mentioned him in his book "Ambassadors Journal" and referred to him as a remarkable zoologist who has created the most charming zoo and lives on the most intimate and agreeable terms with his animals.

And when Jawaharlal Nehru visited the Balvatika he said that - I wish there were many more like it all over India. While with Padmashree Reuben David, Indira Gandhi acknowledged his contribution to wildlife with the words - Reuben, we are proud of you.

He was best known for breeding numerous animals, birds and reptiles in captivity but had a pride of place with a world record in the breeding of mugger crocodiles, flamingoes and albino or white animals. He also released back into the wild, animals which were in excess and could survive there. He also tried various successful experiments in the coexistence of different animals and was successful in creating a natural environment for his proteges by planting innumerable trees in the Kamla Nehru Zoological Park, the Chacha Nehru Balvatika and the Natural History Museum, which is now named after him. A designer by instinct, he created his own brand of zoo architecture. Reuben David was a colourful personality who collected antiques, patronized artists, loved music, poetry, literature, and made twig sculptures. But above all he popularized the importance of wildlife in Gujarat. As an advisor he was supportive in the development of wildlife in Gujarat State, Sundarvan and Indroda Park, Gandhinagar. Sundarvan now houses the Reuben David Nature Library. He also

spread his message of conservation to other cities of Gujarat.

Besides that he believed that man was a far more dangerous animal than animal ! For years he was a much respected contributor to the International Zoo Year Book in which he published details about the rare breedings at the Ahmedabad Zoo, and co-authored a book on the Asiatic Lion. Although internationally acclaimed as an unusual zoo-man, Reuben David, never accepted invitations to travel abroad, as he always wanted to be present for his animals and birds. The longest leave he took was, when he was operated for cancer of his voice box. He lost his voice, but was back at the zoo, armed with an electronic voice machine - for twenty more years. His photograph has been displayed at the Diaspora Museum in Israel.

The zoo complex and the people of Ahmedabad who loved him were his larger extended family. He went to the zoo everyday as long as he lived. Australian anthropologist Colin Groves has dedicated an animal to him, with a Latin terminology, ***Sus scrofa davidi*** and said that - Reuben David belonged to a rare and endangered species - not easy to find !

Source : Dr. R.K. Sahu, Zoo Superintendent, Kamla Nehru Zoological Garden, Kankaria, Ahmedabad - 380 008.

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RELEVANCE OF ZOOS IN DEVELOPING INDIA

R. Rajamani

A description and discussion of the evolution of the zoo movement in the world may have to precede an analysis of the relevance of zoos in developing countries, particularly India. The evolution itself throws some light on why zoological parks came into existence the world over and help understand how and why they came into being in any country. An important feature of the evolution was that even the first of the zoos with the present-day format started in the now developed countries at a stage when they could be considered to have been only 'developing' countries, if we applied the modern criteria to the state of their economies at that time. The very first zoo of the current type started in Schonbrun in Austria in 1759 when that country was no doubt part of an Empire but was not fully developed in the modern economic sense.

Before we study the evolution of zoos in the modern context, a quick word requires to be said about the phenomena of animals and birds in captivity which existed in ancient times, even in countries like India. Thus, most kings and queens had private collections of animals in thir palaces, especially of deer, panthers and birds. The 'ashrams' of sages like Kanva had deer around with whom heroines like Shakuntala played. The Emperor Asoka had an impressive collection of elephants in captivity and even had hospitals for them, as revealed in his edicts. The Moghal Emperors too had impressive collections of animals and birds brought from distant climes too. To quote Abrar Ahmed, "Akbar's biography *Ain-i-Akbari* gives graphic details of all the birds in his court. The manuscript is not only of great use to historians, but also provides ornithologists a peep into the bird world of the time, giving detailed accounts of atleast 13 raptor species" (1). If these collections did not correspond to the description of zoos as we now know, it is only because they wee mostly for Royal pleasure and not for the commoners. Moreover, the forests were next-door to people in those days and there was no need to travel far to see even wild animals like the tiger or the lion. The zoos became more relevant from the angle of recreation,

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conservation and instilling of a sense of nearness to Nature only as urbanisation took people far away from Nature. But this did not happen all too soon but over a gradual period and in a kind of progression which is sought to be shown below, taking the example of the evolution in India:

Period	Type of collection	Ownership/Organisation	Purpose
Pre 1855	Private Menageries	Feudal lords of chieftains	Recreation, mostly for the lords and vassals or lieges
1855 to 1947	Zoos but prisons for animals.Some deer parks	Governments Municipalities Princes' collections	Recreation and entertainment both for locals and people from villages visiting towns
1947 to 1992	Priviate and public zoos less of prisons for animals, very constricted enclosures. Beginning of safari and more deer parks	Governments Municipalities Private Trusts, etc.	More for recreation-more exotics among inmates; very little conservation or captive breeding
1992 onwards*	Mostly public zoos. Better enclosures.	Goverments and public bodies.	Recreation, education and conservation; more exchange of animals

* After the Central Zoo Authority was formed.

India's oldest zoo came up in Calcutta in 1854 as the Marble Palace Zoo to be followed by the zoo in Madras (now Chennai) in 1855 (2). In tune with the concept of being meant solely for recreation, it was described as 'People's Park'. These were places to which people from different strata of society flocked, primarily to commune with Nature and let the children enjoy looking at a few birds and animals lodged in often gloomy and scurvy cages. The concept of a park meant for strolling about took precedence over that of animal watching or keeping and no wonder many of these were called just Parks. In Hyderabad city, the animal enclosures were in the Public Gardens until the regular zoo started in 1959, the animals being shifted only in the early 1960's.

The very slow pace at which even this idea of peoples's parks with some enclosures took root in India is demonstrated by the fact that, in the nineteenth

century, only four other zoos came up viz., Trivandrum (now Thriuvananthapuram) in 1857 , Bombay (now Mumbai) in 1862 (i.e., the Veermata Jijabai Bhosle Udyan Zoo), Calcutta in 1875 and Jaipur in 1876 all promoted by the British Government or the ruling Princes. Almost all of them were appendages to existing Gardens in the heart of growing cities and not Greenfield sites or developments. Such new developments were to commence only after Independece and the desire of people in many cities or towns to have their own recreational areas and Zoological Parks. Many major zoos came up in quick succession. Thus came Ahmedabad in 1951, Delhi in 1955, Darjeeling in 1958, Hyderabad in 1959, Guwahati in 1960, Visakhapatnam in 1975 and Tirupati in 1983.

Thus it is seen that zoos 'growed' like Topsy over the years in a developing country like India for several reasons and their relevance got established in a sense by the very process of their growth and popularity with people, especially after Independence. As S.C. Sharma states rather categoricaly in an article (3), "The strongest argument is that zoos exist because people like them and they will continue to exist as long as they like them." It is interestig that this is a response to an earlier rhetorical question raised by him in the same article which ran as follows : "Why should we even have zoos ? In a country like India where we do not have sufficient resources to provide even its human citizens with basic amenities of life, what justification do we have in spending money keeping wild animals in captivity, depriving them of their liberty and quality of life they would enjoy in the wild ?" (4).

The notions of equity expressed above while referring to the liberty of animals and the quality of life they would enjoy in the wild should be overpowering, but in fact it is not so, as it gets enmeshed in the basic sense of hedonism in human beings who do enjoy looking into the eyes of animals in captivity, which they may not dare to do in the wild ! This is well brought out in the childhood reminiscences of Gerald Durrell, naturalist *par excellence* and writer who refers to the frequent visits he used to insist on making to an Indian zoo when he was a child (5). It seems to make no difference to the attitudes of the human beings whether they live in a developing country or elsewhere.

Poverty does not come in the way of having such simple pleasures as a visit to the zoo with the children, especially in a country like India with a tremendous conservation ethos prevalent among many people even today in trying not to harm animals and birds which are often respected and worshipped. But the sense of unease at having the animals in bondage seems to get submerged in the layers of happiness such visits generate.

But the relevance of zoos in a developing country need not be based on these considerations of pleasure and equity alone. India has not only a tradition of conservation and the need to show compassion to all other life by its citizens written into the fundamental duties of a citizen mentioned in the Indian Constitution, but it also has a rich heritage of species of life conserved by people over centuries in what are today denoted as 'protected areas' having some legal cover or in other areas like sacred groves. The tiger and the elephant still roam in its jungles and there are many villages where the villagers will not harm the migratory birds roosting in their homestead trees. But these traditionss and practices are under threat due to a combination of several factors like growing population, influence of market forces, excessive demand for natural products including animal products etc. The conservation ethos is creaking if not crumbling under the weight of several such factors. In this situation, zoos have some relevance as the animals and birds that are threatened can be kept and bred in captivity and even released in the wild when circumstances are correct and propitious. Crocodiles bred in zoos of India have been released into the rivers where the human population has learnt to live with them or in untenanted stretches as reported by B.C. Choudhury (6). Other examples are bound to grow as habitats shrink and species loved by the people are endangered, though one would like to hope that even this process will be reversed, taking advantage of the global sympathies for the plight of the species and the problems of developing countries in conserving without pain to its people. The concepts of ***in situ*** and ***ex situ*** conservation have to be married in such a situation. Zoos represent the ***in situ*** conservation agencies along with botanical gardens and the like, while the protected areas will continue to be the ***ex situ*** repositories of biological wealth. To quote Shri S.C. Dey, former Additional Inspector General of Forests (Wildlife):

"The zoos in India originally evolved as a source of recreation fostered by the Rajas and Maharajas to entertain their VIP guests and family friends. Subsequently when the government and public bodies started establishing zoos, in addition to entertainment, education also became a part of the process. With the passage of time, the need for zoos for captive breeding programmes to support endangered species *ex situ,* and its role in strengthening *in situ* conservation became more and more apparent. It is because of this, in the conservation of biological diversity formulated in the Earth Summit at Rio, Article 9 of the Convention contains *ex situ* conservation as a step in the achievement of global Bio-diversity conservation. The sub-article 9 (c) recognises the need for adopting measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions "(7). Dr. Conway. President of the NYZS/The Wildlife Conservation Society, goes so far as to say that if zoos do not get out into the natural world and help conserve it, they risk becoming "quiescent museums" ! (8).

The knowledge of species developed by tribals and women in our country over centuries mostly in the process of sustainable hunting for protein or other nourishment is now misused by commercial elements as also poachers and smugglers. But this knowledge is very relevant in the conservation effort through the zoos. From various accounts like those of Abrar Ahmed (9) we know that there are some communities of people like *Baheliyas* or *Chidimars* who have specialised in trapping birds for a living for ages. Economic compulsions make them sell the birds in the market, regardless of the laws which makes them vulnerable in society. Yet here is a fund of knowledge which can be used both in sanctuary and zoo management, given innovative methods of recruitment. Such inductions would further underline the relevance of zoos in countries like ours in promoting not merely entertainment, education and conservation but socio-economic objectives as well. The near symbiotic relationship between some human beings like these tribals or people like the madaries can be canalised towards the zoo movement easier in a country like ours. A survey in Kerala showed that the management of 500 captive elecphants provided employment directly or indirectly to 500 persons (10). Zoos too employ a number of keepers,

whose lot does require improvement; but the point to be stressed in the context of this subject is the availability of manpower in a country like India which also makes zoos relevant and manageable. The argument can simultaneously be advanced for emphasising animal welfare activities in zoos by educating visitors not to tease animals, having better enclosures, training of keepers, associating animal lovers as volunteers and inducting both paid and honorary veterinary doctors for service to the animals and birds.

Of late, the linkages between good science and zoo management has also underlined the utility of zoos in developing countries like ours which have a good infrastructure in the veterinary and biological sciences. The life linkages and nutritional prefernces of non human life which is being studied by these sciences may often be rooted in the need for survival and progress of the human species. But the result of this apparatus is also a boon for the upkeep and genetic upgradation of the species in zoos and in the wild. As an example one may refer to the molecular characterisation of wild animals by DNA fingerprinting for their better management in Indian zoos in the Centre for Cellular and Molecular Biology, Hyderabad by Dr. Lalji Singh and his colleagues (11).

The trapping of animals and birds in our country rarely helped our own zoos. Very often, the animals and birds left our shores for adding to foreign collections, including the zoos. The exchange and induction of animals in many world zoos is better regulated now, but there has been haemorrhage of genetic stock to other countries making our case for easier access to animals from abroad strong. This has been forcefully argued by Sally Walker (12). But we should also learn from this not only to regulate the trade better but also ensure better rehabilitation of the tribals totally dependent on capture and trapping as earlier mentioned. We should also intensify efforts at captive breeding in our zoos which have already proved partially successful. As mentioned by Kamal Naidu, in 1983, ISIS computer records showed that out of 58830 registered animals in cptivity, 38256 were born in captivity (13). There are problems of tracking of genes, disease, nutrition etc., which have to be addressed which are beyond the scope of this article, but there is no gain saying the fact that zoos continue to be relevant to us in a country with so much genetic wealth at the threshold of

extinction, a fate which has suffered not so long ago by the Indian cheetah and the passenger pigeon.

In 1973, the Expert Committee set up by the Indian Board of Wildlife, then chaired by Dr. Karan Singh, gave the following four as the major roles of the Indian zoos.

Conservation

Education

Research

Cultural and ecological functions

Tourism

These conclusions are very valid today and establish the relevance of zoos in a developing country. In the light of the analysis briefly attempted in this article, one may be impudent (or practical) enough to suggest adding a sociological or socio-economic role as well as animal welfare to the zoos and express the hope that India will be a leader in this field very soon. But more important than that should be the happiness generated in the animals in captivity and their keepers, the poor populations having a sustainable relationship with the wildlife and the visitors to the zoos, preferably in that order !

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WINNING PUBLIC SUPPORT FOR ZOOS AND CONSERVATION

M.Kamal Naidu

Winning public support for zoos and conservation is one of the most important aspects of Zoo Management. We may spend crores of rupees on zoos' construction, crores more on their upkeep and maintainance but what is the use if very adverse criticism and displeasure boomerangs in return. Theerfore, a Zoo Manager needs to be an excellent public relation man to get people to speak well of the zoo, and make more people to visit it as a worth while place; those who come need to visit it more frequently, and having come, make their visits to last for longer duration than what they expected it to be. and when they go back, they need to feel satisfied that their visit has been worth while from point of view of relaxation, enlightenment, and as an experience to remember. These objectives of a zoo manager can be achieved by (1) an excellent upkeep of the zoo with clean and aesthetic surroundings with healthy, vigorous and active animals on display, (2) good Public Relation (PR) between the management and the staff which consequently results in a harmonious relationship between them, and thus would reflect between the staff and the visitors and (3) availability of minimal essential facilities for making the time spent comfortable and relaxing. In addition to the above a good education component would be a complementary and essential part of the Zoo Management for contributing towards conservation efforts in keeping with the present main objective of zoo management.

Historically and traditionally zoos began purely as of amusement and entertainment interest. In due course its educational significance came to be realised as is evident from the fact that the Chinese in 1150 B.C. called them as "Intellignece Parks"; while Aristotle made detailed studies on the animals kept in captivity to prepare his treatises on animals and their classification. Again the concept of animal conservation arose only in recent years from mid-forties with establishment of IUCN in 1948., but actually we can date it back to the "Noah's

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Arc" when captive animals were preserved from catastrophic destruction by the floods such that they are preserved for the posterity.

In India the conservational role of zoos was given importance from the early 50's when the Indian Board for Wildlife (IBWL) recommended in 1952 for the establishment of zoos in all major cities on the modern concepts with priorities to education and conservation. It is as a consequence of this recommendation that the National Zoological Park at Delhi was set up in 1955 followed up by many more, including the renovation of the older ones to the required modern standards, as propounded by Carl Hagenbeck in Hamburgh Zoo in 1907. In 1973 the IBWL recommended for the appointment of an Expert Committee to draw guidelines for zoo management in the country. This committee emphasised top priority for education and conservation in the objectives for zoos, with PR as an important constituent, as a lubricant for good management. In 1983 National Wildlife Action Plan emphasised the conservation role of zoos which was made the central focus of zoo management, and thereafter all actions were directed to it. It was with this end in view that the emphasis in zoo education started developing interpretation as a tool of PR and making rapid strides in the country, figuring in the displays, signages, all discussions, and as an extension activity of the zoos in India.

To achieve the goal of the role of education in conservation great efforts are made to explain and interpret the animals, with reference to their environment. Now with conservation taking the priority, the educational signages have been evolving from mere biological and geographical data presentation, to highlighting their importance in the environmental balance, their declining trends, the need to do something about their preservation, and the need to save them from becoming extinct. The role of PR has become more important in its interpretational role, rather than as a means to merely increase the number of visitors, as often in many zoos it is becoming necessary to restrict the entry, due to over-crowding, and the increased stress to the animals, by staggering the visitors. Now the greatest role of the PR is to convert the visitors to the zoos, to become the potential protagonists to the cause of conservation efforts at the global level, making a beginning from their humble vicinity.

To achieve the object of winning support of public, zoo education starts from the premises (1) as to 'whom we are trying to reach' and why ? (2). 'How do we reach them' and why ? and lastly (3) as to 'what do we tell them' and why ? Zoo education is not just providing posters, labels, pamphlets, etc. It is much more. Most important is that we need to realise that people do not come to learn, but for an outing. Therefore to educate them, we need to plan to get their attention and impart in a very subtle manner without a feeling that something is being forced on them. We need to be very clear about the audience and the message.

Visitors surveys conducted in Hyderabad and Delhi zoos in 1980 and 1987 respectively had shown that 70-75% of the visitors come to zoos for recreation and only 10-15% for an educational experience. This fact is also supported by Paul Joslin in 1983 when he said that "zoos attract more visitors than all the major sports events put together". We also know that historically zoos are the most popular cultural institutions. The above surveys have also shown that 50-60% of the visitors are adults and constitute a broad based socio-economic strata of society and those between 3-20 years constituted 40-50%. As regards the educational status 19.2% were illiterate and they were mostly from rural areas as mostly the local illiterates do not have time for this luxury. 19.5% were upto middle school educated, and 55.7% were above high school level. Again on an average the people spent about 2-3 hours at the zoo. As regards the background of origin they were 25.1% from rural, 22.4% from outside the state, including a small segment of foreigners, and the rest being locals from within the cities. It is reported that around the world more than 900 million visitors are attracted to over 800 zoos annually. Therefore zoos have vast scope of impressing a very large segment of the human population to convey the message of conservation and get their support for the cause. In this regard Joslin desired we "turn strangers into visitors, visitors into participants, and participants into believers". William Conway desired to "learn something of permanent value while having fun". Jones and Jones the famous architects involved in zoo designing had quipped that "the best education is recreational and the best recreation is educational."

Considering these observations the question that arises is as to how we would entertain these visitors ? How do we fascinate them ? so that the people are receptive to the conservation message we desire to convey. What are the conditions necessary for creating an optimal learning environment ? The answer to the last question would be based on the fact that learning occurs best when (1) a person's interest has been roused, (2) their expectations are high, and (3) they are mentally challenged. Again people learn best when they are actively involved and experience something first-hand, by using as many senses as possible. It has been established that "people retain little of what they hear, some of what they read, half of what they see, and a great deal of what they do". Therefore a zoo is an excellent school where one could see, read, hear, and also participate and therefore an excellent place where we can communicate our message of conservation, through multi-faceted programmes, utilising wide ranging methods of inter-woven communication techniques.

As a part of rousing their interest and meeting their expectations, the expert committee on zoos had recommedned inclusion of public amenties to be provided like public transportation to and from zoo, and also within the zoo in case of extensive zoos like in Delhi, Hyderabad, Kanpur, Patna, Chennai, etc.; parking facilities, public phones, cloak room facilities, public conveniences, adequate drinking water supply, guide books, and maps, shelters against adverse weather factors like sun and rain, earmarked picnic spots, guides, reading rooms, restaurants and kiosks, prams and push carts for children and the disabled, first aid facility, a childrens corner, etc. so that the public esteem of the organisation goes up and they become receptive to it, and its messages. These also make a visitor to feel a zoo as a convenient and comfortable place to visit, without getting bored or disgusted.

As an extension activity educational visits are to be encouraged and attended to by responsible zoo officials, who could conduct a tour with a theme, depending on the season, and the nature of animals being explained and the level and category of group visitors. The zoo officials visit the educational institutions, nature clubs, and voluntary organisations like the Lions and Rotary clubs, etc. to exhibit films and explain the various aspects of zoo management and its role,

the people may be interested in, as a part of the healthy PR promotion. Frequently the zoo officials are called by the local or from surrounding areas regarding animal menace like monkeys, wolf, wild-boar, nilgai, or even bear and panther problem and seek for relief from them. This is being very successfully implemented and gets a lot of goodwill, and endears these people to the zoo authorities as a measure of gratitude. In India these activities are extended in the several zoos in various degrees.

It has been stated that "Natural resources management is 90% managing the public and only 10% managing the resources". Therefore the zoos have a great role to play in telling the people in view of the large number of visitors of different categories and levels who visit it, and therefore the possibility of reaching a very wide segment with the proper message on conservation and protection of animals and their habitat.

PR is variously defined but the definitions of interest from zoo point of view is from "Public Relations Guide" published by the "Asian Workshop of PR in 1983" which states it as "an instrument by means of which the activities, views, standpoints and goals of an organisation are made clear for the benefit of the public" and this is fortified by Prod Byron Christian as "the conscious effort made to motivate or influence people, primarily through communication, to think well of an organisation, to respect it, to support it and to stick with it through trials and troubles."In zoo management interpretation is considered as an integral part of PR and as defined by Freeman Tilden an authority on interpretation as "an educational activity aiming to reveal meanings and relationships through the use of original objects, by first hand experiences, and by illustrative media." In this connection we need to remember that every action makes an impression, whether it is good, bad or indifferent. Therefore, it should be the duty of every employee to make an impression and to convert every visitor into a friend. As Frank Tefkins a well known PR practitioner stated that "to act defensively to a complaint from a customer only amounts to making enemies, but by being apologetic and obliging we convert him into a friend". A PR officer of a National Bank had once stated that "If my colleagues in the branch who meet the customers daily practice PR, my job will be reduced by

80%, therefore, I concentrate on persuading my colleagues for better customer relations which eventually eliminates the areas of discomfort between the bank and its people" Lincoln had said that "Public sentiment is everything. With public sentiment nothing can fail, without it, nothing can succeed." Therefore, treat everyone who visits a zoo as though he matters and as a very important person (VIP) with tact, courtesy, patience and a smile. If we need to answer the same question a hundred times from the public, we may remember that it is being asked by him only once and for the first time and he goes away enlightened, motivated and happy.

Zoos have played a great part in conservation of birds and animals in the past though it had not been their specific intention. The visitors can be entertained, fascinated and their curiosity roused through exhibit designs which not only thrill, but also educate about the many facets of animals and their intricate relationships with man and his environment, and finally the visitor could leave the zoo with a feeling of respect for the animals and their intrinsic values. Therefore these challenges can be met by designing the exhibits and the display with the appropriate message content. The exhibit designs needs to (1) attract the attention, (2) instill memorable impression, (3) promote an enjoyable experience, and (4) convey a clear educational message. These are achieved by (1) simulating the animals natural habitat, (2) focusing on the animals' outstanding physical features by various optical illusions, and (3) emphasising their ecological relationship. The exhibit should create an initial memorable impression and a visual involvement, so as to influence the perceptual expression of the visitor in all his remaining encounters. This could be achieved by the exhibits being imaginative, innovative and creative with a sense of movement, mystery and exploration, to be not only enjoyable, but also to inspire and stimulate an emotional and intellectual response, beyond the sensational and perceptional levels, to reinforce and contribute to a total learning experience. The exhibit should carry an educational message which is in harmony with it, to satisfy the expectations and needs of the visitor, as Robinson, in 1985 as Director of Washington Zoo stated "A good zoo exhibit must be people oriented. It must

entertain, inform, educate, provide for all people, allow for positive interaction, provide for surprises and new ways to see animals and plants, allow the zoo visitors to view animals without distraction, and be safe for him."

Important tools in zoo education are the labels, which are important and are the main practical educational device for interpretation to a casual visitor. The simplest labels give the name of the species in local language, scientific name and its geographical distribution, some have pictures of the animal as well dividing the board into 4 sections. Studies have shown that the attention span of a visitor is doubled by graphic displays and attractive signs and so also the involvement, learning outcome, and visitor enjoyment of exhibit, and thus create a more positive experience. The Chinese proverb "A good picture is as good as 6000 worlds" holds very true here. Majority of visitors desire to have more details to bring the animal to life. Experience has shown that labels are not read if they are not aesthetically pleasing and in colour with good design and content. In a country like India with a large percentage of illiterates, graphic labels accompanied by voice messages are ideal to create an awareness and the necessary impact.

Zoos have been designed with different themes to make them interesting and educative, the most popular themes being geographical distribution like African, Australian, nearctic, paleantic, etc.; ecological or biomal or habitat wise like swampy, desert, etc., species-wise like monkeys, bears, cats, deer, birds, etc; behavioural like nocturnal, acquatic, burrowing, predatory, prey, etc. Many new developments have taken place in display techniques in these 50 years in India like the 'safari parks' concept for lions at Hyderabad followed by in other zoos called as 'Zoo in Reverse' with people moving in closed vehicles and the animals freely all around. To this concept now even safari for tiger, bear and gaur have been added in Hyderabad to continue a sustained interest of the people. Another concept which had become very popular was the 'nocturnal animal houses' called as the 'moonlit zoo', Aquariums have also began gaining interest and came to be designed very imaginatively like in Patna where it was built like a fish into which

one enters through a wide open mouth; this has been very appropriately created in an appropriate surrounding environment. Many interesting reptile houses have also come up which educate on the need and importance of reptiles.

Labels are being effectively used for direction and information, for giving instructions and information on the systemic position, zoological classification, general description, and also for specific purposes at vantage points, as 'do and dont's' instructions, to indicate the facilities, and as maps, etc. The labels could also be used to rouse interest by asking thought provoking questions to hold the attention and increase the invlovement of the people. This had been tried effectively in Hyderabad, Kanpur, Delhi, etc. with questions like What is the difference between apes and monkeys ? between old and new world monkeys ? between panther and a cheetah ? Indian and African lion, and the rhinos ? etc. The answers to these are also provided with conservational messages at the point of time when the interest has been aroused sufficiently.

In conclusion it is seen that education for conservation has generally been well received through interpretation and good PR approach thus proving the zoos as an excellent media for the preservation of the animals for the posterity.

BIOTECHNOLOGY FOR MANAGEMENT OF CAPTIVE AND FREE RANGING ENDANGERED ANIMALS

S. Shivaji*, D. Jayaprakash and S.B. Patil

Introduction

Wildlife conservation does not necessarily mean an increase in the number of species. Instead, it is the increase in the number with improvement in the quality of the animal population. Scientifically, it is the genetic diversity in the animal population that should be improved by avoiding inbreeding since inbreeding leads to loss of genetic diversity and consequently to species extinction. In general, inbreading causes inbreeding depression which is characterised by increased infant mortality, increased vulnerability to infection, low growth rate, high frequency of genetic defects, low genetic variation and reduced reproductive performance (O' Brien *et al.* 1985). In males inbreeding depression results in low sperm count, decrease in number of motile sperm and increase in morphologically abnormal spermatozoa (Wildt *et al.,* 1983).

A good number of strategies exist in nature to avoid inbreeding such as the existence of a geographical barrier, social pattern of the species, territorial limits of the population etc. But, these safeguards fall apart due to degradation of the environment, reduction of forest coverage and indiscriminate killing of wild animals for sport and pecuniary reasons by mankind thus leading to smaller populations confined to a limited geographical distribution and thus making inbreeding inevitable. In the present situation of diminishing wildlife caused due to human beings it is an irony that human intervention is important to save and propagate species by the use of reproductive biotechnology.

Reproductive Biotechnology and Conservation Biology

Conservation biologists are unanimous in their opinion that sexual reproduction is the preferred strategy for species evolution and maintenance of genetic diversity. But in many cases, both free ranging and captive animals exhibit

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a decrease in reproductive performance which could be improved through reproductive biotechnologies such as artifical insemination (AI), embryo transfer (ET), invitro fertilization and gene transfer. These techniques were initially developed for improving domestic livestock and for overcoming certain human infertility conditions but application of these techniques to wildlife proved to be extremely difficult for obvious reasons. It is important to note that the physiology of most animals are different even within a taxonomic family. Hence to extrapolate the techniques to lesser known species is difficult. Thus, there is a need for species specific research in reproduction on aspects such as endocrinology, gamete biology, cryobiology, reproductive behaviour, maternal care and social pattern. Nevertheless, the existing knowledge and practice has permitted us to apply biotechnology to a limited number of species.

Methods of Assisted Reproduction

Intervention of mankind to improve the fertility status and reproductive performance of an organism is referred to as assisted reproduction (AR). The various methods of AR are :

1. Semen collection - by electroejaculation
2. Semen cryopreservation
3. Semen evaluation with respect to morphology, motility, sperm acrosome reaction, sperm fertilising ability, etc.
4. Artificial insemination or intrauterine insemination (IUI)
5. In vitro fertilisation (IVF)
6. Embryo transfer (ET)
7. Gamete intrafallopian transfer (GIFT)
8. Zygote intrafallopian transfer (ZIFT)

Semen Collection and Evaluation

Ejaculation is a highly effective method for recovering motile spermatozoa from animals. Procedures are simple. In the manual method anaesthetised animals

are induced to ejaculate by digital manipulation and stimulation of the prostrate whereas in electroejaculation rectal probes are used to stimulate the prostrate by a series of electrial pulses (Figs. 1 to 4). Semen thus collected could be evaluated with respect to morphology, motility, sperm number, acrosome reaction and fertilising ability. Table 1 shows the characteristics of ejaculates obtained from tigers, lions and leopards from the Nehru Zoological Park, Hyderabad; Sakkarbaug Zoo, Junagadh; Nandankanan Zoological Park, Bhubaneswar and Sri Chamarajendra Zoological Gardens, Mysore. Based on this data related to sperm number, percentage motile sperm and percentage abnormal spermatozoa it was possible to identify animals in the zoos which could serve as potential breeding males for future programmes. Recent studies on the genetic variation in Asiatic lions and tigers have also helped in identifying individuals with high genetic variability which can be used for breeding programmes (Shankarnarayanan *et al.,* 1997). In fact, various motility parameters such as progressive velocity, curvilinear velocity, straight line velocity, beat cross frequency and amplitude of lateral head displacement which have been positively correlated with fertilising ability of spermatozoa have also been determined for tiger, lion and leopard spermatozoa with an aim to establish baseline data for a good semen sample (Table 2).

Table 1. Semen characteristics of captive tiger, lion and leopard of Indian zoos*

Animal	Number of animals	Ejaculate volume (ml)	Sperm motility (%)	Sperm concentration (x 10^6/ml)	Sperm with normal morphology (%)	Serum testosterone (pg/ml)
Tiger	16	1.42±0.89	46.87±14.93	42.10±20.22	78.61±11.69	1729±1134
Lion	7	3.94±2.50	63.07±17.97	52.04±25.07	79.37±11.58	1849±527
Leopard	11	1.57±1.30	57.05±16.96	52.73±38.67	71.92±15.32	893.77±317

* Semen samples were collected by electroejaculation from animals at the Nehru Zoolgical Park, Hyderabad; Sakkarbaug Zoo, Junagadh and Nandankanan Zoological Park, Bhubaneswar. Values are an average plus or minus standard deviation.

Table 2. Motility parameters of spermatozoa from tiger, lion and leopard of Indian zoos*

Motility parameters**	Tiger (n=52)	Lion (n=121)	Leopard (n=41)
VAP(μm/s)	50.11±5.63	103.6±9.55	74.1±6.53
VSL (μm/s)	59.09±5.15	98.1±8.60	69.2±7.20
VCL (μm/s)	45.39±5.41	143.8±6.70	111.2±9.30
ALH (μm/s)	3.04±0.23	4.3±0.32	3.7±0.42
BCF (Hz)	16.77±0.77	39.1±4.72	37.4±3.20
STR (%)	89.27±2.71	89.5±4.05	86.9±4.52
LIN (%)	74.54±0.24	65.1±6.32	56.5±3.45

* Values are an average plus or minus standard deviation.

** The motility parameters determined include VAP or path velocity (which is the track speed along the average path of each sperm), VSL or progressive velocity (which is the straight line distance between the beginning and end of a sperm track divided by the time elapsed), VCL or curvilinear velocity (which is the track speed of the sperm obtained by dividing the total distance travelled by the sperm during an acquisition by the time elapsed), ALH or the amplitude of lateral head displacement (which refers to the mean width of the sperm head oscillation along the sperm track as it swims), BCF or beat cross frequency (which is the frequency with, which the track crosses the path in either direction), STR or straightness (VSL/VAP) and LIN or linearity (VSL/VCL).

In vitro Fertilisation

IVF provides opportunities to investigate the fertilising ability of spermatozoa and the mechanisms involved in early embryo development. Most studies have been confined to human and nonhuman primates but more recently it has been extended to endangered animals such as the mega cats using initially the domestic cat as the model system (Wildt, 1990). Earlier studies had demonstrated that fresh and thawed spermatozoa of tiger ferilised tiger oocytes with the same efficiency (70% of the oocytes were fertilised) (Donoghue *et al.*, 1992a) and were also capable of fertilising oocytes from the domestic cat but the efficiency was less than 50%. Cheetah spermatozoa were also capable of fertilising cheetah oocytes in vitro but the fertilisation rates between individuals varied from 0 to 73% (Donoghue *et al.*, 1992b). However, the snow leopard spermatozoa were incapable of penetrating cat eggs (Roth *et al.*, 1994). Using the zona free hamster ovum assay we have been able to demonstrate the fertilising ability of tiger, lion and leopard spermatozoa (Table 3) from Indian zoos.

Table 3. *In vitro* penetration of zona-free hamster oocytes by spermatozoa from tiger, lion and leopard of Indian zoos

Animal	Number of oocytes	Oocytes penetrated (%)	Number of sperm per oocyte
Tiger	33	85	9±1
Lion	96	74	24±2
Leopard	36	78	13±3

* Values are an average plus or minus standard deviaion.

Cryopreservation of Gametes and Embryos

Cryopreservation of cattle semen is well established and had led to standardisation of methods for wild animals. It is worth mentioning that cryopreservation protocols are not universally applicable to all animals and need to be modified for each and every species. However, this concept of semen banking is a great boon to wildlife conservationists since such preserved gametes can be used when and where needed and more importantly to improve the genetic heterogeneity in a particular species or to introduce disease resistant genes. Semen from a variety of endangered animals including tiger, lion and leopard have been cryopreserved and also evaluated for their fertilising ability (Donoghue *et al.*, 1992a). At our centre we have cryopreserved semen from the mega cats and have also demonstrated their ability to penetrate oocytes (Table 4). In contrast to semen banking, cryopreservation of oocytes and embryos is more difficult and needs surgical skills such as laproscopy. Non surgical methods of uterine flushing needs knowledge about the anatomy of the female reproductive tract as well as physiology of ovarian cycle of the animal concerned. Further artifical induction of ovulation bypassing the natural cycle also needs homologous compatible hormones.

Table 4. Quantitative motility (%) of spermatozoa of tiger, lion and leopard prior to and after cryopreservation

Animal	Number of	Initial Motility (%)	Motility after cyopreservation (%)	Motility as % of initial motility
Tiger	11	53.75±15.75	24.12±8.39	45
Lion	5	61.42±22.49	30.4±17.98	50
Leopard	6	59.37±8.63	32.14±9.51	54

Intrauterine Insemination

This method is relatively simple and has been effectively used to eliminate inbreebing depression by improving the reproductive performance of animals by various ways such as ensuring reproduction between incompatible partners, eliminating risk of animal transport and by increasing the chances of gene mixing. An excellent example of IUI has been with respect to breeding of Eld's deer (Monfort *et al.,* 1993), an endangered species, consisting of a wild population in Myanmar and a captive population in North American zoos. Both breed well in captivity but have inbred for a very long and exhibit inbreeding depression. Hence attempts were made to breed the two populations by estrous synchronisation and IUI. Oestrous synchronisation was achieved by using intravaginal progesterogen releasing devices and IUI was done with cryopreserved semen which was thawed before use. Pregnancy has now been achieved by IUI in a number of deer such as white tailed deer, fallow deer, red deer and axis deer. (Monfort *et al.,* 1993), in clouded leopard and tiger (Wildt *et al.,* 1995; Donoghue *et al.,* 1993). Attempts are in progress to use IUI in case of the Florida panther which is close to extinction.

Embryo Transfer

Embryo transfer is a powerful tool to conserve endangered species. This technique provides the means to increase the number of offsprings of a desired female and also facilitates genetic input from females unable to sustain a pregnancy by the use of surrogates. The method is complicated and involves ***in vitro*** maturation of oocytes recovered by laproscopy, IVF and embryo transfer. These steps have resulted in the birth of young in mouse, sheep, pig, cow, horse, red deer, white tailed deer, chital deer and fallow deer. Such studies in lions, tigers and leopards have progressed to the extent of oocyte recovery, oocyte maturation and IVF and thus far it has resulted in the production of a tiger cub following IVF and ET (Magyar *et al.,* 1988; Dixon, 1986; Jabbour *et al.,* 1994; Wildt, 1990).

GIFT, ZIFT and ICSI

GIFT and ZIFT have been successfully used for a variety of laboratory

animals and human beings and could be potentially used also for wild animals. Recently two new methods, namely ICSI and zona drilling have been developed and used with success in human beings (Tournaye *et al.*, 1994; Schutze *et al.*, 1994). ICSI is the acronym for intracytoplasmic sperm injection and in this method a spermatozoon is directly injected into the oocyte cytoplasm so as to achieve fertilisation even in the absence of motility. This method could be applied wherever the sperm quality is poor and it could be used in conjuction with IVF and ET. However, another method of AR uses a UV-laser microbeam and an optical tweezers trap, to drill holes into the zona pellucida of oocytes, to catch and transport a sperm through the hole into the perivitelline space and to bring it in close contact with the oolemma (Schutze *et al.*, 1994).

Conclusions

Assisted reproductive technology could thus play an important role in improving fertility among captive and free ranging endangered species. But AR technologies have been applied to wild animals only in a limited way because of the inherent difficulties involved in handling of the animals and standardising techniques which many a time have to be done in the wild under very difficult conditions. However, considering the dwindling population of wild animals AR methods need to be standardised before it is too late and preferably before inbreeding depression sets in. Further AR techniques for wild animals would logistically be more difficult but with the cooperation of various experts and with both national and international efforts AR methods could significantly improve the breeding status of endangered animals. Further recent developments in reproductive biotechnologies such as cryopreservation of spermatogonial stem cells and their subsequent ability to undergo spermatogenesis following transplantation into the testis of a host animal of the same or different species opens the possibility of Xenogeneic spermatogenesis i.e., the ability to generate spermatozoa in another species if the donor species is incapable of doing so (Brinster and Zimmerman, 1994; Clouthier *et al.*, 1996; Avarbock *et al.*, 1996). Further the ability to clone a progeny via transfer of nuclei from embryonic stem cells into enucleated oocytes or more recently by transfer of nuclei from adult mammary cell cultures would open upon newer avenues and strategies for conservation of endangered life (Campbell *et. al.*, 1996; Wilmut *et. al.*, 1997).

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Fig. 1 Tranquilising a tiger using a blow pipe loaded with a dart containing Xylazine and Ketamine

Fig. 2 Collection of blood from a tiger

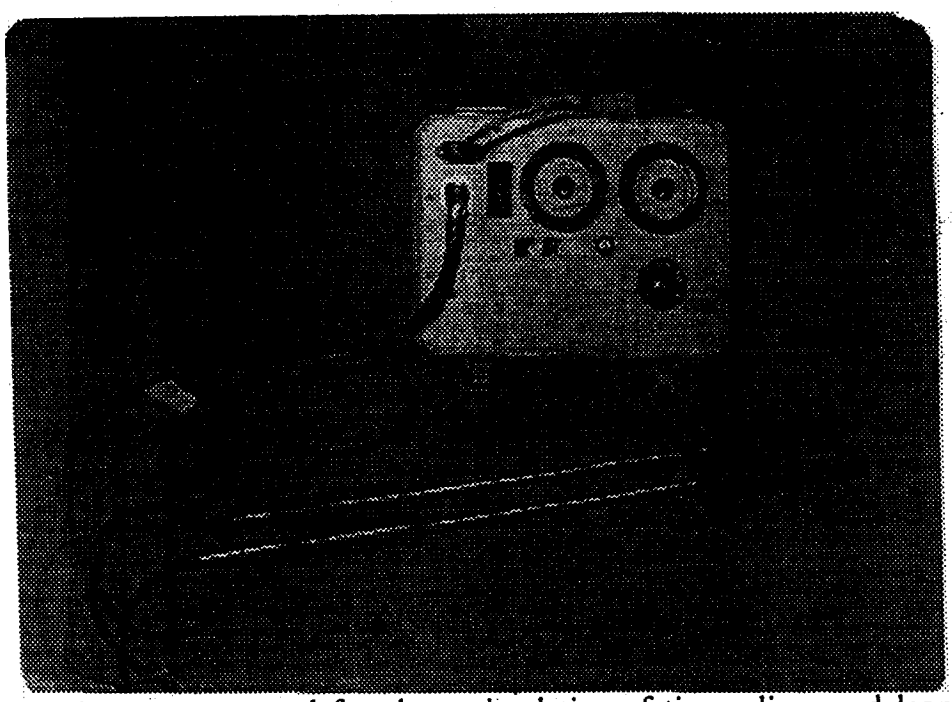

Fig. 3 The apparatus used for electroejaculation of tigers, lions and leopards

Fig. 4 Collection of semen from a lion using a rectal probe for inducing ejaculation

CAPTIVE BREEDING OF RED PANDA IN DARJEELING ZOO

N.C. Bahuguna

The word 'panda' brings the image of a black and white animal in the mind. Hardly anybody knows that it is a small beautiful cute looking animal whom the name originally belongs to. The first panda known to the West was a red panda from India in 1821, when Nathanel Wallich, a Danish botanist in Calcutta, sent a pelt to Maj. Gen. Thomas Hardwicke, a British Army Officer and an amateur naturalist. The first man to publish the scientific account about this animal, was a French zoologist, Frederic Cuvier in 1825. He gave the scientific name *Ailurus* for its cat like appearance and *fulgens* for its brilliant colours. In 1869, when a big bear like mammal resembling the red panda became known to science, the two pandas were named 'the giant panda' and 'the lesser panda' respectively on account of their sizes. Subsequently the giant panda snatched the name and fame of the smaller cousin. The biologists also lost their interest in the red panda. Not to speak of its scientific importance, even the status of the animal in the wild is not known to the world.

The red panda is found in the forests of the Eastern Himalayas where there is dense bamboo between altitude of 1500m and 4000m. Its evolution is intimately associated with the rise of the Himalayas, when Brahmaputra river cut deep gorges through these mountains dividing the red panda population into Chinese and Indian races. Since then the animal has been evolving in two separate subspecies : *Ailurus fulgens fulgens,* found in Nepal, North Eastern India and Bhutan and *Ailurus fulgens styani* found in China and Myanmar.

The red panda is a puzzle for the scientific world. While all other warm blooded animals do more work to maintain the body temperature in winter, the red panda takes more rest to avoid loss of heat. If the temperature falls too low to bear, the red panda migrates to lower altitude.

The two pandas have very close resemblance. They have similar behaviour and anatomical features. More than 90% of the diet of both the pandas in the wild consists of bamboo. Therefore, they were once considered the nearest

Padmaja Naidu Himalayan Zoological Park, Darjeeling - 734 101

relatives. But the DNA fingerprinting analysis shows that the nearest relative of red pandas are the New World racoons, while the giant panda is closer to bears. Thus the development of these pandas may be considered a superb example of evolutionary convergence.

First information about the red panda originated from India. All subsequent collections of this species also have their roots in India or nearby areas within Nepal. Yet its presence remained unnoticed in India till early nineties and the biologists working on this animal thought it extinct here. Presently in India, the red panda is found in Darjeeling (West Bengal), Sikkim and Arunachal Pradesh. In Darjeeling the animal is found in Neora Valley and Singalila National Parks and adjoining areas. Singalila forest has been the source of all the wild *fulgens* on display in Darjeeling zoo or may be throughout the world.

Padmaja Naidu Himalayan Zoological Park (PNHZP or Darjeeling Zoo) was created in 1958 for the conservation of the Himalayan fauna. Being local animal, the red panda was here since beginning. Once on display, the animal began to attract the attention of outside world and its demand started increasing. It is gathered that in the sixties when there was no act to restrict the trade of wild animals hundreds of red pandas were brought and dispatched to various destinations. By then the wildlife lovers had already begun to realise the importance of conservation. Therefore, in West Bengal, first ban on hunting of animals was imposed as early as 1958. However, there was an exemption on the hunting of wild pigs, bears and carnivores. In fact, first comprehensive attempt to control the hunting of wild animals came through Wildlife (Protection) Act, 1972 which became enforceable with effect from 1st May 1973.

This Act also did not help much. The zoos had exemption in the Act and therefore capture, transport and collection of the red panda remained unhindered in the seventies. In the eighties, situation began to change and it became extremely difficult to bring the red pandas from the wild without proper permission. An amendment in the Act in 1991, however, brought all the zoos under the control of Central Zoo Authority of India. In spite of this, till now no zoo has been penalised for not maintaining records. Yet complete and proper recording in PNHZP has resulted in total control on such transactions in the

nineties in this area.

The effect of procurement of red pandas from the wild was clearly visible on their management in the zoo. More the arrival from the wild, more the deaths in captivity and no births. Since the animal was easily available from the wild, no attempt was made to breed the animal.

Once it was clear that no new animals will be brought to zoo from the wild, management techniques of PNHZP were thoroughly reviewed. The behaviour of the animal was studied. The diet was changed. Although, there is not much information on the feeding habit of the animal, the knowledge of local hunters and experience of the staff were used to improve the diet. Some modifications were also made on the basis of the literature available from the Western Zoos. In the wild the red panda feeds on the maling bamboo (*Arundinaria maling*). This bamboo is not available near the zoo. In captivity pareng bamboo (*Arundinaria hookeriana*) is supplied. The red panda also feeds on fruits, berries, insects and small animals. To compensate this, the animal is also given apple, banana, carrot, corn flakes, honey and milk. Although, there is not much scientific basis for choosing this diet, regular breeding is sufficient to prove the correctness.

The red panda is arboreal. Hence climbing facilities were increased. Earlier, to check escape of the animals, the tree trunks were wrapped with tin sheets. These sheets were removed. Dry logs and branches were placed in the enclosure in addition, to make extra provisions for climbing.

In nature the wild animals are more active during dawn and dusk or night. They are tuned to take more rest during the day time. In the zoo, they are expected to change their routine. The zoos remain open during the daytime only. Consequently, when they do not need much area, the large outdoor enclosures are made available to them. On the other hand, when they need space for their activities after the zoo closes, they are forced to enter the small cubicles.

To overcome this problem, the old system of confining the animals during night time was discontinued. Arrangement was made so that red pandas may use the entire enclosure throughtout the day and night. Instead of cubicles

for night shelters, nest boxes were provided. The feed is given in these nest boxes. These are so designed that birds or rats can not access the food easily. If they try, they will not find it easy to escape if the red panda attacked. These nest boxes also take care of biological needs of the animal, especially breeding need. One chamber is kept dark, in case the female chooses it for giving birth. The doors of these nest boxes prohibit the movement of animal in infant stage but pose no problem for the mother. At least 2/3 nest boxes were placed in each enclosure because red pandas shift the cubs like cats.

The wild animals are not used to human being in the nature and therefore they are quite susceptible to disturbance. It has been observed that the red panda, the snow leopard and the Siberian tiger do not rear the young properly if they feel disturbed. In India, the zoos are visited by large crowds. Most of these people come just for entertainment. The visitors expect the animals to remain active and perform tricks. To activate the animals, they often tease them. Increase in the enclosure size and provision for the privacy of the animals, helped against this problem. Thus, if disturbed the animals could take refuse in safer places.

Still the zoos can not substitute natural habitats where the animals can move freely and migrate to far off place. This movement helps in reducing dependence on a particular patch for food or shelter and helps in body exercise. Due to lack of exercise the animal may become physically unfit. Therefore, arrangement was made for natural enrichment of the enclosures, so that this small area may be optimally utilised.

Darjeeling is a tourist place. The maximum flow of visitors is restricted to April, May and October. This suits the red panda management. The mating season of animal is restricted between January and early March, while births occur mainly in June/July after a gestation period of 111-158 days. Except June there is hardly any visitor in the Zoo after the birth of cubs. By October when the rush again starts the cubs are safe from disturbance.

PNHZP is striving for the conservation of Himalayan animals. A zoo can reach this goal through reintroduction of captive animals in the wild or

through conservation education. Education is the essential part of zoo management. Information can be provided to the people on various aspects of wildlife. How do the animals live in nature ? What are their natural requirement ? What problems are they facing ? What is their status in the wild ? There are many more questions which the zoos can easily answer. In the past the visitors used to go back disappointed when they found only a few animals in Darjeeling Zoo. They would compare it with other zoos in the country. They used to be interested in quantity and not in quality. Publicity through TV and newspaper has, however, changed the attitude of the people. Now many tourists come to the zoo in search of the red panda and the snow leopard. They feel disappointed only if, they are not able to watch these animals. But the population increase due to breeding success has ensured cent percent sighting of these animals here. The phrase 'sighting' may look out of place in the zoo, but a good zoo aspires for simulating natural condition and atmosphere.

Successful and systematic breeding of the red panda is the result of scientific development. The road to success was not very smooth. There have been problems also Many of these are still unsolved. If there is any problem there is no outside help. The Western knowledge does not suit Indian conditions. This is evident from the fact that the first panda gifted by Rotterdam Zoo did not survive long, because it could not adjust to its natural food.

This death in May, 1993, resulted in a lot of adverse publicity. However, the improvement made in housing the red panda soon brought results. During the next winter, two females showed signs of pregnancy. The hopes were soon dashed when bulging of stomach, in one of the females began to reduce. But soon, the other female gave birth to two cubs in June, 1994.

Till then one male was sharing the only enclosure with all the females. Immediately after birth, the mother, with the babies, was separated from other red pandas. Due to shortage of enclosures, this female was kept confined till the cubs became grown up. With these births, soon the lost confidence was regained. In the meantime European zoos also agreed to donate more red pandas to increase genetic diversity. Analysis and study of previous deaths, though took time, became the guideline for future imports.

In 1994, when three red pandas were brought from Europe, the donating zoos were requested to introduce them to the feed available in India. After their arrival, same feed was continued and changes were made gradually. In addition, exchange of visits between Darjeeling and European zoos helped in understanding the techniques and problems of different conditions.

In 1995, three females gave birth. However, only one, the same old mother did rear and save its cubs. In 1996, a female born in the zoo in 1994 gave birth to two cubs, making her own birth a successful breeding. A breeding in a zoo is called successful only if the animal born there, survives to brcome parent. Since 1996, all adult females have been breeding. This year fourth captive generation of red panda is expected in Darjeeling.

The effect of these breedings has been undone by the high mortality rate. This is basically due to the disturbance caused by the visitors. This problem is often compounded due to common entry of PNHZP and Himalayan Mountaineering Institute (HMI), which prohibits restrictions on the HMI entrants. Such entry is more harmful after the zoo hours, when the animals could otherwise buy peace. A female brought from Spain is so susceptible to disturbance that it is unable to take care of the cubs. She leaves them during the daytime. She would climb up the tree at the slightest noise. She would not bother even if they cry. She remains with them from dusk to drawn only. Consequently, her cubs have been dying every year.

In the first year, the post-mortem findings complicated the analysis. The cause of death of the cubs was assigned to *Pasteurella* infection. Thus veterinary examination and biological observations had no relation with each other. Further investigations showed that *Pasteurella* species remains in the body of the animal. Therefore, all red pandas were susceptible to this infection. In the past, many animals have died of this disease but there was no casuality among adult animals in the recent past. It can be inferred that due to changes made in diet, the animals must have developed sufficient resistance. The cubs on the other hand, were not being reared by the mother. Therefore, they became too weak to resist the infectiion.

In 1997, two red pandas died of panleucopenia a disease not reported earlier in Darjeeling. It is not clear whether this was a new disease in the area arriving with the new animals brought from Europe, or should it be ascribed to lack of proper post-mortem analysis in the past.

In spite of all these problems the future of red panda in PNHZP, is bright. On the contrary, the red panda population has dwindled in the wild due to capture for display in the zoos. Preliminary survey in Singalila National Park and adjoining forest areas shows the presence of only 26 red pandas in the wild while the habitat has the carrying capacity for more than 100 animals. Since this reduction of population is mainly due to capture for the zoos, the zoo community must come forward to save this species from extinction.

Reintroduction is the ultimate goal of a zoo. PNHZP has now standardised the technique for breeding the red panda in captivity. Therefore, the stage is set for the reintroduction of red pandas in the wild after preparing an action plan.

In the wild, the red panda is confined to the small areas near Darjeeling. Therefore, reintroduction efforts should be concentrated in this region only. Such attempts with small population at single location often fail. Therefore, PNHZP is making efforts to extend its captive programme in other locations in the vicinity of red panda habitat. Other Himalayan states must also come forward to save the red panda. Sikkim has already joined and is housing the red pandas. Uttar Pradesh (U.P) is in the process of planning while Arunachal Pradesh and Himachal Pradesh may join. Although, U.P. and Himachal are a bit far from the habitat, yet suitable sites are available there for captive breeding programme. In addition, there is need to encourage Nepal and Bhutan to join the Indian programme.

It is still not too late but survival of this animal in the wild may not be possible without external efforts. Therefore, all those aspiring for nature conservation must come forward to join the red panda conservation programme.

CAPTIVE BREEDING OF GIRAFFE IN ALIPORE ZOO

A.K. Das

Introduction

The giraffes being the most spectacular of living mammals and the most striking exhibits of a zoo, a study of their breeding behaviour in captivity is worth noting. This study was undertaken to provide information on (1) breeding season, (2) age of sexual maturity, (3) mating behaviour, (4) gestation period, (5) pregnancy, (6) birth, (7) parturition, (8) calf standing and (9) suckling of giraffes in captivity. This paper is based on the data collected at the Alipore Zoological Garden, Calcutta from 1986 to 1998.

Materials and Methods

Alipore Zoological Garden, Calcutta had procured one male and two female girafees (*Giraffa camelopardalis rothschildi*) from Koln Zoo, Germany in exchange of a zoo-bred Indian one horned rhinoceros on 14th January 1986. But one female died after two months of its arrival due to an accidental strangulation leaving one male ("**Sagar**") and one female ("**Uttara**") in the zoo-stock. They have been kept in an enclosure having two exhibition areas measuring 120 ft. x 125 ft. (36 x 37.5m) and 70 ft. x 66 ft. (21 x 19.8m) respectively. The ground of both the exhibition areas with a Banyan tree in the middle of each exhibition area are covered with 10 inches (25 cm) thick silver sand and fenced by 18 ft. (5.40m) high 12g x 3 inches (7.5cm) mesh wire-netting. A 5 ft. 7 inches (1.67m) high gratted guard railing is running along the said wire-netted fencing about 4 ft. (1.20m) away from it. There are four indoor areas (stalls) in between two exhibition areas, each measuring 14 ft x 28 ft (4.2 x 8.4m). Each of the two indoor areas are facing one of the two exhibition areas. The indoor areas are used for feeding and housing the giraffes. The floor of each indoor area in covered thickly with pieces of cut paddy straw. The average daily ration of food for an adult giraffe at the Alipore Zoo consists of the following :

Zoological Garden, Alipore, Calcutta - 700 027

	Items of food		Weight in kg
1.	Wheat Bran	...	3.500
2.	Crushed Oat	...	0.300
3.	Groundnut Oil Cake	...	0.250
4.	Mustard Oil Cake	...	0.375
5.	Indian Corn (Maize) (Soaked)	...	0.375
6.	Crushed Barley	...	0.875
7.	Pulse (Musoor Dal) Boiled	...	0.375
8.	Bengal Gram (Soaked)	...	0.375
9.	Common Salt	...	0.060
10.	Black Salt	...	Lump Sum
11.	Molasses	...	0.125
12.	Ripe Bananas	...	2.600
13.	Orange	...	4 pieces
14.	Apple	...	0.875
15.	Bean	...	0.875
16.	Carrot	...	1.000
17.	Onion	...	0.375
18.	Sweet Potato	...	1.000
19.	Guava (Ripe)	...	0.375
20.	Green leaves of trees belonging to the genus *Ficus* & *Acacia*	...	Lump Sum

The food grains and other concentrates as mentioned above are fed in wooden mangers hung on the walls of the indoor areas (stalls) about 7 ft. (2.10m) above the floor. For the young giraffes mangers are fixed on the walls at a lower height [about 4 ft. (1.20m) above the floor]. Drinking water is provided in wide mouthed water troughs which are hung on the wall about 6 ft. (1.80m) above the floor. Water troughs are also hung at a lower height for the young giraffes. Branches of trees with green leaves belonging to the genus *Ficus* and *Acacia* are hung with a rope from the trunk of the Banyan tree standing in each exhibition area.

For the purpose of this study, data have been collected from my own

observations from 1986 to 1998 supported by the records maintained at the Alipore Zoo in the form of daily reports and other registers. Behaviour of mating, parturition, calf standing, etc. of giraffes have been recorded by me with the assistance from some zoo-staff.

Breeding Season

Giraffes have no particular breeding season in captivity. Crandall (1964) reports that a female Uganda giraffe in New York Zoological Park has been noted to be in oestrus in every month except January and calves are born in any month of the year.

At Alipore Zoological Garden four female giraffes came in oestrus in the months of May, July, October and December during the period from 1987 to 1996. The inter- oestrus interval as recorded in four female giraffes were 14, 15 and 16 days and the period of oestrus was 24 hours. Seventeen oestruses of giraffes had been recorded and the four females gave birth to 14 calves during the period of observation. These data are presented in Table-I.

Table - I

Breeding season of giraffe, *G.c. rothschildi*, in Alipore Zoo

Month	Number of oestruses recorded	Number of births recorded
January	2	0
February	2	3
March	1	1
April	4	2
May	0	1
June	1	1
July	0	2
August	1	0
September	2	1
October	0	0
November	4	2
December	0	1
Total	**17**	**14**

Sexual Maturity

Fowler (1986) reports that sexual maturity of giraffe is reached at approximately three and a half years. Crandall (1964) reports that first oestrus in a female giraffe occurred at the age of 3.5 years in Copenhagen Zoological Garden. Grzimek (1972) reports that sexual maturity of giraffe occurs at three years.

The sexual maturity and birth of first calf in cases of three female giraffes in Alipore Zoo are shown in Table - II.

Table - II

Observation of sexual maturity of giraffe, *G.c. rothscildi* in Alipore Zoo

Name of specimens	Date of birth	Date of first oestrus recorded	Age at the onset of first oestrus	Date of birth of first calf	Age when first calf was born
"Teesta"	15.4.88	28.11.90	2 years and 7 months	28.2.92	3 years and 10 months
"Sonali"	29.11.92	14.2.95	2 years and 2 months	9.5.96	3 years and 5 months
"Ayesha"	27.11.94	4.4.96	1 year and 11 months	27.6.97	3 years and 2 months

Mating Behaviour

It was observed that the dominant male mated with the receptive female. Before mating the male giraffe licks the urine of the female with his tongue and produced "*flehmen*" response to test the receptivity of the female. The male giraffe thereafter followed the female closely and attempted to mount frequently. But the female initially moved away and sometimes rubbed her neck along the male's flank before allowing the male to mount. In course of chasing and following the receptive female by the male giraffe a series of mountings occurred. Coitus was very brief, lasted only for a few seconds. Although many mountings occurred during the period of oestrus (24 hours), pregnancy did not occur in each oestrus. These data are presented in Table - III.

Gestation Period

Asdell (1946) records the gestation period of giraffe between 14 and 15 months. Crandall (1964) reports that the gestation period of giraffe is roughly 14.5 months. The gestation period of giraffe is approximatly 455 days (Fowler and Boever, 1986).

The highest and lowest gestation periods in the present observation were recorded as 455 and 440 days respectively and the mean period was 443 days. Gestation periods as recorded in the present study are shown in Table - III.

Table - III

Observation on gestation period of giraffe, *G.c. rothscildi* in Alipore Zoo

Names of the mating pairs (Male x Female)	Oestrus	Date of oestrus/ mating	Date of birth of calf	Gestation period (in days)	Mean gestation period (in days)
"Sagar" X "Uttara"	1st	15.1.87	14.4.88	455	
	2nd	20.8.88	13.11.89	448	
	3rd	2.1.90	29.3.91	452	
	4th	27.9.91	29.11.92	450	
	5th	15.4.93	10.7.94	450	
	6th	12.11.94	11.2.96	454	
	7th	8.11.96	No pregnancy	—	
	8th	22.11.96	7.2.98	440	
"Sagar" X "Teesta"	1st	28.11.90	28.2.92	451	443
	2nd	28.2.93	27.4.94	454	
	3rd	18.9.94	8.12.95	445	
	4th	27.3.96	No pregnancy	—	
	5th	9.4.96	No pregnancy	—	
	6th	23.4.96	22.7.97	454	
"Sagar" X "Sonali"	1st	20.2.95	9.5.96	444	
	2nd	9.6.96	7.9.97	453	
"Sagar" X "Ayesha"	1st	4.4.96	27.6.97	448	

Pregnancy

The female giraffe did not show any sign or symptom of pregnancy after mating at the initial stage of pregnancy. Even upto ten months of pregnancy she did not show any appreciable change except the slightly distended abdomen. In the advanced stage of pregnancy the abdomen was found to be more distended and there was pronounced enlargement of the udder and vulva.

Birth

Births of giraffe are usually of single young (Crandall, 1964). Shortridge (1934) reports twins in two instances.

At Alipore Zoological Garden 14 births always with single young in four female giraffes were recorded (Fig.1) and the stages of parturition were found to be more or less the same excepting the duration of parturition which was found ranging from 1 hour 30 minutes to 2 hours 5 minutes. This variation of the time of parturition was even noticed in the same female.

The female giraffe was found to move through out the enclosure before and during the entire process of parturition slightly spreading the hindlimbs when she was found to be straining frequently. She was occasionally found to take food and sat down on the ground. During parturition the forelimbs of the calf appeared first followed by the head and neck placed in between the forelimbs. The stages of parturition are presented in Table-IV.

Table - IV

Observation of stages of parturition in giraffe, *G. c. rothscildi* in Alipore Zoo (as recorded during the birth of second calf of "Uttara" on 13.11.89)

Time	Stages of parturition
8 - 15 hours	Tip of amniotic sac found inside the vaginal opening
8 - 25 hours	Amniotic sac started to come out
8 - 30 hours	Tip of hooves of forelimbs of calf found visible surrounded by sac.
8 - 35 to 8 - 45 hours	Process of emerging of the calf continued, a portion of both forelimbs found outside the vaginal opening
8 - 55 hours	Frontal part of mouth with nose began to come out

9 - 10 hours	Head came out of the vaginal opening
9 - 15 hours	Amniotic sac ruptured
9 - 20 hours	Neck came out
9 - 30 hours	Head and neck of the calf found swinging when the mother moved, shoulder came out.
9 - 35 hours	Calf came out gradually when it swung due to the movement of the mother
9 - 45 hours	Calf fell down on the sand bed

Soon after parturition, the mother was noticed to eat the amniotic membranes frequently while she was licking and cleaning her calf. A large amount of blood tinged fluid from the vagina was found to be discharged for about two hours following parturition. The placenta was expelled by 12-45 hours and not eaten by the mother till its removal by the keepers.

Abnormal Presentation of Foetus

Grzimek (1972) said that not every birth of giraffe proceeds smoothly. Saha *et al.* (1996) reported a case of dystocia in a female giraffe ("Uttara") in her fifth pregnancy in Alipore Zoological Garden when traction by fixing nooses of rope to each of the protruded forelimbs were applied and a dead foetus was pulled out by 16 keepers on 10.7.94.

Calf Standing (second calf of "Uttara")

Soon after birth the wet, shaggy calf lying on the ground was able to raise its neck. It swung to and fro and repeatedly touched the ground. Suddenly it made the first attempt to stand on its limbs. But the limbs did not work properly. They slipped away and the calf kept falling back. But the calf after several attempts finally achieved a standing position by 10-30 hours (i.e. 45 minutes after birth). The time taken for standing by ten other calves as recorded in Alipore Zoo was found ranging from 38 minutes to 1 hour and 25 minutes.

Gijzen (1958) reported of a calf standing at 37 minutes of birth. Kristal and Noonan (1979) reported of a calf standing at 43 minutes. Robinson *et al.* (1965) reported calf standing at 1 hour and 27 minutes.

Congenital Knuckling

The process of calf standing did not always go on smoothly in Alipore Zoo. Two instances of congenital knuckling of pastern joint in two new born calves were recorded. The mother 'Teesta' in her first pregnancy gave birth to a male calf on 28.2.92 (Fig.1). The calf after normal standing was not able to suckle even on the second day of its birth due to the deformity of knuckling at pastern joint. For rendering some corrective measures four bamboo splinters each of 8" (20 cm) in length were fixed on the leg extending from the hoof to the fetlock joint by wrapping a crepe bandage surrounding the affected area of the left foreleg in optimum tightness. The calf was found thereafter to walk properly and started to suckle. The crepe bandage of the foreleg was removed after 3 weeks on 20.3.92 when the calf was found to move on its four limbs with normal gait and posture.

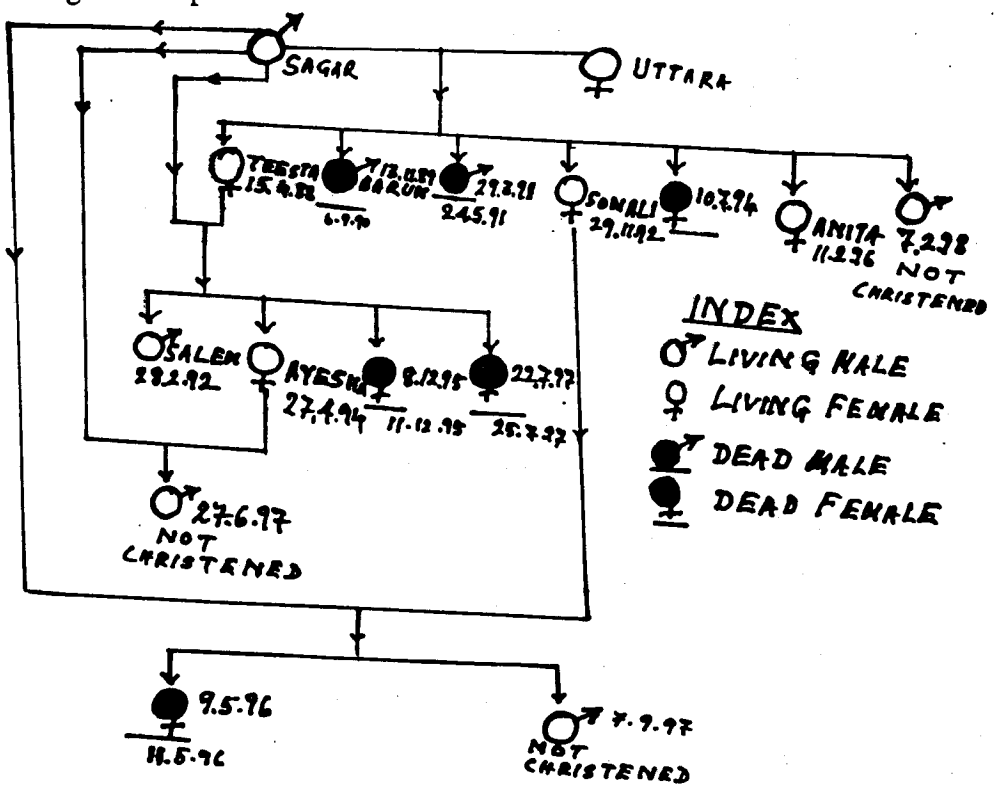

Fig.1 : Genealogy of giraffe, *G.c. rothschildi* in Alipore Zoo

The mother 'Ayesha' in her first pregnancy gave birth to a male calf on

27.6.97 (Fig.1) with congenital deformity of knuckling on its left forelimb which was corrected in the same way as done in the first calf of "Teesta". But this time the bandage was removed after 4 days.

Calf Suckling (in case of second calf of 'Uttara')

The calf after standing started to move unsteadily and went towards its mother ("Uttara"). The mother repeatedly stepped aside uncomfortably. But ultimately the calf managed to press its head and neck under her belly between the mother's front limbs and to reach the udder. At about 11-10 hours the calf started taking mother's milk for the first time (i.e. 1 hour and 25 minutes after birth) when the mother stood steadily for about a minute.

Calf suckling in case of two other births ("Sonali" and "Anita") as recorded in the zoo were of 50 minutes and 1 hour and 15 minutes respectively.

Gijzen (1958) reports calf suckling at 30 minutes and 50 minutes of birth. Kristal and Noonan (1979) report of a calf suckling at 90 minutes of birth. Robinson *et al.* (1965) report a calf suckling at 1 hour and 35 minutes.

Hand-rearing

It was observed that the calf-mortality occurred (3rd and 4th calves of "Teesta" and the 1st calf of "Sonali") due to lack of maternal care. In each occasion hand-rearing of calf was tried after failing to suckle on the first day of birth but never succeeded.

Discussion and Conclusion

Giraffes mate throughout the year and calves are produced during all seasons in capivity although there are peak periods of matings and births. Higher number of oestruses were observed in the months of January, February, April, September and November and less number of oestruses were observed in other months of the year. Similarly, higher number of births occurred in the months of February, April, July and November.

The variations in the peak period of mating and birth may be due to climatic conditions and other factors of the artificial environment in captivity.

There is much individual varition in the age at which the female giraffes

become sexually mature. It appears from the data recorded at Alipore Zoo that the female giraffes become sexually mature at the age between 1 year and 11 months and 3 years and 10 months. Fowler (1986) and Crandall (1964) report that the sexual maturity of giraffe is reached approximately at three and a half years. But no clear conclusion can be drawn from the small examples of Alipore Zoo.

The range of gestation period of four giraffes as recorded in 14 births was from 440 to 455 days with an average of 443 days. These data compare well with the gestation periods given by other workers (Asdell, 1946, Fowler and Boever, 1986; Crandall, 1964).

Female giraffe does not become pregnant after mating in each oestrus period in captivity. The data of pregnancy show that out of 17 matings, pregnancy occurred only in 14 cases. It is not clear from the limited observations whether age, physical condition and number of matings in each oestrus have any role in pregnancy.

Although Shortridge (1934) reports twins in two instances, Crandall (1964) reports that births of giraffe are usually of single young. In Alipore Zoo, births of giraffe as observed were of single calf in 14 instances which confirm the report given by Crandall (1964).

Calf standing at Alipore Zoological Garden was found ranging from 38 minutes to 1 hour and 25 minutes. These data conform well with the times of calf standing given by other authors (Gijzen, 1958, Kristal and Noonan, 1979; Robinson *et al.,* 1965). The congenital deformity of knuckling at pastern joint is very common in giraffe calves in captivity which can easily be corrected by using bamboo splinters.

The times of calf suckling as recorded in Alipore Zoo are also well comparable with the data given by other authors (Gijzen, 1958; Kristal and Noonan, 1979; Robinson *et al.* (1965).

The attempts of hand-rearing of giraffe calves had never been successful in Alipore Zoo possibly for want of feeding of colostrum which contains antibodies of pathogens. So, the question of hand-rearing of a giraffe calf should only be considered as a last resort.

A C K N O W L E D G E M E N T

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COMPARATIVE GROWTH AND DEVELOPMENT OF MOTHER AND HAND REARED JACKAL CUBS (Canis aureus) AT ARIGNAR ANNA ZOOLOGICAL PARK, CHENNAI

A. Manimozhi, N. Baskar, N.Krishnakumar and M. Sekar

Introduction

The only jackal species occurring in India, the Golden Jackal *(Canis aureus)* commands an important "niche" in the ecosysem "food web" because of its peculiar food habits (Kotwal et al, 1991). They live mostly in open grassland habitats, where it feeds mainly on small rodents. Although they are mostly active by day, they also hunt in moon light, and in areas where they have been persecuted they are usually nocturnal. In the 19th century they occurred over most of the states in India, but have declined with spread of agriculture and depredation of habitat that led to reducation in rodent population. Now it is no more common and listed in Schedule II of Indian Wildlife (Protection) Act, 1972. Little is known about the jackal's family life and its other habits. How long the male remains with its mate or family, what part, if any it plays in caring for the young, their upbringing, growth and dispersal, all remains to be discovered (Prater, 1980). Reuther and Doherty (1968) and Mihai Cociu and Maria Cociu (1976) reported on birth seasons of the jackals in captivity. Naaktgeboren (1968) reported on the gestation period of jackals in captivity. Rajasekar (1993) studied at Guindy National Park about the days of the jackal.Newton (1985) reported the relationship between jackals and langurs. Apart from these reports literature on growth and development of jackal cubs seems to be scare. Hence the growth and development of 2 hand reared and 4 mother reared jackal cubs were observed at Arignar Anna Zoological Park, Chennai (AAZP) with the objectives to find out whether significant differences exist in these traits between the mother and hand reared cubs and also within the cubs of each group.

Arignar Anna Zoological Park, Vandalur, Chennai-600 048

Materials and Methods

Four jackal cubs of about 10 days old were brought to AAZP on 31-01-95 as orphans. They were hand reared, and two of them died after two weeks. The remaining two (1:1) were successfully hand reared. The female of another pair of jackals gave birth to 4 cubs (3 : 1) on 12-02-95. The body weight, length, height, etc. were recorded in a printed format every 10 days separately for two hand reared orphan cubs received on 31-01-95 and four mother reared cubs born on 12.02.95. The mother reared cubs were caught individually and marked with ear clipping for identification.

The jackal cubs were caught individually in well aerated fresh gunny bags and weighed. While taking body measurement the mouth of the cubs were tied tightly with soft thread without obstruction to the nostrils.

Students 't' test was used to find out difference between mother and hand reared jackal cubs by adopting the method of Snedecor and Cochran (1968). Analysis of variance (one way ANOVA) was carried out to know the difference among the cubs of mother and hand reared cubs by adopting the method of Campbell (1989).

Observations and results

While receiving from the public the cubs were very small, eyes were just open and the hairs all over the body were yellowish brown in colour. The average weight was 337. 50 $\pm$ 73.95 grams. On this basis the age was estimated as about 10 days. The cubs were introduced in a 1.2 x 1.2 x 1.2m caged box with wooden floor. The entire surface area was provided with hay. Boiled cow-milk was fed 6 times a day with the help of a feeding bottle with nipple in lukewarm condition. The cubs were fed six times a day. The timings were 6 A.M., 8.00 A.M., 12 Noon, 3.00 P.M., 6.00 P.M., 10.00P.M. This practice was continued upto the age of 40 days. The frequency of feeding was then reduced to 4 times and gradually to 3 times a day. The feeding bottle was washed with hot water and sterilised before and after each feeding. When they started consuming flesh, the milk was gradually stopped. The cubs were 45 days old, when they started eating beef. Two of the cubs died on 2nd and 3rd week of

Ear : The mean ear lengths of mother and hand reared jackal cubs were 6.06 $\pm$ 0.11 cm and 6.25 $\pm$ 0.25 cm respectively at the age of 61 days. The mean ear lengths at the age of 181 days were 9.6 $\pm$ 0.12 cm and 9.1 $\pm$ 0.20 cm in mother and hand reared cubs respectively (Table 1 Fig.1). The mean ear length did not vary significantly between mother and hand reared cubs ($p>0.05$). Among the mother reared cubs also it did not vary significantly ($p>0.05$ $F=0.18736$) in their ear lengths.

DISCUSSION

In order to keep a careful check on the health and development of the hand reared or mother reared cubs, it is better to study the growth rate of the cubs in zoological parks (Basavaraj et al. 1994). The growth rates of mother and hand reared jackal cubs showed that there were a regular increase in their body weight and length, shoulder height, length of tail and ear from 61 to 181 days of age. The same trend was also reported by Crandall (1964) and Cory (1968) in leopard and lion cubs respectively. All parameters except shoulder height revealed higher growth rate in mother reared jackal cubs than the hand reared cubs. This also coincides with the findings of Crandall (1964) in leopard and Cory (1968) in lions. According to Marma and Yunichis (1968) the body measurements of young snow leopard also showed positive trend in growth and development.

Among the jackal cubs of the same litter (mother and hand reared) no significant difference could be noticed.

The mother reared cubs showed highest development presumably due to the fact that mother's milk fulfilled all the required growth promoting nutrients,. In contrast the cow's milk may not offer all the nutrients promoting growth and further the cubs may not assimilate the cow's milk properly.

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Table-1 : Mean body measurements of mother and hand reared jackal cubs *(Canis aureus)* from 61 to 181 days old

Age in days	Mother eared cubs (n=4)					Age in days	Hand reared cubs (n=2)				
	Mean Weight (Kg)	Mean head & body length (cm)	Mean tail length (cm)	Mean Shoulder height (cm)	Mean ear length (cm)		Mean Weight (Kg)	Mean head & body length (cm)	Mean tail length (cm)	Mean shoul-der height (cm)	Mean ear length (cm)
43		NOT RECORDED				43	0.988 ±0.01	34.25 ±0.25	9.25 ±0.25	19.25 ±0.25	5.4 ±0.10
53		NOT RECORDED				53	1.225 ±0.03	39.00 ±1.0	10.25 ±0.25	20.00 ±0.0	6.25 ±0.25
61	2.05 ±0.09	45.25 ±1.48	14.50 ±1.12	23.00 ±1.0	6.06 ±0.11	61	1.138 ±0.04	42.00 ±1.0	10.75 ±0.25	21.50 ±0.0	6.25 ±0.25
71	2.125 ±0.09	46.75 ±1.30	15.50 ±0.87	26.25 ±0.43	6.45 ±0.11	71	1.45 ±0.05	43.75 ±1.25	11.75 ±0.25	25.00 ±050	6.75 ±0.25
81	2.475 ±0.11	50.60 ±1.12	16.88 ±0.41	27.25 ±0.43	6.50 ±0.0	81	2.00 ±0.1	44.75 ±0.75	12.75 ±0.75	25.50 ±0.25	6.75 ±0.25
91	2.888 ±0.09	52.00 ±1.87	17.50 ±0.35	28.00 ±0.71	6.83 ±0.08	91	2.225 ±0.03	45.50 ±0.50	14.50 ±0.50	27.50 ±0.50	6.90 ±.10
101	3.175 ±0.08	53.25 ±2.28	18.38 ±0.41	30.25 ±1.30	7.00 ±0.0	101	2.325 ±0.03	46.50 ±0.50	16.25 ±0.25	28.50 ±0.50	7.45 ±0.05
111	3.688 ±0.06	57.00 ±0.71	19.50 ±0.50	31.50 ±0.50	7.83 ±0.15	111	2.525 ±0.03	48.75 ±0.75	16.75 ±0.25	28.75 ±0.25	7.95 ±0.05
121	3.883 ±0.22	59.25 ±0.43	19.75 ±0.83	32.25 ±0.43	8.10 ±0.1	121	2.725 ±0.03	50.00 ±1.00	17.00 ±0.0	30.00 ±0.50	8.25 ±0.05
131	4.188 ±0.04	60.25 ±0.43	20.75 ±0.83	33.00 ±0.0	8.28 ±0.04	131	2.775 ±0.03	51.80 ±0.80	17.75 ±0.25	30.50 ±0.50	8.55 ±0.15
141	4.600 ±0.1	62.25 ±0.43	21.00 ±0.71	33.75 ±0.43	9.00 ±0.0	141	2.863 ±0.06	53.50 ±0.50	18.25 ±0.25	31.25 ±0.25	8.75 ±0.25
151	4.763 ±0.16	63.75 ±1.09	21.75 ±0.43	34.50 ±0.50	9.43 ±0.13	151	3.125 ±0.03	54.30 ±1.30	18.50 ±0.0	31.25 ±0.20	8.80 ±0.20
161	4.913 ±0.21	64.75 ±1.09	22.00 ±0.0	35.25 ±0.43	9.48 ±0.04	161	.350 ±0.10	55.40 ±1.40	19.30 ±0.30	31.50 ±0.50	8.95 ±0.15
171	5.075 ±0.24	65.50 ±0.87	22.25 ±0.43	35.50 ±0.50	9.58 ±0.08	171	3.625 ±0.8	56.50 ±0.50	19.60 ±0.2	32.75 ±0.25	9.00 ±0.20
181	5.475 ±0.28	65.75 ±0.83	22.25 ±0.43	35.50 ±0.50	9.60 ±0.12	181	3.975 ±0.03	57.55 ±0.77	19.85 ±0.15	32.50 ±0.25	9.10 ±0.20
191						191	4.600 ±0.20	58.00 ±0.50	20.35 ±0.15	33.25 ±0.25	9.25 ±0.25
201		NOT RECORDED				201	4.675 ±0.08	58.50 ±0.50	20.75 ±0.25	34.40 ±0.40	9.25 ±0.25
		NOT RECORDED									

all values are Means ± Standard deviation

MEAN BODY MEASUREMENTS OF MOTHER AND HAND REARED JACKAL CUBS

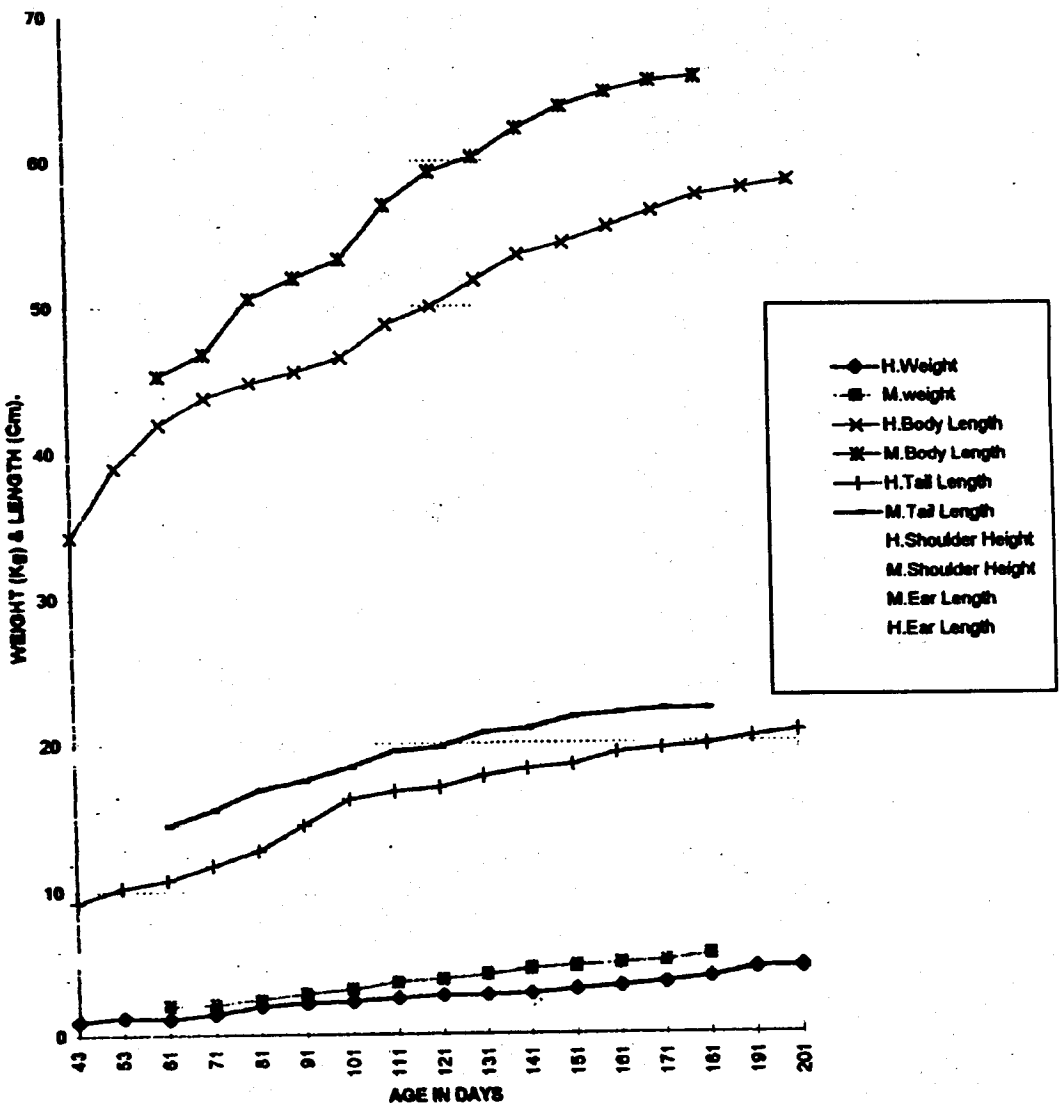

Fig. 1

SUCCESSFUL BREEDING OF CHIMPANZEE (*PAN TROGLODYTES*) IN NANDANKANAN ZOOLOGICAL PARK

B.C. Prusty

A pair of chimpanzees named Zulu (Born on 12.10.88-male) and Pampata (Born on 5.11.90-female) were brought from Singapore Zoo on 16.5.94 to Nandankanan Zoological Park, Bhubaneswar (NKZP) in exchange of 2 pairs of gharials (*Gavialis gangeticus*) and a pair of sloth bear (*Melursus ursinus*). Chimpanzee enclosure is one of the major attractions of NKZP as their playful as well as angry moods entertain the visitors even in the worst of weather conditions.

These two exotic apes have been kept with great care and special attention by the park staff. The animal keepers, curator and zoo veterinarians have been personally involved in their up-keep. To achieve the objective of captive breeding everybody was highly concerned and Zulu and Pampata also never disappointed the management. After the successful mating during August'98 started the count down for the great event. There was lot of discussion and debate among the staff regarding management during conception as well as postnatal management. Information were down loaded from the computer through internet regarding the management practices. Signapore Zoo also provided tips for the postnatal management on our request. Our apprehension was about the behaviour of Zulu towards the new born baby. Some suggested that Zulu and Pampata should be separated at the time of parturition. Attemps were also made to gradually separate them by increasing their separation period. But the separation was not tolerated by Pampata and when separated, literally she used to cry and Zulu also became very much violent forcing us to reunite them to prevent injury to both of them. Since the separation process was not successful, ultimately, the practice was abandoned and they were allowed to live together.

The event of birth of a baby chimpanzee took place on 12.5.99 at 5.00 P.M. The labour pain started at 9.00 A.M. after which Pampata did not

Nandankanan Zoological Park, Mayur Bhawan, Janpath, Sahid Nagar, Bhubaneswar - 751 007

accept any food. Being a sincere husband, Zulu also refused food and remained attentive and totally devoted towards Pampata. Every time she got pain due to spasm, she called Zulu who responded promptly and after close inspection, consoled her to keep patience. Nearly 20 times Zulu attended Pampata in this manner till the final delivery of the baby.

At 5.00 P.M. when Zulu realised that the final stage had come he manoeuvered with his hand and pulled the baby through its head out of the womb and gave a pat on the back of Pampata who swiftly turned around and lifted the baby to her arms. There after Zulu ran around the enclosure hilariously as if declaring his fatherhood.

Might be it was a coincidence that minutes after the birth of the baby, there was heavy down pour in and around NKZP after a dry spell of six months. Hence, the staff of NKZP named the new born as **"Barsa"**. Surprisingly, since then NKZP got regular rains almost every day, beating the oppressive heat of the scortching sun as if the summer came to an end.

Special care was taken to keep the animals free from infection by adopting special sanitary measures. Animals were kept off exhibit to give them rest, particularly, to the mother and the baby. Special diets (milk, egg and fruits) with vitamin supplements were provided for proper lactation of the mother. Even during pregnancy Pampata had been given homeopathic medicine to supplement Calcium, Phosphorus and Iron requirement and subsequently with health tonic.

Arrangement had been made to keep watch on the mother and the baby round the clock. One wooden platform in the night shelter had been provided with the hope that the mother and the baby would use the same for privacy. But the platform was hardly used by them. Rather, Zulu was covering the mother and the baby at times when privacy was required.

Despite all care the baby survived for only five months and died of loose motion on 22.10.99. Neither it was possible to separate the baby from the mother nor it was possible to administer drugs to the baby and ultimately it succumbed.

BEAR ENCLOSURES IN NANDANKANAN ZOOLOGICAL PARK

S.K. Patnaik

Nandankanan Zoological Park near Bhubaneswar, Orissa is holding three species of bears like sloth bear, Himalayan black bear and European brown bear for nearly 30 years now. To house these three species a compasite open-air circular enclosure has been constructed in the park with wet moats. Though as per modern standards much more space should be provided to each species to somewhat meet their biological needs, this set of enclosures has comfortably held the 3 species for over two decades and has provided necessary facilities for the keepers and zoo management to handle these animals quite smoothly. It has been possible to attend to all the three species from one small area in the centre of the circle.

Since all the three individual enclosures are identical, only one of them is being explained. Each arch shaped enclosure has an exhibit paddock with a 5m vertical high wall made of stone massonary. There are 2 feeding cubicles behind this wall of 3.4 x 4.0m, each with 2.0 x 1.0m opening on the outer walls with iron rod railings. Each cubicle has opening into the paddock while they have sliding doors. Besides this, there are two feeding cubicles each of 4.0 x 3.0m under the partition wall between the enclosures. They provide additional accomodation in case of need and also provides for isolating the mothers before and after parturition and keeps the cubs safe from other bears.

The semi-circular type display area is about 30.0m wide on the viewers' side and is covered with grass and stones. The soil is retained through a 0.5m high parapet wall. From this point, the random rubble massonary moat wall slopes down to the moat bottom, which is 3.0m. wide with cement concrete base to retain water in the moat. There is arrangement for filling the moats and draining out the used water. Each exhibit has a separate drinking water pool and two cave like structures to enable the animals to take shelter during hot days, rains and for climbing on them for exercise and to prevent monotony. As they destroyed the trees which were inside the enclosures, artificial perches

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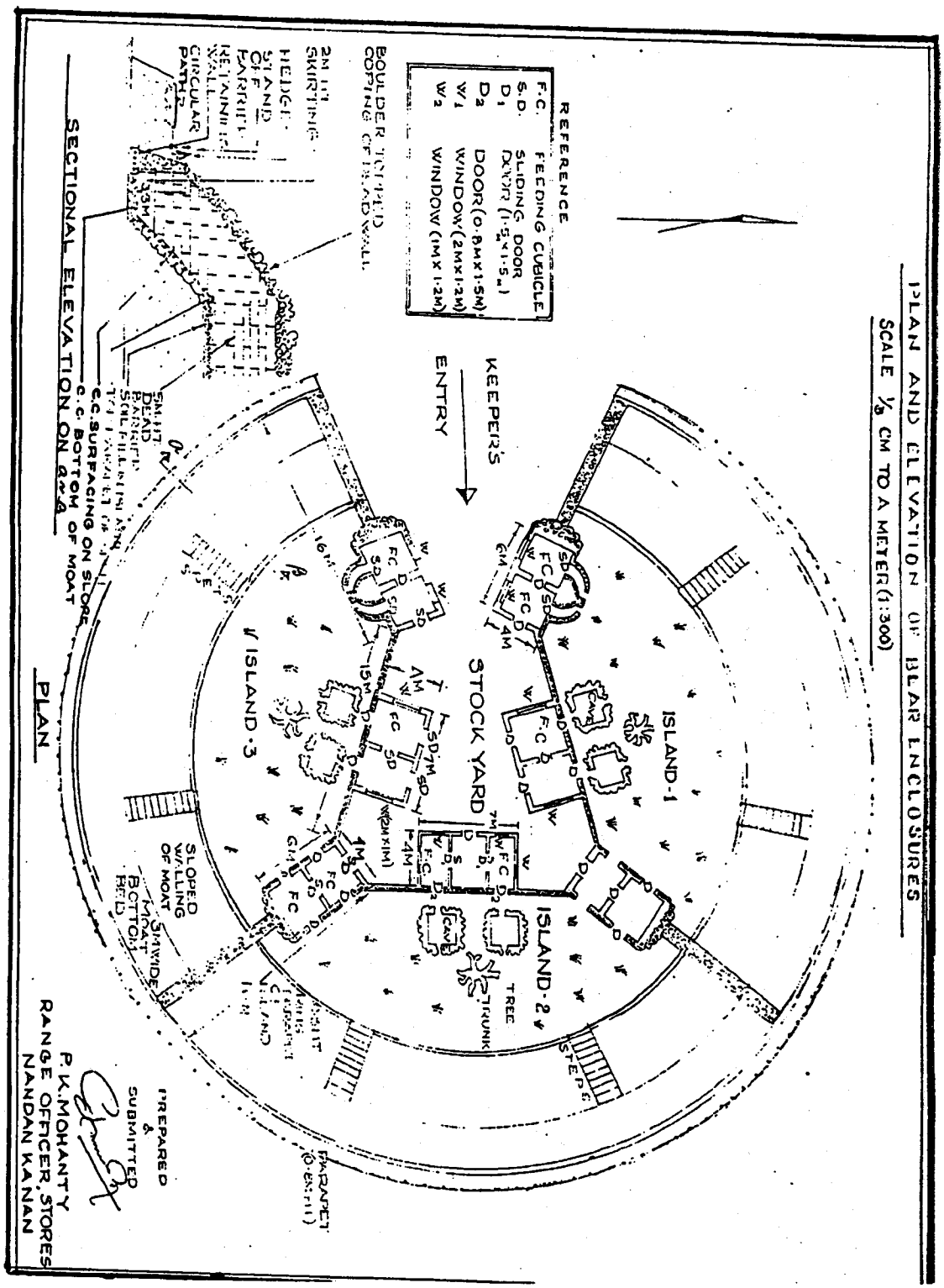
and logs have been provided for their use.

The viewers' side retaining wall is 3.0m. high with a projection of 0.8m. above ground. There is a green hedge of about 0.8m. wide towards the visitors, followed by a stand off barrier.

The exhibits are separated from each other through a 5m high dead wall with rough stones on the top for aesthetic touch.

All the night shelters are approached and serviced from the same entry and can be operated by one keeper. All of them have sliding wooden doors to outside, as well as between the chambers for easy transfer and treatment.

This composite enclosure is found to be quite convenient to operate, though there should be more space than the present area. The night shelters should also have covered 'keepers galleries' and squeeze cage for treatment of animals without shifting them to the Zoo Veternary Hospital. The parapet wall as well as viewers' side can be still reduced in height by increasing the depth of the moat for better visibility even if the animal is in the moat. An irregular shape of the exhibit area can be more aesthetic than regular geometric shape. If the space is increased, hillocks can also be created with caves, etc. for better simulation of the animals' usual habitat.


PLAN AND ELEVATION OF BEAR ENCLOSURES
SCALE 1/5 CM TO A METER (1:300)
REFERENCE
F.C. FEEDING CUBICLE
S.D. SLIDING DOOR
D1 DOOR (1.5M x 1.5M)
D2 DOOR (0.8M x 1.5M)
W1 WINDOW (2M x 1.2M)
W2 WINDOW (1M x 1.2M)
KEEPER'S ENTRY
STOCK YARD
ISLAND-1
ISLAND-2
ISLAND-3
TREE TRUNK
CAVE
STEPS
SLOPED WALLING OF MOAT
MOAT BOTTOM RCC
PARAPET
2M HT SKIRTING HEDGE ON ISLAND OF BARRIER
CIRCULAR PATH
BOULDER PITCHED COPING OF ISLAND WALL
SECTIONAL ELEVATION ON A-A
PLAN
PREPARED & SUBMITTED
P.K.MOHANTY
RANGE OFFICER, STORES
NANDAN KANAN

DIET MANAGEMENT FOR ZOO ANIMALS

N.V Giridharan

Introduction

The zoo harbours a wide array of species with differing food and feeding habits. While nature offers a great variety of flora and fauna to its creatures for sustenance, in captivity, they are entirely at the mercy of its keepers. Though, the zoo scenario has now changed with the provision of semi-natural environment, it is still not the same as being in its own 'native' environment. Also, it is wellhigh impossible to feed the same kind of natural feeds to the animals as they are used to in the wild. Yet, if one has a preliminary knowledge of the feeding preference of the animal(s) concerned and combine it with a basic knowledge of nutrition, proper diets can still be provided to these wild animals.

Nutrients and nutritional deficiencies

Nutrients can be defined as essentials that are required for growth and maintenance of one or more species of animals. Not all animals require all nutrients in their diet; thus the requirements of tigers and lions are not the same as that of elephants and rhinos.

The principal nutrients are the carbohydrates, lipids, proteins, vitamins, minerals and water and they fulfill three principal roles in the body, viz., structural components, sources of energy and regulators of metabolism. Proteins make up the structure of muscle, bone, skin, hair etc. and it together with the lipid form the cell membranes. The greatest utilization of nutrients by animals is for energy; lipid supplies to maximum - 9.3 Kcal/gm followed by carbohydrates - 4.1 Kcal/gm and proteins - 4.5 Kcal/gm. Animals require energy for work, maintenance of body temperature and biological states and for the synthesis of new tissues and maintenance of existing tissues. Minerals and vitamins in general, function as regulators of metabolism and constituents and activators of enzymes. The

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deficiency of a particular nutrient(s) result(s) in deficiency symptoms that reflect the aspect of metabolism that is impaired. For example, the B-vitamin, thiamine functions in the co-enzymatic conversions of pyruvic acid to acetyl co-enzyme A (acetyl CoA) in cellular metabolism. Thus thiamine deficiency, results in accumulation of pyruvic acid in blood causing symptoms of poly-neuritis due to the effect of pyruvic acid on nerve tissue.

Some of the nutritional deficiencies seen commonly in (studied in laboratory animals like rodents, cats, dogs, fowls, etc.) is outilined in Table 1. Though nutritional deficiencies due to major nutrients like carbohydrates, proteins and fats are not reported in zoo animals, there are number of cases where in vitamins and minerals were involved. Thus among vitamins, A and D deficiencies were reported in turtles and tortoises, wild felids (vitamin A), young giraffe and monkeys (vitamin D) and thiamine deficiency in minks, ferrets and polecats. Among minerals, calcium deficiencies were often seen in giraffe and zebra, and sodium deficiency in camels. These are often attributed to faulty selection of feeds and wrong feeding strategies.

Feeding behaviour and special requirements

A feeding system in a zoo should aim primarily at fulfilling the animal's physiological status, which vary during pregnancy and lactation, growth and maintenance and also in sickness. The problem of feeding a wide variety of captive species is to recognize, how they deviate from the common patterns that are familiar to us. This entails a knowledge of their feeding behaviour in wild and a thorough knowledge of their digestive tract physiology.

Based on feeding behaviour, the animals can be broadly classified into herbivores, carnivores and omnivores. While herbivores subsist only on plant materials, carnivores prefer a meat based diet. Omnivores are cosmopolitan in their eating habits and consume a wide variety of plant and animal foods.

Herbivores : They constitute a wide spectrum of animals that have evolved digestive tracts with anatomical adaptations containing a symbiotic microbial population of bacteria, protozoa and the like. These microbes often perform digestive functions that the host is incapable of, such as digestion of cellulose.

As a result, herbivores can survive on feed stuffs that many have low nutritional value to others.

Among herbivores, the ruminants with four chambered stomachs (goat, sheep, cattle, deer, giraffe and camel) are most efficient in the use of roughages and forages. The first compartment of the stomach, the rumen, functions as a large 'fermentation vat' and added to that they have the habit of remastication of feed, which is unique to them. Aided by microbial fermentation, they derive much of their energy from cellulose and meet much of their aminoacids and proteins from digesting the microbial protein. The microbes also provide them with B-complex and the K vitamins. Similarly, there are monogastric non-ruminants, who also use microbial fermentation to maximal use. These are the pregastric fermenters like hamster, vole, kangaroo, pig, hippopotamus and the hindgut fermenters like rabbits, guinea pigs, capybara (caecal fermentation) and horse and zebra (colon fermentation). Animals like rabbits and hares produce soft fecal pellets in the early morning hours (different from the hard fecal pellets produced later on the day) called cecotrophs, which are directly ingested from the anus. Cecotrophs have high protein, fiber and water contents, and they are also rich in B-complex vitamins. So, these animals are termed as pseudo ruminants. The nutrient requirement of all these herbivores are more or less similar with high percentage of fibers, low requirement of fats and proteins and no requirement of B and K - vitamins. At the other extreme, we have the bulk eaters like elephants and rhinos, whose digestive efficiency is poor. They meet their nutritional requirements by high levels of feed intake and fast rate of food transit without digesting fiber. Same strategy is adopted by the giant panda, an animal belonging to order carnivora, but subsisting mainly on bamboo shoots.

Carnivores : Carnivores are important group of zoo animals starting from reptiles (lizards, snakes, turtles) to higher mammals like lions, tigers, leopards, hyenas, etc. They are fastidious compared to herbivores and need a highly digestible, high quality food source with nearly all nutrients. They may have also some unique dietary requirements that can be met only by the consumption of meat. Cats, for example have a dietary requirement for the aminoacid taurine, for performed vitamin A (they cannot convert B-carotene in plants to vitamin A)

and for essential fatty acid-arachadonic acid. Taste also becomes important to them, and canids usually have a 'sweet tooth'.

Omnivores : They comprise a large group consisting of apes, monkeys, bears, pigs, most of the rodents, the flying fox, the sloth, many of the birds, etc. Their digestive tracts are intermediate in complexity between those of carnivores and herbivores. More than 50% of their diet comes from carbohydrates, with moderate amount of protein and fat coming from meat.

Special requirements : The unique case of giant panda has already been mentioned earlier. There are a number of other interesting cases, worth mentioning. Koalas, the Australian arboreal marsupial have a special requirement of eucalyptus tree leaves; so also the giraffe which loves to have the leaves of *Acacia* plant and it along with camel can go without water for long hours. Camels, incidentally, among the zoo animals have the highest requirement of salt, i.e. 122g/day. Porcupine, a herbivorus animal, enjoys bone gnawing, which keeps its teeth in shape as well as supply it with calcium and phosphorus. It was observed, that compared to Asian elephants, the African elephants are more likely to suffer from nutritional deficiencies, including declined fertility when there is a total shift from tree leaves to meadow grass (as it occurs in captivity).

There is an exclusive club of animals (which includes man as well) redvented bulbul, frugivorus bats, guineapigs and monkeys-that require specific supplementation of vitamin C in their diet, as they lack the enzyme L-gluconolactone oxidase, required for denovo synthesis of vitamin C. There is yet another exclusive-owl and squirrel monkeys and fowl-family which thrive only on D_3 form of vitamin D and not the normal D_2 form that are utilized by others. Then there are the 'leaf eaters' (colobus, langur and proboscis monkeys) with their incredible complex stomachs, that have habitats ranging from Africa to East Asia. They cannot tolerate to ordinary monkey chow and have special requirements for leaves and flower petals. They have a 'rumination process' akin to ruminants, and are totally dependant on an importation (from parents) of a specific bacillary stomach content, to ensure this fermentation process.

Feed stuffs and feeding strategies

Once we have understood the basic nutritional requirements of the animals under our care, we have to look for feed stuffs that provide these requirements in balanced proportions.

Properties and classifications of feed stuffs

Feed stuffs are dietary ingredients that provide nutrients or contribute other desirable properties such as bulk or palatability factors. These can be classified into several groups according to their major contributions: roughages, concentrates, mineral and vitamin supplements and non-nutritive feed additives.

Roughages : These are bulky feeds high in fibre and low in digestible energy. These include hay, straw, fodder, hulls, shells, maize, legume and grass silages, tree and shrub leaves, woods, etc.

Concentrates : These are low in fibre with a high energy or protein content. They compose mainly the cereal grains and protein supplements. Concentrates which supply energy consists of cereal grains and other non-cereal seeds such as amaranthus green and buck wheat, grain milling by-products (wheat and rice bran), beet pulp, citrus pulp, molasses, fats and oils, etc. Samples of concentrates which supply protein (over 20% crude protein) are soyabean meals cotton seed meal, canola and sunflower meal, fish meal and dried milk products like casein, skim milk powder, etc.

Mineral supplements : Thse can come from various vegetable and animal sources or can be supplied as mixtures which include lime stone, dicalcium sulphate, salt and trace mineral mixture.

Vitamin supplements : These are sources of specific fat and water soluble vitamins which can come from various vegetables and animal sources or can be supplied as a special mixture mixed with the main diet.

Non-nutritive food additives : A variety of additives are often added for purposes other than primary nutrients. These are anti-biotics, bacterial preparations (probiotics). colours and flavours, emulsifying agents, enzymes, hormones and food pellet binders.

Feeding strategies

Specific nutritional data for most of the wild species are limited and mostly non-existent. Yet, a common sense approach, taking into consideration all the factors described above can help us to formulate standard diet for zoo animals. Feeding strategies based on such basics are given in Table 2 and Table 3.

Such diets can be formulated using the feed stuffs described above. The nutritive values of most of the food ingredients have been worked out (refer Nutritive Value of Indian Foods-published by National Institute of Nutrition, Hyderabad) and this can be used as a guide for preparing diet charts. Nutrient requirements of domestic and laboratory animals are known and the requirement of representative species, related to its wild species can also be used as yardstick. Thus, the diets formulated for cattle and sheep are good for ruminants, cats for wild felids, dogs for wild canids, chicken for birds, rhesus monkeys for their wild counterpart, so on and so forth.

A synthetic diet based on local ingredients used in our institute for feeding rodents, rabbits, and primates along with mineral and vitamin supplements are given in Table 2, 3, 4, 5 and 6. This is amicable to pelleting and can be sterilized and used for a wide variety of zoo animals especially mammals. This can be supplemented with fruits and vegetables, if necessary depending on the species. Already such synthetic diets are in vogue, in the west. For example, zupreem, a meal mash with additives is very popular for carnivores in the zoos of USA and Europe.

While selecting feed ingredients certain precautions have to be taken to prevent deterioration in quality expecially while in storage. These are the following :

1. Use fresh forages and silages, as long term storage and exposure to sun destroys vitamn A and E (Both the vitamins are heat liable).
2. Fishes are important food item for minks, otters, polecats, ferrets, badgers, skunks, pelicans, penguins, dolphins, etc. Avoid feeding fishes like carps and herring which contains the enzyme, thiamenase as this may destroy the thiamine in the diet. As an alternative cooked fishes or fishes like butter fish and mackerel which are thiamine free, can be used.

3. Cereals and yeast are deficient in sulfur containing aminoacids like methionine and cystine. So a cereal based diet should be supplemented with pulses, to balance the diet.
4. Avoid use of rancid oils and fats, as it leads to gastric disturbances in animals.
5. Milk powder or casein, though excellent sources of protein are very expensive and their quality often gets deteriorated during long time storage.
6. Soyabean meal before being used, should be heated to deactivate the enzyme, trypsinase (Trypsinase acts on the proteolytic enzyme - trypsin of the animal).
7. While using fish meal, care should be taken to see that the meal is not from oily fishes like herring which can lead to oxidation of vitamin A and E in the diet. Use of white fish or addition of anti-oxidants to the diet can over come this problem.
8. Salmonella (an infectious bacteria) contamination is a major problem in fish, meat and bone meal. So, periodic check up for such microbial contamination should be done before using these diets.

Problems of feeding pure synthetic diets

Though the use of ready-made synthetic diets, are a boon to zoo keepers world wide, certain management problems do exist in certain cases. It was observed that higher mammals adapt better to synthetic diets, than reptiles and birds. But even in the former it is not a success story with every species. In nature, foraging for food is an important activity; it is both a pleasurable and rewarding experience. But in captivity, when the food is given in a readymade form that does not require much tearing and chewing, monotony creeps in, and some animals even resent such diets. For example, pelleted syntehtic diets were found to be a total failure with elephants. In a case reported from USA, cheetahs were found to have palatine perforations leading to nasal infection. This was traced to the commercial meat mash diet provided to them that did not require proper usage of its denture for tearing and chewing. Substitution of meat mash

with ox-tails and other whole meat products completely eliminated the problem. Many of the monkey chow used in zoos in the west were found to be responsible for the increased incidence of type II diabetes and obesity in zoo macaques. Many of the chows were lacking in fibre and the carbohydrates were in excess. Some of these diets were also found to have excess iron, resulting in iron storage diseases in Madagaskar lemurs. In the wild, these lemurs could have been protected against excessive iron consumption, because of their special affinity for tamarind and other fruit/tree bark which contain tanins (tanins bind to iron).

Conclusions

In the absence of a true knowledge on the individual nutritional requirement of most of the wild animals, diet management in zoos is really a challenging task. But if one understands the natural habitat of the animal concerned and keep a close observation on the animal(s) under their care, many hurdles can be overcome. Some practical suggestions on the diet managment of zoo animals are outlined below :

1. It was observed that mammals are more adaptable to synthetic pelleted diets compared to birds and reptiles. So natural feeds should be continued for the latter with liberal supplementation of vitamins and minerals. Even for mammals, total dependence on synthetic diets has to be discouraged. Wherever it is possible such diets should be balanced by natural dietary items which the animal is habituated in wild.

2. The preparation of synthetic diets is a costly affair, but the cost can be reduced by the efficent use of locally available food ingredients.

3. However, one may provide proteins through the use of fish meal, soyabean meal and milk and milk products, they are still not a proper substitute, for what the animals encounter in the wild. In many zoos in the west, meal worm and earthworm cultures are established and this is an ideal cheap protein close to nature. Going a step futher one can have small animal farms breeding frogs, mice, rats, rabbits, etc., which provide a consistent good source of protein round the year.

4. Rapid industrialization and urban expansion have contaminated many habitat(s), and as a result the water tables are polluted by industrial wastes and heavy metals. The safe upper limit of the metal toxicants is given in Table 7. It is advisable to have periodical check up of water used by the animals, for microbial as well as industrial pollution with the help of private or government agencies.

The present day zoos are no longer mere place of entertainment; it is a serious commitment in the direction of conservation and preservation of wild fauna and flora. It is true, that the zoo animals are held in captivity against their wishes, and they have no choic but to eat whatever is provided. And for that reason alone, we should have a genuine concern for them and to feed them proper and feed them well.

Suggested Reading

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Table - 1 : NUTRIENT DEFICIENCIES IN ANIMALS

NUTRIENTS	DEFICIENCIES
Carbohydrates (Available)	Growth retardation, Ketoacidosis
Fibre (Non available carbohydrates)	Diverticulosis
Protein	Severe growth retardation
Fat	Dermatitis
Vitamin A	Oligospermia and Low fertility
D	Cage paralysis
E	Low fertility and Muscular dystrophy
C	Scurvy
K	Coagulation disorders
Thiamine	Polyneuritis, Beriberi and Anorexia
Riboflavin	Vascularisation of cornea
Nicotinamide	Canine black tongue and Diarrhoea
Folic Acid	Megaloblastic anaemia
B_{12}	Degeneration of spinalcord
Biotin	Spectacled eye
Choline chloride	Fatty liver
Sodium, Potassium, Chloride	Dehydration
Caicium, Phosphorus	Decreased bone density, Osteoporosis and Cage paralysis
Iron	Anaemia
Zinc	Hypogonadism and Delayed wound healing

Table - 2 : FEEDING STRATEGIES

NUTRIENTS	CARNIVORE	OMNIVORE
Carbohydrates	Minimal or nil Cannot tolerate fibre > 2%	> 50% of diet With 4-5% fibre
Protein	High (20-30 %)	12-18 %
Fat	High (20-30 %)	4 - 5 %
Energy	From Fat & Protein	Carbohydrate + Fat
Vitamins	High requirment of all vitamins	Moderate
Minerals	High requirement especially macro	Moderate

Table - 3 :FEEDING STRATEGIES (HERBIVORES)

NUTRIENTS	RUMINANTS	FERMENTERS	NON RUMINANTS AND FERMENTERS
Carbohydrates	High % of roughage, poor utilization of starch & sugars	8-10 % Roughage + 30-40% starch & sugars	Mainly starch & sugars + 2 - 3 % fibre
Protein	Not required	8 - 10 %	10 - 12 %
Fat	Not required	> 2 %	> 2 - 3 %
Energy	< 2% Carbohydrate	Carbohydrate	Carbohydrate + Fat
Vitamins	No B-Complex & K Only A, D_3 & E	No B-Complex & K Only A, D_3 & E	All requirements
Minerals	Low	Low	Low

Table-4: COMPOSITION OF ANIMAL FEED USED IN NCLAS* ANIMAL FACILITY

DIET COMPOSITION FOR RODENTS
(RATS, MICE AND HAMSTERS)

	ITEMS	PERCENTAGE
1.	Wheat flour	22 %
2.	Roasted Bengal gram flour	60%
3.	Skim Milk Powder	5%
4.	Casein	4%
5.	Refined Groundnut oil	4 %
6.	Salt Mixture with starch	4.6%
7.	Vitamin & Choline mixture with starch	0.4%

DIET COMPOSITION (MONKEYS, RABBITS & GUINEA PIGS)

1.	Wheat flour	61%
2.	Roasted Bengal gram flour	28%
3.	Casein	1%
4.	Refined Groundnut oil	5%
5.	Salt Mixture with starch	4.8%
6.	Vitamin & Choline mixture with starch	0.2%
7.	Vitamin C 50 mg/100 g diet	

EXTRA DIET FOR MONKEY - RABBIT - GUINEA PIG

1.	Bengalgram	20g	20g	25g
2.	Groundnuts	15g	-	-
3.	Plantain-alternate day	1	-	-
4.	Lucerne grass	-	100g	50g

* National Centre for Laboratory Animal Sciences.

Table - 5 : COMPOSITION OF MINERAL MIXTURE MIXTURE (g/100 g OF SALT MIXTURE)

1.	Calcium carbonate $CaCO_3$	38.1400
2.	Cobalt chloride $CoC_{12}.6H_2O$	0.0023
3.	Cupric sulfate $CuSO_4.5H_2O$	0.0477
4.	Ferrous sulfate $FeSO_4.7H_2O$	2.7000
5.	Magnesium sulfate $MgSo_4.7H_2O$	5.7300
6.	Manganese sulfate $MnSO_4H_2O$	0.4010
7.	Potassium iodide KI	0.0790
8.	Potassium phosphate monoasic KH_2PO_4	38.9000
9.	Sodium chloride NaCI	13.9300
10.	Zinc sulfate $ZnSO_4.7H_2O$	0.0548

Dry and grind to a fine powder before weighing. Grind in a mortar a portion of NaCI with KI. Grind together the remainder NaCI with other salt. Finally, add the NaCI-KI mixture. Store in cool dry place.

Table - 6 : COMPOSITION OF VITAMIN MIXTURE

One gram of vitamin mixture contains the following :

1.	Vitamin A+	2000 IU
2.	Vitamin D+	200 IU
3.	Vitamin E	10 IU
4.	Vitamin K (Menadione)	0.5 mg
5.	Thiamine	0.5 mg
6.	Riboflavin	0.8 mg
7.	Pyriodoxine	0.5 mg
8.	Calcium pantothenate	4.0 mg
9.	Niacin	4.0 mg
10.	Inositol	10.0 mg
11.	Para aminobenzoic acid	10.0 mg
12.	Biotin	40.0 µg
13.	Folic acid	0.2 mg
14.	Vitamin B_{12}	3.0 µg
15.	Choline chloride++	200.0 mg

Mix all the above ingredients and add sufficient amount of starch to make up to 1 gram.

\+ Vitamin A and D are available as commercial preparation, vanitin. Add appropriate volume of this concentrate to the oil before mixing it with the diet.

++ Prepare a 50% (W/W) mixture of Choline chloride with starch and add at 0.2 % level at the time of preparation of the diet.

Table - 7 :SAFE UPPER LIMIT OF TOXIC SUBSTANCES IN DRINKING WATER

SUBSTANCE	SAFE UPPER LIMIT (mg/lt. PPM)
Arsenic	0.20
Cadmium	0.05
Chromium	1.00
Cobalt	1.00
Copper	0.50
Fluoride	2.00
Lead	0.10
Mercury	0.01
Nickel	1.00
Nitrate	100.00
Nitrite	10.00
Vanadium	0.10
Zinc	25.00

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MANAGEMENT OF GAURS (BOS GAURUS) AT NEHRU ZOOLOGICAL PARK, HYDERABAD

Mir Gowher Ali Khan, Dattatri Rao and Navin Kumar

The south Indian home range of the gigantic wild bovid - the gaur (*Bos gaurus*) is the thick forests of Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Maharastra states. In India there are more gaurs in the south than in the north.

It was from the month of September, 1967 that the Nehru Zoological Park, Hyderabad (NZP) started receiving gaur calves in the age group of 2-8 weeks old caught from the forests of Andhra Pradesh for hand rearing. Until now the Zoo has received 45 (22 males and 23 females) calves. It is a common sight in most of the forest areas, where gaur population is abundant, that these animals descend from the hilly areas in the morning for grazing in the open plains and mix with the village cattle. While returning to the hills in the evening, sometimes the young gaur calves lag behind and join the herd of domestic cattle and in the process get caught by the villagers and later handed over to the forest officials for eventual transfer to the NZP.

HAND REARING

On arrival at the NZP, the calves are kept under the charge of two dedicated and experienced keepers, supervised by the Zoo Veterinarian. They are fed with cow/buffalo milk in the dilution of 1 : 1 for a week and 1 to 1.5 litre of milk is fed to them both in the morning and afternoon. The quantity and the dilution of milk was either increased or decreased according to growth.

As the young calves do not readily adjust to the feeding bottle, the dish feeding practice is resorted to.

In this method the milk is placed in a big plastic or aluminium bowl. The keeper washes his hands thoroughly and places the right hand well dipped in the milk and offers his one or two fingers as teats to the calf. This method

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was very encouraging as we have observed the calves accepting it well and taking the milk to their satisfaction.

PRIMARY HEALTH CARE

As soon as a calf arrives, it is administered a dose of broad spectrum antibiotic orally daily for three days to protect it from pathogentic microbes, causing gastrointestinal disorders.

The faecal sample is examined to assess the worm load in the calf and positive cases are treated with Piperazine adidate/Mebendazole or other broad spectrum anthelmintics. The examination of faecal sample and deworming are carried out as a routine.

Constipation and diarrhoea are commonly observed in the captive calves and are sucessfully treated with mild purgatives/laxatives and broad spectrum antibiotics and astringents respectively.

DISEASES OF GAUR OBSERVED IN CAPTIVITY

Gaurs usually suffer more or less from the same major viral, bacterial, helminthic and other systemic diseases as their domestic cousins (*Bos indicus*). The NZP, where the gaurs are being reared in captivity since September, 1967, has encountered many important diseases. These are summarised below.

VIRAL DISEASES

Foot and Mouth Disease (FMD) : An outbreak of FMD amongst the gaur was recorded in the month of March, 1972. The affected gaurs were adults in the age group of 2.5 to 3 years. All the seven (3 males and 4 females) gaurs were affected, except an 8 month old male. Out of the seven, one male died and six recovered. The source of infection was attributed to an outbreak of FMD amongst the cattle in Hyderabad city. Type 'C' virus was isolated from the lesions at the Veterinary Biological and Research Institute, Hyderabad (VBRI)

Symptoms and lesions were similar to those encountered in the domestic animals i.e., high fever (107^{0}F) ropy salivation, nasal discharge and tenderness of the hooves. Ulcers were present in the oral mucosa and the tongue, lips, hard palate and in between the interdigital space. One adult male died, six animals

responded to the oral and parenteral therapy with broad spectrum antibiotics, a mouth wash, and application of 4% Sodium bicarbonate solution to the mouth and hoof lesions. One male calf (8 months old) remained un-affected which was earlier vaccinated with FMD vaccine (I.V.R.I.). The morbidity and the mortality observed was 87.4% and 14.2%.

Rinderpest : An outbreak of rinderpest broke out in the gaur population (3 males and 3 females) in the month of January, 1979. Two gaurs (one female aged 20 and the other female aged 8 months) died suddenly on 25/1/1979 and 29/1/1979 respectively without showing any typical sympoms of rinderpest. The remaining animals died between the period from 2.2.79 to 18.2.79. They manifested following clinical signs : high fever, dullness, off feed, dyspnoea with pronounced bronchial sound, blood shot eyes with lachrymation, photophobia, salivation and mucopurulent discharge from both the nostrils.

Out of six animals only three had diarrhoea with mucus and foetid smell. The animals died within three days after the onset of the symptoms. Broad spectrum antibiotics (intramuscularly) and other symptomatic treatments were found ineffective.

Postmortem lesions consisted of congestion and erosion on the buccal mucosa and gums. Congestion of heart, lymph nodes, trachea, lungs, liver, abomasum, intestines and urinary bladder was noticed. Zebra markings in the large intestine were seen in three cases only. Rinderpest infection in these animals was confirmed by gel diffusion test using spleen and lymph node slurry against reference rinderpest serum.

BACTERIAL DISEASES

Haemorrhagic Enteritis (HE) : Majority of gaurs (sub-adult and adult) suffered from this ailment. There was high fever (107—108°F), anorexca, dullness, increased respirations, conjuctiva highly injected with or without lachrymation, diarrhoea, admixed with blood and mucus, later on loose motion was observed, but "shooting diarrhoea" was not seen. In few cases opacity of cornea was noticed, along with swollen eyelids. Many brands of broad spectrum antibiotics and other life saving drugs proved ineffective and the sick animals succumbed within

a period of 1—8 days.

On necropsy severe haemorrhagic gastroenteritis along with bronchopneumonia, hepatitis, nephritis and cystitis were observed. Tissue samples were sent to VBRI for investigation but no organisms of etiological significance could be detected except isolation of *E.coli*.

It is of academic interest to mention here that a typical incidence wherein three adult female gaurs, aged 2.5—3 years were affected with HE within a period of seven days (28.8.72 to 3.9.72). The clinical signs observed were those already mentioned above, in addition to thick mucopurulent nasal discharge, salivation and ulcers on the lips, tongue and dental pads and swelling of the sub-maxillary lymph node. All three animals died within 3—7 days of illness, between 31.8.72 to 9.9.72 in spite of best possible treatment and care. Suspecting these cases to be rinderpest, one of the gaurs was administered anti-rinderpest serum. On necropsy all the gaurs exhibited haemorrhagic gastroenteritis, hepatitis, pneumonia and nephritis. Clean zebra markings were present in the rectal mucous membrane in one of the gaurs. Gel diffusion test conducted with positive hyper-immune serum against the samples at VBRI proved negative for rinderpest.

E. Coli infection : A research scheme was undertaken by VBRI to study the prevalance of *E.coil* serotype in the stool samples from some captive wild animals including gaur. The rectal swabs and the sample of fresh droppings of gaur were collected and cultured. Three strains of *E.coli* were isolated from gaur. The serotypes recorded were 01, B/S (1), U/T (1).

BLOOD PROTOZOAN DISEASES

Theileriasis : This disease was recorded in a female gaur calf aged about four months on blood smear examination. The clinical signs observed were high fever (105 F), off feed, champing of the jaws and diarrhoea. Later on opacity of cornea of both eyes was noted. The calf recovered with parenteral administation of Achromycin (Cyanamid), Strinacin (M&B) and Neblon astringent powder (Indian Herbs) orally. Application of Terramycin eye ointment (Pfizer) proved effective for corneal opacity.

HELMINTHIC DISEASES

At NZP faecal samples of all the animals and birds are examined microscopically to determine the extent of worm infestation once in a month and deworming programme is taken up regularly. The helminthic ova of various species detected in gaur population during such examinations are listed below :

Nematodes : *Toxascaris, Strongyles.*

Cestodes : *Moniezia expansa*

Trematode : Amphistomes

Ciliates : *Balantidium coli*

Of these *Moniezia expansa* infestation is worth mentioning. Three gaur calves (one male and two females) aged 4-8 months were found positive for the tape worm infestation. In two cases tape worm segments were detected in the dung and in one male calf ova were detected.

SYSTEMIC DISEASES

Hypothermia : A case of hypothermia was noticed in a male calf aged 6 months. This calf got fully drenched inside the open enclosure during a sudden downpour, in the night in June, 1975 which incidentally happened to be the first monsoon showers of the year.

Next morning, the calf was found dull with-half closed eyes and hiccups. The body temperature was sub-normal (93°F). Pulse was weak with slow heart beat. The animal responded to broad spectrum antibiotics, Belamyl (Sarabhai), Mifex (M&B), and Betnesol (Glaxo) injections given twice a day at 12 hourly interval for two days. The body temperature rose to 100°F by the afternoon with eventual recovery.

Hyperthermia : One gaur cow, 2.5 years old was found shaking her head frequently with anxious expression in one of the afternoons of May 1975 in her open enclosure. (April and May are the hottest summer months in Hyderabad). She was wobbling. Before she could be removed to the resting room, she fell down many a times on the ground and got up with great difficulty.

On close examination the respiration was rapid with pyrexia (107°F) and redden eyes and was frothing at the mouth. She was treated as follows :

- splashes of cold water on the head and body,
- ice cold water enemata,
- injection of Streptopenicillin intramuscularly and
- injection of Novalgin intramuscularly.

The condition became worse and the animal died during the night. On necropsy congestion of brain was observed.

Parotitis : An adult male gaur developed a swelling (5—7.5cm in diameter) at the left masseter region. The swelling was hot and painful. Potassium iodide was given internally with warm solution of Magnesium sulphate spray externally. It subsided with in a week's time.

Rickets : A male calf aged about 4—6 weeks was received at NZP for hand rearing, developed rickets at the age of 6—8 months. Initially both the knee joints were swollen, later as the condition progressed, the hind legs and the rump were also involved. Both the knee joints were found bent inwards and the hock joints were badly shaped. The back was arched. Administration of Calcium along with other essential minerals and vitamins proved in-effective. The calf died at the age of 4.5 years.

Arthritis : Swelling of both the knee joints were observed in two calves, aged 4—6 months. The animals were seen limping. There was little rise of body temperature. Appetite remained normal. The swellings were hot and painful. It responded to the intramuscular injection of Achromycin and application of Belladona and Glycerine to the knee joints.

Myositis : Neck of a female gaur (8—10 months old) was found twisted to the left side. Little swelling was observed at the base of the neck. It was treated successfully with Novalgin intramuscular injection and spray of Magnesium sulphate dissolved in warm water.

Renal Colic : A male gaur (2.5—3 years old) died of renal colic on

31.5.1974 after two days of illness. The clinical signs were frequent protrusion of the penis along with prepuce with straining, arched back and shivering of both the fore limbs. Rubbing of the head, horns, and neck with the wooden posts, thus exhibiting signs of distress and severe pain. Colicky pains were also observed and the animal was squatting and getting up at regular intervals.

On necropsy pyelonephritis was diagnosed in both the kidneys.

Tympanites Associated with Arthritis

A full grown male gaur which was rescued from a dry well was received at NZP. To hold this wild and strong animal, it was decided to house it in a strong enclosure having cement concrete wall at the back and strong iron railings on other three sides. Though it was kept away from the public gaze, it remained very aggressive and could not adjust to the captive condition. It was seen hurting itself by striking with full force at the iron railings, most of the time. In doing so it developed multiple injuries, especially at both the knee joints. This resulted in open wounds, becoming septic in course of time. Later on the animal became weak due to exhaustion and poor intake of food and remained recumbent till it died of tympanites.

CAPTIVE BREEDING

Few of the guar calves caught in the wild and hand reared at NZP have attained maturity and bred successfully in the park. Three wild caught females gave birth to 7 (3 males and 4 females). Three of the zoo born females in turn have given birth to 5 (4 males and 1 female) gaur calves. Three males (two wild caught and one zoo born) have sired all these females.

In females silent heat lasting for 24-36 hours was observed. There was no bellowing and mounting on other females as seen in domestic cows. The males were seen sniffing the external genitalia of the females in oestrus exhibiting ***flehmen*** reflex as observed in many species of animals both domestic and wild. The details of breeding of gaur are given in the Table-1.

A study of the table reveals that 12 calves (7 males and 5 females) were born during the period from April, 1977 to January, 1998. The births were

recorded in the months of January-2; April-4; May-1; September-1 and November-4. In one case mating was recorded during February. The gestation period recorded once was 270 days. The inter-parturition interval recorded twice was 1 year, 10 months and 3 days and 1 year, 3 months and 18 days.

Longevity : Out of 57 gaurs (45 wild caught and 12 zoo born), 33 (17 males and 16 females) specimens died within 3 years of age. Thus the percentage of mortality upto 3 years of age was 57.9%. The maximum longevity recorded for this species at NZP is 11.5 years for a wild caught male speciman (Bull No. 51).

TABLE - I DETAILS OF BREEDING OF GAUR AT NEHRU ZOOLOGICAL PARK, HYDERABAD

Sl. No	SIRE	DAM	DATE OF MATING	DATE OF PARTU-RITON	GESTA-TION PERIOD	SEX OF CALF	SURVIVAL		INTER - PARTURITION INTERVAL
							Died in 1Month	Survived	
1.	Bull No. 18	Wild Caught No. 12 (Parvathi Senior)	—	13.4.77	—	Female	—	—	—
2.	"	"	—	26.4.78	—	Male	—	—	—
3.	"	No. 13	—	14.4.77	—	Female	—	—	—
4.	"	"	—	8.5.78	—	Male	—	—	—
5.	Bull No. 47 Krishna (Zoo Born)	No. 42 Radha	14.2.85	12.11.85	270 days	Female	—	—	—
6.	"	"	—	16.9.87	—	Female	—	—	One Year, 10 months & 3 days
7.	"	"	—	4.1.89	—	Male	Died on 22.2.89	—	One year, 3 months & 18 days
1.	Bull No. 47 Krishna	Zoo Born No. 50 (Parvathi Junior)	—	10.4.89	—	Male	—	—	—
2.	"	No. 52 (Gangavathi)	—	23.11.89	—	Female	—	—	—
3.	Bull No. 47 Krishna	No. 52 (Gangavathi)	—	25.11.91	—	Male	—	—	—
4.	Bull No. 51 Govind	No. 55 Gowri	—	10.11.96	—	Male	—	—	—
5.	"	"	—	12.1.98	—	Male	—	—	—

IMPROVED ZOO ANIMAL HEALTH CARE-CRUCIAL FOR PROPER ZOO MANAGEMENT

B.M. Arora

The modern zoos have, at their core, two compelling missions; education and conservation biology. The first is transformation of entertainment experience and the second implies efforts to provide conducive environment for their propagation. These efforts benefit wildlife in the ways enabling them to produce and be repositor rescueing the void habitats. To achieve these goals the major constraints are in holding on to the concept of theoretical management approach with regard to conservation and upkeep of the zoo collections on scientific philosophy. Most of the problems being faced by our zoos in perspective management of species are husbandry and health management such as inbreeding curses (high infant mortality, stillbirth, dystocia, etc.); nutritional, behavioural or physiological stresses, contact with toxic substances, exposure to exotic disease agents, foci of endemic diseases, inadequate preventive medical programmes for control of certain infectious diseases such as tuberculosis (TB), rabies, Ranikhet disease, trypanosomiasis, fascioliasis, etc. These veterinary scientific measures are sure to play an important role at different levels, conserving and facilitating animals, to build their population. At the individual level, the animal must be kept healthy so that it can survive, reproduce and rear its young ones. Attention to the individual animal is critical in small captive populations. The zoo veterinarians using available information and skills protect the health of their charges or help restore the same in compromized individuals. The veterinary scientific practice needs two pronged approach to provide adequate zoo animal health care.

I. Husbandry Management : Husbandry refers to the measures and knowledge required to manipulate and regulate factors affecting the physiological and psychological welfare of the members of a population. It is the discipline of animal management science involving the manipulation and regulation of the biotic and physical environments for promoting a species survival. Husbandry

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management includes providing;

(i) Conducive environment containing suitable substrate/topography, hygiene and sanitation, in and around the enclosures/exhibits including disposal of the animal wastes.

(ii) Nutrition for maintenance, reproduction, sick, orphans, etc.

(iii) Breeding strategies.

(iv) Restraint and transporation aids and measures.

II. Veterinary Medical Management : It is vital component of animal care involving institutions of medical and surgical procedures in daily life for amelioration of impairments of wild fauna. It includes provision of;

(i) Regular health monitoring services for physical examinations, diagnosis of ailments and treatment.

(ii) Clinical and postmortem examinations.

(iii) Preventive medical practices.

(iv) Veterinary medical record system.

III. Skilled Manoeuvres : Since the modern concept for zoos is that of scientific institution mandated for biological conservation, they need deployment of well trained and knowledgeable scientific and technical staff.

I. Husbandry Management :

(i) Housing : Taking ethical care of environment of the animal exhibits is of utmost importance adressed to welfare issues of the animals. Maintenance of the hygiene in and around enclosures/exhibits should be given utmost priority. This reduces spread of diseases by aerosolization, insects and contact of infected excretions and secretions. While planning construction of exhibit, mainly space provision for the species prevails than enrichment requirements of the species. The drainage systems for disposal of animal wastes and house washings usually get crippled and alternate convenient approach of arranging the discharge of affluents directly into the water bodies such as moats, ponds, etc. often made, which in turn give rise to many problems. The following components help in

improving the situation.

a) Containment barriers : Not only they avoid contact of animals with public but also prevent psychological stress and spreads of zoonotic diseases.

b) Exhibit/enclosure layout : Adequate size and construction of enclosure must commensurate with physiological and biological needs such as sunlight, temperature humidity, shade, hiding, feeding, resting, drinking water, drains, sewers, etc. to keep substrate and frequenting areas neat and tidy.

With passage of time in major and medium zoos, the population of foundation stocks of the several native mammalian species particularly deer and antelopes increase excessively in number and space for their frequenting in enclosures becomes limited. The enclosures of these herbivores, therefore, become denuded of vegetation and substrate losing their natural topography with time. The lion-tailed macaque (*Macaca silenus*) ia arboreal by habit, managed in small space without feeding cells, it destroys the available vegetation and debarks the tree of its enclosure. Sloth bear (*Melursus ursinus*) destroys all kinds of vegetation including the trees in the enclosures. The exhibits unprotected for natural calamities and without feeding cells are visited by crows, vultures, rats etc. in search of food. Such circumstances jeopardise the survival of the species. The herbivore species at the time of parturition in the unprotected kraals/yards attract crows which may damage the eyes, rectum, navel region and hooves of the offsprings despite vigilance by dams. The imperative alternative, therefore, is to design the enclosures with enough area (possibly to manage 10% additional members) with facilities for hiding, resting, breeding, etc. Hence careful planning for designing the enclosures in view of kind of species and its biology to be housed has to be carried out. Swapping programmes are regularly devised for prolifically breeding species. Large sized flying birds such as peacock, flamingo, pelican, painted stork, adjutant stork, etc. require special enclosures. Keeping these birds in small cages bring them not only misery but also adversely affects reproduction and they have to survive without any breeding success. Breeding of gallinaceous birds such as grey jungle fowl, chir and monal pheasants and tragopans in the major zoos has suffered setbacks mainly due to lack of husbandry expertise.

The zoos, which have moat systems for creation of barriers between the animals and the visitors, too, may have certain shortcomings. Wide and deep moats having steep straight or slanting banks render them unable to climb when entered by animals, particularly neonates and old animals. Due to slippery banks of the moat, falling and getting fractures in limbs by animals is not uncommon. Deaths due to drowning of neonates of sika deer (*Cervus nippon*) and cape buffalo (*Syncer caffer*) have often been experienced in National Zoological Park. At Nandankanan Biological Park, Bhubaneswar 4.3% mortality was reckoned to be due to drowning. Such accidents occur because with time, landscape becomes such that animals cannot distinguish between the moat and strata of the enclosure. Animals may also fall into moats inadvertently during chasing and fighting particularly in the breeding season. In case of the deep moats, availability of sufficient water to maintain flow is an important problem in many zoos. In such circumstances the water in the moats starts stagnating and becomes the breeding site for algae, mosquitoes and other microbes and stinks. Hence, improperly designed enclosure moats may prove death traps especially for juveniles.

Fence barriers in place of moats, too, have proved harmful to some extent, when the area of the enclosure is small and there are always some kind of stress and threats surmounting case of timid animals such as blackbuck, chinkara, chowsingha, chital, etc. It is especially risky if the animals get disturbed in such enclosures; they rush here and there in an effort to escape and dash against the fence. The chain-link fence does not give conspicuous image of barrier to animals. The designing and fabrication of enclosures and houses of the inmates are undertaken keeping in view the species ethology.

The enclosures should be designed with capture and handling facilities for collection of animals for the sake of treatment, isolation, preventing infighting, addition of members for swapping programmes, disposal of the dead animal carcasses, etc.

(ii) **Nutrition** : Feed stuffs or items available in natural habitat or simulating to the natural habitat are provided in the environment of the modern zoos and safaries. When captured or newly acquisitioned animals from other captive facilities are introduced they may not adapt to the suddenly changed

diet. The feed may not be suitable for the digestive system and the animal may suffer from malnutrition and may even die from inanition/dehydration, if systematic efforts to acclimatise the animal to the new environment are not made. It is also well understood that the availability of food for animals in natural environment is subject to change in seasons and most of the herbivores may be susceptible to severe undernutrition during hard summer in extreme tropical conditions or frozen Himalayan winter. In captivity there is supply of often fixed diets more or less in tune with the availability of the commodities irrespective of other considerations. Such diets are never the complete diets and need supplementation for maintenance of the vitality of the animals. Certain guidelines are ascribed as follows.

a) Feeding timings should be strictly adhered to until and unless there is some emergency; otherwise the animals may pick up undersirable habits and vices.

b) Regular checking of the diets for quality, quanity and timely distribution must be ensured. Nutritional and related problems may be counteracted by change of diets. The dietary manipulations in overcoming such problems should be recorded.

c) Individual diets should be modified to match the changing physiological state of the animal i.e. for new born, young growing, pregnant, lactating, sick, recovering, etc. In hard summers (due to high ambient temperature) mammals have been found to eat less. They have to be supplied with sufficient water.

d) Non-availability of adequate balanced ration and conducive environment cause repression of growth, delayed sexual maturity, low conception rate, increased prenatal mortality, infertility and increased susceptibility to infectious diseases (even predisposes to its own carrier microbes such as *Pasteurella sp., E. coli, Staphylococus, Actinomyces*, influenza virus, *Paramphistome sp.*, hookworms, etc.). Adequate housing arrangement should be made to protect them from extreme weathers (hot and cold). In summer the carnivore species such as lions and tigers may eat substantially less (about 30-40% less).

e) Attention should be diverted to study abnormalities related to nutrition, metabolism, consumption of toxic substances, etc.

f) To avoid conflicts and fights among cage mates, feed should be provided either on a long stretched platform or at several points so that each animal/individual gets easy access to take its quota of ration. Trampling of weak, neonates and subadults intimidation by ones must be avoided. The deprived individuals exhibit progresive weakness and debilaty and recover if timely attention is given for such cases ensuring full diets. Agressive individuals should be isolated immediately, particularly in herbivores and monkey troops. Big cats, canids and ursids after weaning from mother, should be fed individually. Small cats and puppies should be fed thrice a day. Ectotherms require attention to ambinet temperature as food is digested incompletely. Reptiles such as python, king cobra, etc. are fed once a week. Most amphibians remain active and feed well at 20°C to 25°C. Snakes, turtles, crocodiles, lizards, etc. remain active and do well between 25°C to 35°C (77° to 95°F). However, diurnal lizards and crocodiles are given voluntary access to the higher temperatures between 32° to 37° (89°F 99°F). As the temperature goes down in winter the metabolism of aquatic animals, reptiles, etc. is very much depressed and feeding requirements of many species are curtailed. In such cases force feeding should be avoided.

g) Studying the digestive physiology of mammals, the types, quantity and quality of food should be determined and provision to the captive animals be made accordingly. Compared with grazers, the species feeding mainly on plant material other than grass are endowed with smaller physiological capacity of the rumen and reticulum, higher counts of ciliate protozoa and large bacteria, higher levels of rumen ammonia, propionate and valerate which facilitate them to meet their energy requirements from comparatively less amounts of feed. Feeding habits depend to a large extent on the degree of preference for certain plants and their availability. Even during dry season when the choice of food is limited, different animal species retain a particular feeding habit. The protein content of diet is lower in grazers. The number of protozoa and large bacteria differ according to animal species and diet. The large bacteria belong to rumen micro-organisms with complex nutrient requirements and their abundance depends

on the availablity of soluble carbohydrate and amino acids. High ammonia nitrogen level would be indicative of high protein availability and resultant high amino-acid content of the diet. The pattern of volatile fatty acids with high levels of feed intake and low levels of propionate suggested that a relatively high proportion of energy consumed was lost as methane (CH_4). As long as there are no nutritional deficiencies this metabolic coupling will, with only lesser deviations, be maintained with a constant turnover of micro-organisms and *metabolites* irrespective of animal species or diet. In general, smaller ruminants (deer, antelopes) have greater turnover than large ones (barasingha, sambar, wild buffalo).

iii) Breeding perspective : In the zoos, central role of reproductive process in well being or even survival of rare and endangered species is considered serious and needs to be evaluated and handled by the competent experts. Non breeding of the certain breedable pairs of rare and endangeered species despite their living together is not infrequent in the zoos. On the other hand excessive and extravagant breeding in the small populations has lead to genetic depression, loss of genetic variability, expression of undersired traits and increased susceptibility to diseases. Of the several adverse effects encountered, high infant mortality and stillbirths marked in white tiger (*Panthera tigris*), dystocia, abortions, stillbirths in Manipur deer (*Cervus eldi eldi*) are the major inbreeding curses. The success of desired breeding programme depends upon the amount of need for medical care to the species involved. Undesirable characters of a species shall be eliminated by planned breeding (pairing of selected sexes) of the species having healthy genetic diversity. Social and behavioural considerations must also be taken into account when neonates are concerned. Extreme care is needed not to disrupt the maternal bonding process or not to subject the mother/infant to unnecessary stress. It has often been seen that inquisitive social wildlife managers perform certain undesirable acts for their own curiosity and publicity such as lifting the cubs of the tigress soon after their birth and rearing them on the pretext that mother abandoned them and then they undertook the venture of raising them for the sake of safety and survival of the infants. Higher casuality is likely to be experienced in such instances.

iv) Restraint and Transportation : The zoo management in its routine practice frequently necessitates handling and restraining of wild animals for various purposes such as;

(a) Conservation : Programme needs transfer of animals within zoo or to other zoos as the breeding necessity to introduce fresh blood or to reduce congestion or to provide mates to the breeding individuals. Transfer for rehabilitation into wild is yet a dream action programmed for 21st century. Sedation of zoo animals is carried out for semen collection, artificial insemination and castration.

(b) Medical Procedures : The animal is completely immobilized for clinical or radiological diagnosis, TB testing, collection of blood samples, tissues, ectoparasites, dressing of wounds, management of fractures, dislocations, dystocia, trimming of hooves, cutting and removal of deformed horns/antlers, etc.

(c) Research Studies : To study morphometry, physiological values, genetic traits, blood chemical values, milk, characteristic of vaginal mucus, etc. restraint is necessary.

Success of the restraint operations depends upon the skill of the veterinarians who can meticulously estimate the dosages of restraint drugs, aim the target without inciting/provocation/excitement of the object and induce and achieve uneventful recovery to the animal. Losses in such operations are due to dashing of targeted animal against hard objects, head on collision or falling into the water moats. When down with effect, goring by the companion animals can not be ruled out. The physical condition of the animal to be restrained and environmental condition at the time of operation are all to be evaluated.

Zoos are obviously dependent upon having live animals for exhibition and for this purpose, physical animal exchange programme between zoos is still a regular phenomenon. It helps to improve the health of the stock and their breeding potential. Exchange is an active process and must continue if the zoo has to develop with its healthy denizens. The acquisition procedure of animals should not be bureaucratic administrative decision. It needs technical input right from the collection, quarantining, health certification, shipment for delivery,

screening for the health implications at the destination/embarkment, transportation and safe release. There are instances of pitfalls and ambiguity in working methodology leading to serious accidents and losses of many species. Accidents have taken place because of shortcomings in planning of the programmes. In 1986 sixteen (16) deer and antelopes despatched as a gift of Prime-minister of India to President of Zambia, the National Zoological Park, New Delhi lost all the animals en route from Delhi to Bombay (Mumbai). A cheetah (*Acinonyx jubatus*) died in 1995 en route from Delhi to Hyderabad Zoo. In April, 1993 a wild ass and a leopard succumbed during transport in the same vehicle from Junagarh to Delhi. In 1984 five rhinoceroses (*Rhinoceros unicornis)* were captured from wild and stationed at Assam Zoo and then lifted and realeased into Dudwa National Park of Uttar Pradesh. Imperfect crating claimed miscarriage and death of one female and traumatic injuries in all the animals. There are numerous such instances of losses experienced by the various important zoos.

Mortality in the avifauna confiscated from the traders consequent upon their release into zoo cages is always high. We have not achieved yet expertise in successfully managing such rehabilitations.

Presently under the guidelines, developed by IATA some unskilful individuals make decisions for swapping and perform procedures that require the medical knowledge and skills of the veterinarians, such International Programmes generally meet with disaster. In any swapping programme, the animal safety must be ensured while crating, transportation, embarkation and release for rehabilitation. In case of stressed individuals, deaths on arrival at destination is occasional unfortunate and rare event.

II. Veterinary Medical Management :

(i) Clinical Practice : Monitoring of health in the collection provides critical information on current disease status and also identifies changes which can help measure the effectiveness of a conservation programme in the zoo. Normal physiological parameters of body systems in wild mammals, aves and reptiles are subtle. Discerning veterinarians should be able to diagnose the suffering of his inmates by the objective physiological signs such as diarrhoea

due to disease, change of the food and coughing due to pulmonary tuberculosis, parasitism or pneumoconiosis. Etiology of anorexia is subjective and needs laboratory support to determine the specific cause. A range of modern precision techniques are employed to monitor the haematological and biochemical changes for quick diagnosis. In case of infectious diseases, clinical microbiogical and serological investigations facilitate differential diagnosis.

(ii) Diagnosis and Treatment : It is purely a prerogative of the Veterinary Specialist. Each exhibit should be carefully observed everyday. This practice of continued monitoring of animal collections to assess their health and condition will facilitate collection of accurate comprehensive history on time, an essential element for diagnosis of abnormalities in them.

(iii) Euthanasia : Some foreign zoos occasionally practice euthanasia for disposal of certain animals and advocate euthanasia as "a necessary evil" We still are in state of confounding confusion for adoption of this method of relieving the crippled creatures from agony when suffering from incurable diseases/ affections.

(iv) Preventive Medical Care : The programme has many vital elements relevant to disease prevention, good husbandry and management procedures that decrease incidence of morbidity and mortality. Establishment of a comprehensive preventive medicine programme is fundamental to zoo management.

(a) Quarantine : None of the zoos have standard quarantine facilities. Whenever any animal is collected/received it is usually subjected to quarantine by keeping them in the dispensary wards meant for sick animals for treatment or convalescence. At times they are straight away taken to the enclosures/exhibits and maintained therein without undertaking screening for infectious diseases. Such animals already under the changed environment and stress are likely to contract the newer infections or fall sick due to its own carrier microbes gaining upper hand due to the predisposing factors. *Pasteurella* in herbivores and carnivores are known to cause pathogenic effects following transportation stress.

Health assessment of animals at destination prior to their release from quarantine to the main collection is extermely important; all animals must be

well scrutinized. Animals that are doing poorly i.e. those that are not feeding or manifesting loss of body weight should not be released into the main collection. All animals that die in quarantine should be necropsied. Necropsy is the key to determining causes of mortality. Dead animals should be refrigerated if the necropsy can not be performed immediately. Tissues from all major organs not just those tissues with gross lesions should be collected and fixed in neutral buffered 10% formalin. From lesioned tissues specimens for cultural examination should also be collected aseptically.

Therefore, protocols must be developed for each species intended for release so that the health of animals can be assessed properly, and where applicable, appropriate diagnostic tests should be performed prior to release. The release of the infected animals into smaller insular populations could be insidiously devastating.

(b) Necropsy investigations : It has been observed that Zoological Gardens are not adopting the right procedures and not getting rountinely involved in laboratory investigations either at antemortem or postmortem stage to establish the cause specific diagnoses. Collection, perservation and despatch of the specimens for the laboratory investigations are being done only under extraordinary compelling circumstances. Usually specimens received are autolysed/ dried/improperly preserved. Lack of specific pattern of morbidity and mortality losses data related to various specific diseases of taxon/species is a major constraint to developing any strategic preventive health care programmes.

(c) Parasitic Control : Regular screening of faecal samples of all the herbivores twice and for carnivores thrice annually should be undertaken. Standard floatation techniques will identify most parasitic infestations by identification of the shed ova. Direct examination of fresh faeces suspended in saline is necessary to detect and identfy protozoan parasites. Direct examination in case of primates and reptiles as well as any groups with recurrent episodes of diarrhoea, will be helpful in institution of appropriate anthelmintic therapy. Epidemiological studies to determine host-agent-vector-environment interaction and curtailing of life cycle of the endemic parasite is of utmost importance. The zoo veterinary medical units in their preventive programmes are often less attentive about ectoparasitic

infestation causing health implications such as incapacitation, unthriftines and causing haemoprotozoan and reckettsiae diseases.

(d) Sanitation : Procedures that provide for cleanliness of exhibits, food preparation and storage areas and animal holding areas are important for control of infectious agents including parasites, viruses and bacteria. Although routine sanitary procedures are the duty of keepers/staff under curatorial supervision, the veterinarian should oversee and review procedures to be sure that cleaning agents are appropriately used. Quaternary ammonium compounds, phenolics, chlorhexadine solutions and iodophores are all effective bactericidal agents and are virucidal for many common agents. In some cases specific compounds should be used. Phenolics in areas contaminated with tuberculosis or dilute (3%) sodium hypochlorite solution in outbreaks of resistant viruses are recommended. Feed and water containers and utensils should be cleaned daily. In exhibits with water components, water quality must also be monitored. Food wastes and excrements should be removed at least daily and disposed off in such a way as not to attract crows, vultures, insects, rodents etc.

(e) Pest control : Control of vertebrate and invertebrate pests is an important part of preventive medicine programme because of the significance of pests as vectors or reservoirs of disease. Arthropod vectors may transmit a variety of viral, bacterial and parasitic agents. Birds and mammals may shed infectious agents, serve as reservoirs of diseases that affect to any addition either by birth or acquisition, or provide an appropriate host for sustaining parasitic life cycles, thus increasing exposure to animals in the zoo collection. Vermins are also harmful because of the loss that occurs from damage to stored food. Veterinarians should also be aware of the types of pesticides being used for vermin control, as well as the signs of exposure to nontarget (i.e., collection) animal species. Veterinary staff should be consulted and approve any potentially harmful product to be used in or around the zoo.

(f) Environment hazards :

Air pollution : During our disease investigation studies we have encountered incidence of pneumoconiosis in captive mammalian species found

to be 11.1% (5/45) in artiodactylids, 84.2% (16/19) in carnivores and 77.2% (17/22) in non-human primates dying in the Zoological Parks. The epidemiological explanation for the occurrence of pneumoconiosis in wild animals in Zoological Parks/Gardens could be explicited as under.

Besides the inhalation of dust, dirt and various emissions raised by movements of people and vehicles, particles from drying polluted water moats, dumped heaps of garbage and sewer effluents in the zoos become added sources of pollution in the atmosphere already laden with fly ash and carbon particles emanated from various sources together with silica/sand/stone particulate matter from quarries, masonry works, etc, All these sources continue to be the cause of pneumoconiosis, more frequently in animals whose confinement in the same environment is almost lifelong.

Climatic effects : The season exerts a noticeable influence particularly on the reptile, amphibian and mammalian species when they are maintained in different climatic conditions than their natural environments. Some animals such as bats, hedgehogs, binturong, ground squirrel and bear cope with the cold weather by going into hibernation. During this period animal shelters in a burrow or den and goes to sleep. Whether zoos have such provision or not has to be seen. Cold blooded animals such as insects, amphibians and reptiles find it difficult to live in extremely cold climates as they need to draw their heat directly from the surrounding to survive. On the other hand warm blooded animals generate their own heat internally and are able to maintain a constant body temperature. They have better chance of surviving in cold climates. Therefore the zoo authorities should be judicious in selecting the species for their facilities. High mortality in reptiles and mammals related to seasonal hypothermia and hyperthermia effects are put on records of some zoos.

(g) Immunoprophylaxis : Prophylactic vaccination is practiced to prevent the population against endemic diseases. Literature from the advanced countries evidenced the use of various viral and bacterial vaccines in captive wild animals. Zoos in India are hardly practicing immunizations regularly in their valuable collections. This is perhaps due to lack of recommendations about veterinary standards. In fact mortality due to infectious diseases is a loss to the point of no

return particularly in case of endangered species or small population. There is no authentic evidence or record of immunodeficiencies.

The endemic livestock diseases against which effective vaccines available are, anthrax, haemorrhagic septicaemia (HS), rinderpest (RP), foot and mouth disease (FMD). In zoological collections at times immunoprophylaxis has been practiced. In the country FMD outbreaks in artiodactylid species are causing heavy tolls despite preventive measures being taken. There is no report of adoption of a constant surveillance and immunization programme against rinderpest (RP). from the zoological parks.

(v) Veterinary Medical Record System : Design and implementation of a standard veterinary medical record system is necessary. Records of birth, weaning, health, disease, death, etc. are the daily events in the large zoo collections. The present procedure of abstracting the information from the regular file records is not only time consuming but at times yields erroneous or incomplete information. Computer integrated record system information for species, breeding profiles, medical vita etc., is needed to rapidly and easily gain access to complete medical knowledge for the species being managed. Computer also facilitates more about the medicines being used. Causes and incidences of morbidity and mortality, patterns of treatment and formulations of medicaments can be an easy task, which is necessary particularly in the case of endangered species. The epidemiology and pathogenesis of diseases can not be studied in small disjointed populations. The present lack of a comprehensive, consolidated veterinary medical information network poses the great obstacle to plan and formulate effective health monitoring of threatened species. The complete data base should be on life history, clinical data, necropsy examinations and preventive procedures of the species and the available literature. The centralized disease base should be managed by a veterinarian and should be accessible to all the concerned veterinary and taxon advisory groups, researchers and conservation biologists. Design and implementation of medical improved records can be consolidated by internet system to establish a central data base.

III. Skilled Manoeuvres :

Zoo animal medicine is a practice with a humane face. Therefore, zoos have the humane obligations to provide care, treatment and preventive medical programmes for the inmates. To acomplish this fact it requires proper professional direction inclusive of use of clinical laboratory and animal husbandry services. The deployment of personnel should depend on the type and size of the institute, number of animals, physical facilities, financial support, etc. Professional and trained supporting personnel are necessary to implement programmes concerned with veterinary medical care and ethical husbandry manoeuvres. The awareness in this respect has recently been growing as a result of tremendously grievous losses already experienced.

The veterinary medical programmes should emphasize for maintaining the standards and used current technologies for management of small rare animal populations. The veterinary coverage should be available through out and without lapse of time in any zoo. Besides that of zoo collections, health of personnel looking after them has to be regularly checked up, since they may trade infections with each other.

IMPROVED HEALTH CARE-CRUCIAL FOR PROPER ZOO MANAGEMENT

Jacob V. Cheeran

In wild and free living state the animals are affected mainly by epizootics in endemic areas. But in zoos, large scale outbreak of diseases are rare but with certain exceptions. Fulmination of an outbreak is easy unless attended properly and can be contained if effective measures are taken up.

Since most of the animals come often from a limited lineage, they are likely to suffer from genetic disorders. Nutritional disorder is another type of illness which is commonly noticed, since food habits of animals in zoos are so wide and varied. Parasitic infestations, which is of a persistent nature is noticed in many zoos. Unlike in the wild, animals in zoos are looked after properly, treated in case of illness, free from predation, competition, etc.; hence many of them live longer than in the wild. This will cause the incidence of diseases of senility and kidney failure and development of neoplasms. Comparatively intelligent animals may develop behavioural problems arising out of boredom and hence environmental enrichment is a must.

Occurrence of heriditary diseases came to lime light in the 70s on publication of several articles and problems arising out of inbreeding were highlighted. This awareness has been caught up with zoo managers and has resulted in the preparations of stud books and calculation of inbreeding coefficient. Now we are aware of the need for introducing exotic blood to keep a minimum level of heterozygosity for a healthy population.

A well balanced formulae for nutrition is a tough problem facing the zoo veterinarians. The zoo may have king cobra which may require a live snake as its food or a vulture which is a carrion eater or another animal like anteater. Herbivores in their natural habitat will have their own preferred food, emergency food and starvation food depending upon the quality of habitat and also influenced by season and phenology. Nutrient content especially that of proteins, varies

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considerably not only between different types of fodder but also between seasons, stage of growth of the plants, etc..

Hence with facilities available, the chaffed fodder given to herbivores in the zoo will be considerably deficient in certain nutrients and various deficiency diseases are very likely. Hence additional supplementation with concentrates, vitamins and minerals are a must in most cases.

Persistent parasitic menace is often present in many zoos. A closed and confined area without much dispersal is conducive for the multiplication and spread of the parasites. Although Central Zoo Authority prescribes regular and periodical examination for the presence of parasitic fauna, some of the zoos are still burdened with heavy parastic infestations. Most of the risks will be from parasites which do not require an intermediate host, like ascarids, strongyles, etc. Carnivores are likely to get infected with tape worms through meat, if proper meat inspection is not conducted on a regular basis.

Herbivores can also get parasitic infection through cut fodders. Grass harvested from water logged area may cause fluke infestation. This is a point that has to be taken care of by the zoo managers. Introduction of wild caught or animals introduced from other zoos is good, from genetic point of view but if no proper care is taken these animals may also bring in diseases.

Animals in the wild do not ordinarily live upto 'ripe old age' and hence are not likely to get affected by the diseases of old age. Herbivores in the wild which are sick and old may suffer from predation while the carnivores which looses the capacity to hunt may starve to death. When resources are limited in the habitat it will lead to competition and fight. This may be among the species and between the species. The competition may not be for the food alone, but also for other requirements like mate, cover, shelter, etc., All these factors reduce the number of animals in the population which are sick and old. But in the zoo where there is little competition for biological requirements and sickness is attended to, the animals will often live longer and show illness of old age.

Carnivores may often suffer from skin and intestinal cancers. Interestingly in herbivores, these incidences are less. However, failure of vital organs mostly

to begin with kidney and followed by the failure of other vital organs can be anticipated.

Animals which are endowed with higher intelligence when kept in captivity will develop boredom and show vices. They are primates, carnivores and elephants. The study of environmental enrichment has gained importance in recent years. Furnishing enclosures which will keep them engaged and satisfy their curiosity is gaining importance.

The zoological garden of the present day which is considered as a place of *ex-situ* conservation should have a healthy population to achieve the objectives of the zoo like conservation, research, education and entertainment. Since the animals are not living in their natural environment several aspects as mentioned above are important to achieve the goal.

ZOO ANIMAL HEALTH : PREVENTION IS BETTER THAN CURE

L.N. Acharjyo

The zoos were originally conceived solely for recreational purposes. But with the alarming rate of decline of wild animals from their natural habitats through direct or indirect intervention of man, it was felt that zoos can play an effective role in their conservation movement. Apart from recreation, the other main objectives of a modern zoo are conservation through captive breeding and rehabilitation; wildlife education and interpretation, research and monitoring besides other scientific pursuits. However, to accomplish these objectives the maintenance of zoo inmates in optimum health condition is imperative and paramount. By health it means the state of complete physical, mental and social well being of an individual and not merely the absence of disease.

Maintenance of good animal health is one of the most difficult tasks in any zoo. Yet more onerous job is efficient and prompt diagnosis, restraint and treatment once an animal falls sick. The concept of zoo animal health management is rapidly changing. Therefore, the approach to this complex branch of science has to be multifaceted and need to be appreciated by all concerned. The handling of wild animals in captivity for treatment, post-operative management, shifting and transportation is not bereft of hazards for the animals which may include physical injuries, stress and strain. Inadequate knowledge about the biology of such a wide spectrum of wild animals exhibited in zoos may heighten their health/disease/mortality problems. Furthermore, individual therapeutic approach of sick animals may not always yield the desired results. It seems that at times the new emerging animal health problems in a zoo kept ahead of our ability to control or eliminate the existing diseases/mortality. Hence more emphasis may have to be given on general preventive health and biosecurity programmes to keep the zoo animals in an optimum state of health to justify an old axiom that "prevention is better than cure."

The scope of preventive programmes in a zoo is enormous and it covers the period from the time of entry of the animal into the zoo premises till its final

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disposition. The effective preventive health programme involves a comprehensive package of good management practices which involves housing, feeding, sanitation, routine management and disease control measures. Inadequate and improper implementation of the above practices adversely affects the health of the animals resulting in sickness or death. This paper attempts to blend together various thoughts and ideas on preventive health practised in Zoos to minimise the incidence of diseases/mortality.

HOUSING : While designing the enclosure, the physical activities (like jumping, climbing, burrowing, swimming, etc.), climatic and biological factors and social requirements of the animals under display has to be given priority. The enclosure should effectively confine the animals to prevent escape, to prevent interaction between visitors and animals especially dangerous ones and must ensure safe conduct and easy day to day management of animals therein. The enclosure must facilitate easy viewing of the animals for monitoring, shifting, crating or treatment.

Adequate living space as per the need of the species to be displayed for free movement and exercise with provision for protecting from extremes of weather is one of the basic needs. It is worth mentioning here that "Recognition of Zoo Rules-1992" has already included the minimum prescribed size of feeding/retiring cubicle/enclosures required for important mammalian species kept in Indian zoos. The enclosures should be well lighted and ventilated for the comfort and welfare of the animals. There is a tendency to divide and sub-divide the existing enclosure when the animal population increases depriving them of their due share of living space and creating problems of health and hygiene. The quality and type of living space of the animal is of greatest importance for its well being and may vary from species to species. For this purpose the zoo animals can be broadly divided into four main groups.

(a) Animal that lives above the ground (flying or climbing on trees, rocks etc.) e.g. birds, monkeys, bears etc..

(b) Animal that lives on the ground (walking, hopping, crawling, etc.) e.g. deer, antelopes, etc.

(c) Animal that lives in the ground which may be permanent or temporary (burrowing or digging) e.g. fox, Indian pangolin, burrowing snakes, etc.

(d) Animal that lives mostly in water or sometimes needing access to water (swimming, diving, etc.), e.g. dolphin, otter, crocodile, tiger, waterfowl, etc.

Attempts have to be made to reproduce a natural home for the animal as far as possible where it can feel to be living in a natural surrounding. The physical, physiological, biological and socio-psychological requirements of animals in captivity vary from species to species. The environmental needs have to be so enriched that the animals must enjoy their liberty and feel free to display their natural habits and instincts and perform their breeding rituals like dancing, chasing, play, exploration, display, etc. as in the wild. As a part of this endeavour some of the following provisions may be provided inside the enclosure to avoid undue stress resulting from human activities and for the benefit of the animals.

Retreating or Resting places like sleeping shelves, elevated platforms, perches; trees, rock caves, sand banks, etc.

Hiding places like dens, burrows, pools, holes, bushes, grasses, stones, etc.

Place to give birth and to rear the young like nest boxes, nesting materials, hollow trees, cubbing dens, crawls adjacent to display enclosure, etc.

Materials for skin, foot, antler, horn and claw care like rubbing trees, logs, stones, artificial termite hills, pools, wallowing pools, mud bath, dust bath, etc.

Materials for camouflage like trees, bark and vegetation of different nature, etc.

Articles for stimulating activity like play objects, vegetation, trees, swings, raised platforms, sand, soil, poles, etc. Play objects may be replaced from time to time.

Problems in designing and construction of enclosure may lead to unfavourable environment that may promote health hazards. Nails, staples broken wires, splintered glasses and paints, etc. used for construction of enclosures are a source

of danger to the animals. If the animals are confined by moats (day or water), the moat has to be designed to allow the animals into it or out of it as otherwise the animals specially the young ones may fall into the moat and are likely to sustain injuries or get drowned or face difficulty to get out. The impact of improper housing on disease conditions among zoo animals can be eliminated or minimised by providing suitable housing facilities. For example if the ground of hoofed animals like deer, antelopes, etc. are not hard enough there will be abnormal growth of hooves due to poor wearing. For soft footed animals like cats the ground should be soft, otherwise sore paws may develop. Similarly if trees or logs are not found inside the enclosures of big cats for sharpening their claws, the claws may over grow in a curved-in fashion and thus can injure the foot pad. Rubbing the body against tree trunks by some of the animals like rhinoceros, elephant, etc. has beneficial effect on the hair and skin simulating the effect of combing and brushing of domestic animals besides giving a sense of pleasure. Many species of animals tend to hide temporarily from visitors where as the solitary animals like to avoid each other. For appreciation of such behavioural needs and to overcome stress from fear/disturbances of visitors, the enclosure environment has to be suitably enriched and modified as discussed above.

The nocturnal animals are usually exhibited in nocturnal house only to avoid undue stress and strain. Reptiles are sensitive to extreme fluctuations in atmospheric temperature affecting their health and longevity as they are exothermic animals. Reptile enclosures should have special provision for protecting them from extreme heat and cold.

The animals also need privacy/undisturbed atmosphere and this can be achieved by not allowing the visitors to see the animals from all sides. The enclosure should have a good drainage system to flush out the excreta, other debris and rain water.

FEEDING : The wild animals have the freedom to gather and eat their choicest food items from innumerable flora, fauna, mineral and water sources available in

the wild. In contrast the same animals in captivity are dependant upon the food supplied to them.

As per the food habits, the animals have been classified as carnivorous, herbivorous, omnivorous, frugivorous and insectivorous, etc. As such the digestive system varies considerably in different species as per their food habits and nutritional requirement. If the food does not suit them, it is likely to cause digestive and nutritional disorders. As it may not always be feasible to provide the exact dietary requirements to zoo animals as in the wild state, suitable substitutes have to be found out. For this purpose a thorough understanding of nutritional requirement, physiological functions, sociological and behavioural attitude, food preference and acceptability/palatability, availability of different types of food ingredients in the locality and their nutritional value is necessary. The routine practice in zoos is to provide mixed diet of many ingredients fortified with vitamins and minerals to greatly minimise nutritional deficiencies.

The quality, quantity and type of food has a direct bearing on the health of the species. Therefore, the diet selection should be proximate to the natural diet of the involved species as in the wild. Nutritional requirements of a particular category of animal are similar. They need protein, carbohydrate, fat, minerals including trace elements and water but their intake varies according to species. Quantity of food required by an individual depends upon the age, size, sex and physiological status of the animal like pregnant and nursing mothers, young, growing and sick animals, etc. Ruminants like deer and non-ruminants like elephants with functional caecum are fed with large amount of roughages to keep the gastrointestinal tract efficient and healthy. Lack of roughage may lead to constipation and telescoping of the intestine. The cervids replacing antlers have high demand for minerals. Feeding of big cats with only carcass meat without liver, lungs, adrenals, bone, etc. may cause avitaminosis A and mineral deficiency.

The gallinaceous birds like peafowls and pheasants require a higher level of protein which is met by intake of lots of insects and other animal matter in nature. The birds of prey need both roughages and minerals and so the whole animal food is preferred by these birds.

It may be kept in mind that young and growing animals consume more quantity of food. They utilise the food more efficiently and have greater requirement of proteins, vitamins, minerals and energy producing food. They are more susceptible to nutritional deficiency diseases. It should be ensured that the new born animals receive colostrum (initial milk secretion) which is rich in proteins, vitamins and maternal antibodies. It is highly nutritious, easily digestible and prevents infant mortality. A bland and monotonous diet over long periods is not desirable for good health. Therefore, suitable variations should be made at times to break the monotony. The animals in captivity have to be fed on the optimum but not on the minimum scale.

Intake of inadequate and poor quality of food is bound to produce nutritional stress and culminate in deficiency diseases.

The feeding behaviour which has a profound influence on the health and sickness differs from species to species. The feeding practice in the zoos must meet the feeding behavioural needs of the species to avoid disease. There are **nocturnal feeders** and **diurnal feeders**. The former have to be fed late in the evening to avoid spoilage before they are consumed by the animals. There are **continuous feeders** like peafowls and **occasional feeders** like Indian python, king cobra, etc. The large cats are fed six days in a week with one day fasting. Fasting in herbivorous animals like deer and antelopes may cause harm to their digestion by producing intestinal twist and constriction. There are some animals **feeding for long periods** and others **feed for short periods**. The ruminants in nature spend much time in foraging. Providing most of the diet to such animals in the form of concentrates without foraging facilities may meet the nutritional requirement, but the time spent on feeding is reduced to a great extent and may upset digestion. It has been observed that depriving them of foraging time leads to abnormal behaviour like fence licking and stereotypic behaviour such as lip, neck and tongue movements.

There are **group feeders** like deer and **individual feeders** like large cats. For the former group there must be sufficient feeding space to enable the animals to have their share of food and to avoid infighting causing injuries. Carnivorous

animals show aggressive behaviour and intolerance towards other individuals during feeding time resulting in fighting and injuries. Therefore, they should be fed individually and simultaneously. The snakes have to be fed individually or simultaneously as otherwise two snakes seize the opposite ends of the same prey and as they approach one another, one engulfs the other.

Most of the animals in zoos are **euryphagous** (those that eat varied diet) and yet there are others which are **stenophagous** (those that take specialised diet). There may be also animals which are **monophagus** (eating one particular kind of food) like ants for Indian pangolin, live fish for gharial, snakes for king cobra, etc.

Feeding may be influenced by internal rhythms like skin casting in snakes, hibernation, rutting, etc.

Usually the wild animals specially the newly captured animals like to remain away from man due to psychological fear and starve in reaction to captivity. Once they start taking food in presence of man it is an indication that the animal is settled to captivity conditions. Isolation of individuals from social group is known to have produced fasting for several days. Food intake is greatly increased in an individual if it is in the company of members of the same species.

The manner of offering of food to zoo animals is very important as it affects the intake of food. For example the flamingoes are adopted to strain fine food articles out of water and they are unable to take dry food. Giraffes should not be fed on the ground and their feeding troughs should be placed sufficiently high so that it can reach easily. Feeders and water troughs should be arranged in such a way to avoid contamination with faeces and urine. Many wild animals and birds like rodents, parrots, etc have their teeth/beak adopted for a hard diet of definite abrasive effect. If the food is too soft, they may result in over growth of tooth/beak and may warrant surgical intervention.

Clean water from protected water supply system may be ensured for all zoo animals daily to maintain good health. Hygienic storage, distribution, timely and regular feeding of wholesome, fresh and nutritious food must be ensured to

ward off diseases. This can be ensured by daily inspection of all food items for quality and quantity before feeding.

The health and mortality of zoo animals is also influenced by accidental intake of foreign bodies such as nails, wire, glass, coins, keys, plastics and rubber which are found inside the offered diet or enclosure due to defective construction/ repair/preparation of diet or due to negligence of visitors or workers or due to vandalism by visitors. Similarly special precautions are to be taken from ingestion of toxic paints, poisonous insecticides and pesticides used for pest control programme in the zoo premises and organophosporus compounds used for eradication of ectoparasites.

SANITATION : It is well known that the general sanitation and hygiene of the animal enclosures as well as the surrounding areas are of utmost importance for preventing diseases. The infectious agents remain in highly dormant form in nature and highly concentrated form in zoos because of confinement. The excreta and food refuses of all animals should be systematically collected and dumped at appropriate places far away from animals. The left over food items of carnivorous animals which decompose early along with its excreta emit very foul odour demanding more attention for efficient and quick cleaning than that of other animals. The floor of the animal houses should be thoroughly cleaned and this can be achieved better if the floor is crack free. The drainage should be good enough to keep the animal house and the surrounding areas clean. The area in and around animal enclosures and visitors' utility places like picnic spots, drinking water points, kiosks/restaurants and toilets, etc. have to be regularly cleaned and disinfected. Selection of disinfecting agents should be on the basis of effectiveness and safety. Disinfectants containing phenolic compounds should not be used in feline enclosure as they are sensitive to such compounds.

The pools inside enclosures and moats (both dry and wet) should be cleaned and disinfected at regular intervals. The pools of large mammals are rapidly polluted due to faeces, urine, skin cells, hair, food remnants and other rubbish and so it needs special attention for cleaning and refilling with clean water. The

utensils and food and water troughs have to be thoroughly cleaned and disinfected preferably with hot water before serving food and water. The accumulation of garbage and decaying vegetation in the zoo premises can act as a reservoir and breeding ground for the disease causing microbes and vectors. Therefore, due importance should be paid for their regular disposal out of the zoo premises.

Periodical operations to eliminate the spread of mosquitoes, flies, snails, rodents, cats, crows, stray dogs, etc. have to be carried out as many of them serve as a good transmitter of diseases to zoo animals. Chemicals which are usually poisons used for control of these pests must be used in such a way that they do not reach the animals in any way. Periodical removal of old soil/sand and replacement with fresh soil/sand sometimes help in the control of infection. Lime treatment of the soil and burning of the ground is desired in places where infection has been detected. In case of any outbreak, the sanitary measures have to be intensified.

The post-mortem room has to be cleaned and disinfected after each post-mortem examination. The dead animals after the necropsy have to be buried deep with lime and salt in specified burial ground with provision to prevent the entry of grave diggers like dogs, foxes, jackals, etc. or the same can be burnt preferably with the help of an incinerator at the quickest possible time to prevent the spread of infection.

ROUTINE MANAGEMENT : Incidence of management linked health hazards can be substantially reduced with efficient and effective routine regimen. A day's routine work in a zoo beings with checking of all the animals and their enclosures to identify problems of management if any. Experience has shown that majority of deaths occur within a month of birth or arrival of animals in the zoo. Such contingencies require special attention and care during this period. Traumatic injuries resulting from capture operations, fighting during rutting season/ feeding time, fighting due to incompatibility among animals, inter- and intra species fighting, etc. is responsible for about 20 to 25 per cent of total deaths in captive wild ruminants. Improved methods of capture and management may be able to lessen the incidence.

The deleterious consequences of inbreeding like still-births, congenital anomalies, early mortality, abortions, etc. can be eliminated by planned breeding. Genetic management of captive population has a significant role in the zoo animal breeding which could sustain and help in their conservation for several generations. It is always advisable to introduce unrelated and fresh blood frequently amongst zoo inmates to avoid the spoils of inbreeding.

Any disturbance during pregnancy may result in abortion, pre-mature birth or still-birth. Disturbance to nursing mothers often result in rejection of the new born. Losses due to cannibalism specially among carnivores can be prevented by separating the pregnant mothers before parturition from the rest of other animals to a place without disturbance.

It is unethical to keep single animals from holistic point of view as it may lead to boredom, captivity stress, psychological problems and even infertility. Stress conditions play an important role in health and mortality during or soon after capture operations/shifting/transportation, excessive heat, excessive cold and during the settling down of newly received animals predisposing to diseases or sudden death. Species which react excessively to sound, sight and small of one another should not be kept in adjacent enclosures as otherwise it will add more stress, Various kinds of vandalism to animals by visitors such as disturbances during feeding/mating/resting time, feeding unsuitable articles, inflicting injuries, teasing, etc. also add to the misery of zoo animals. Feeding by visitors should not be allowed as it may lead to over feeding and digestive disorders.

Sudden introduction of new animals without prior acquaintance into an enclosure having resident animals usually results in severe fighting causing grevious injuries or death. Many deaths or injuries of small mammals and birds have been reported due to attack of predators like snake, civet cat, jungle cat, feral animals like stray dogs and cats and free living macaques/langurs/rats/squirrels/crows. They also deprive them their full quota of diet by eating away the food. These problems can be curtailed by timely and proper maintenance of enclosures with provision to prevent their entry inside animal enclosures.

Inspection of the enclosure from time to time is essential for any foreign materials such as plastic bags which are thrown inside the enclosure by general public or accidentally by bird or blown by wind. Such objects when consumed by animals result in clogging of intestine and may end fatally. Over crowding can be a chief source of management hazard and responsible for causing diseases. Therefore, suitable caution should be exercised to control the population of prolific breeders. These are only some of the many routine management problems the zoo is expected to overcome for keeping the animals healthy and lessening the mortality.

DISEASE CONTROL MEASURES : Disease is the manifestation of disturbances in the normal physiological process leading to structural and functional alterations in the cells of the living body of an individual and arise as an aftermath to the collision between pathological agents and a susceptible host. All diseases are influenced by several factors such as environment around the host (air, water, food, climate, space for movement and social surroundings), inherent resistance and senility. An understanding regarding the pathogenesis and also how exactly the extraneous factors interfere with health is essential in order to institute effective disease control measures.

However, the following preventive measures are usually adopted for zoo animals.

Quarantine : A new animal can be a potential source of pathogenic organisms or parasites to the healthy inhabitants of the zoo. Therefore, proper quarantining of the newly received animals is one of the most important measures to prevent the entry of infectious diseases or parasites into the premises of a zoo where the animals might have been free from these infections. The quarantine period depends upon the species involved and health status of the animal. The minimum period of quarantine practised is 30 days which may extend upto 3 to 6 months in case of primates. The quarantine area should be away from display area and zoo hospital.

Quarantine helps the animals to adjust to the new environment, builds up strength and offset the ill effects of crating and transportation. During quarantine

the animals should be carefully observed daily for animal's behaviour, appetite and symptoms of any disease problem. Physical examination for any nasal discharge, lacerations, ulcerations, injuries, ectoparasites, etc. can be carried out. Parasitic screening for 3 consecutive days is desired to detect any probable endoparasitic infestation. Other clinico-pathological examinations of blood, urine, skin scrappings, etc. can be done simultaneously to avoid frequent handling for detection of any disease in sub-clinical stage. Suitable therapeutic measures have to be given before allowing them to enter in the enclosure. Special attention has to be paid to hygiene and sanitation of the quarantine enclosure, equipments and utensils used for the animals as well as the keeper.

Isolation : If an animal is found suffering from any infectious disease, it has to be immediately isolated from the rest of the healthy animals and kept away in an isolation ward. This helps in preventing the spread of infection to other areas of the zoo. Here the sick animals can be given the required treatment.

Vaccination : Usually all the wild cats are given feline enteritis vaccine soon after their arrival and repeated yearly. The other vaccines which are in use against diseases among zoo animals are foot-and-mouth disease, rinderpest, haemorrhagic septicaemia, anthrax, canine distemper and Ranikhet disease. But these have not been in use as a regular basis because of some inherent difficulties such as capture of animals, non-availability of informations on reaction of vaccines in different species, etc.

Animal Health Monitoring : Health monitoring of zoo animals is a complex subject which requires keen day to day observation. The animal keepers have to be trained for detection of illness at the initial stage such as changes in over all appearance, behaviour, defecation, urination, appetite, water consumption, rumination, vomition, change in activity pattern and discharges from natural orifices, etc so that the illness if any in animals can be detected promptly and reported to the concerned authorities. Soon after an investigation can be carried out to diagnose the cause of sickness and appropriate action can be taken up by improving the management or through suitable therapeutic measure or both.

Regular periodical examination of faecal samples of all animals has to be carried out to detect any endoparasitic infestation. For achieving better results the animal enclosures of a zoo can be devided into different units and a daily reporting system which is already in practice in some of the Indian zoos can be implemented.

Post-Mortem Examination : No dead zoo animal should be disposed off without post-mortem examination unless otherwise specifically required as in the case of anthrax, rinderpest, etc. The diagnosis established by post-mortem examination helps in adopting suitable disease control measures in other healthy animals. There should be a separate post-mortem room with all equipments away from zoo veterinary hospital, quarantine, isolation ward and display areas for this purpose.

Zoo Veterinary Hospital : In spite of all the practically possible preventive measures, the problem of disease among zoo animals do exist because of confinement, captivity stress, lack of sufficient knowledge on the management of such a varied species of zoo animals and congregation of a large number of visitors of unknown health status. So to deal with sick animals, every zoo should have well equipped zoo veterinary hospital under the charge of specially qualified and experienced veterinarians and required number of trained supporting staff. Facilities for controlling the zoo animals by providing squeeze cages, blow pipes/ capture gun with required equipments and chemicals, etc., a laboratory for carrying out some of the common disease diagnostic tests, operation theatre with surgical equipments for performing operations, sufficient quantity of medicines and indoor wards to house seriously sick animals for treatment should be available.

The combined and coordinated efforts of all concerned with the upkeep, management and disease control programmes will go a long way in keeping the zoo animals free from diseases and in sound health.

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DEVELOPMENT OF MYSORE ZOO

C.D. Krishne Gowda

Introduction

The benevolent Ruler and one of the architects of the then modern Mysore State itself, His Highness Sri Chamarajendra Wodeyar was also a creator of what was to become the famous Mysore Zoo in the year 1892. The Maharaja would have only the best for the "Palace Zoo" as it was known in those days. It was in the year 1909, that the Palace Zoo was named as "Sri Chamarajendra Zoological Gardens" to commemorate the illustrious founder and since then it bears the nomenclature. He engaged Mr. G.H. Krumbaigal, German landscaper and horticulturist who had created the beautiful and now well known Brindavan Garden in Mysore and the Cubbon Park in Bangalore.

Sri Chamarajendra Wodeyar being a lover of nature was responsible for establishing many parks and gardens. The Bandipur sanctuary and the zoo were established during his time with the intention of entertaining the important guests of the time by providing them an opportunity to see the wild animals he loved so much. On realising the popularity of the zoo after ten years of its beginning, the Maharaja felt it would be appropriate to open the institution to the public, considering its importance as a recreational and educational value.

Location

Mysore Zoo is located in the heart of Mysore city with the picturesque Chamundi Hills in the background, just one kilometre from Mysore Bus Stand and two kilometres from city Railway Station.

Area

In the beginning, the area of the zoo was only 10.9 acres. Between 1906 and 1907 another 6.22 acres were added and since then the zoo has steadily expanded. Mr. G.H. Krambeigal, the then botanist and superintendent of Lalbagh, Bangalore can be given the credit of laying out the gardens, so

Panchavati Thota, Chamundi Hills Road, Mysore - 570 010

tastefuly and skillfully. Now the zoo has been expanded to 100 acres, besides acquiring Karanji Kere area to the extent of 150 acres and another 150 acres of area at the foot hills of Chamundi, for establishing the Chamundi Safari.

Even today no old zoo in the country had been able to expand its area wihin the city, as most of the zoos have closed down, such as old Madras (now Chennai) Zoo due to space problem but Mysore Zoo could expand and modernise besides making all-round progress.

During those days only few zoos were established in different provinces in India, by Maharajas, Nawabs and British Rulers. They were established in Madras (now Chennai), Trivandrum (now Thiruvananthapuram), Calcutta, Mysore, Lucknow and Victoria Garden at Bombay (now Mumbai). A little later, a zoo came up at Baroda (now Vadodara) and Jaipur as well. Among these Madras, Calcutta, Mysore and Trivandrum Zoos were considered as the best zoos in the country.

Management of Mysore Zoo by Different Departments

1. From 1892 to 1912- Under the control of private management of the then Maharaja of Mysore.
2. From 1912 to 1948- Under the provincial rule of the Maharaja of Mysore.
3. During 1948 - Transferred to Parks and Gardens Department and subsequently to the Horticulture Department.
4. During 1972 - Transferred to the State Forest Department
5. During 1978 - An autonomous body known as 'Zoo Authority of Karnataka' was formed and governed by the Governing Council.

Breeding Programme

Breeding and successful rearing of zoo animals is of great interest from several points of view. Conservation of rare species is one of the primary roles of the zoo. In recent years the zoo has succeeded in rearing almost all rare animals in captivity adopting many modern breeding techniques, such as (1)

artificial insemination, (2) embryo transplantation, etc. Thus the zoo, by breeding can enable the species to survive. Such animals nearing extinction can be propagated in captivity and reintroduced to the wild; for example, European bison, Przewalski horse, Arabian oryx, Swenhoe's pheasant, white winged wood duck, etc. The species which are threatened by extinction can find refuge in the zoo, where they can be multiplied rapidly, for survival or eventual return to the wild. The present modern zoos are no longer the consumers of wildlife, in turn, they have become the survivors of wildlife.

It has been the unique feature of the Mysore Zoo to be the only zoo in the whole of Asia, which has bred the large mammals. It has also bred successfully many species of animals in captivity. The pioneering work so far covered more than 120 species of both exotic and indigenous animals, thus contributing *in-situ* conservatin of wildlife in a big way. Breeding Programme of the zoo has been appreciated and recorded by the Indian Board for Wildlife.

Perhaps Mysore Zoo is the first zoo in the world which bred successfully both Asiatic and African elephants and also the great Indian rhino and black rhino in captivity. Likewise it has bred chimpanzee, orang-utan, gaur, giraffe, American bison, hippo, etc. in captivity.

Other animals bred in Mysore Zoo are Nilgiri langur, swamp deer, thamin deer, rhesus macaque, stump-tailed macaque, tiger, white tiger, mouse-deer, Indian gazelle, four-horned antelope, Nilgiri tahr, hog-deer, slender loris, civet cat, leopard-cat, lesser panda, Ladakhi goat, sloth bear, etc.

Other exotic animals and birds that have bred in the zoo include zebra, south American tapir, red kangaroo, guanaco, eland antelope, mandril, hamadryas baboon, lemur, wallabies, capuchin monkey, diana monkey, marmoset, European fallow deer, American bison, sikka deer, gnu, barbery sheep, maned wolf, black swan, rhea, emu, etc.

Mysore Zoo was the first zoo where the penguins and seals were reared successfully.

In all cases of these large mammals, the factors responsible to determine success are Mysore's favourable climate, the comfortable enclosures enjoyed by

the animals and rich and nutritious diet provided to them and continuous observation on both the male and the female to bring them together in right time which is being acceptable to each other.

Special Exhibits

This is the only zoo in India that supports maned wolf, an extremely endangered species and both the African and Asian elephants here. Four varieties of bear (Himalayan black, brown, sloth and Malayan sun bear) are displayed. Three varieties of rhinos, two horned white and black from Africa and mono horned great Indian rhino from Assam are here. Giraffe, zebra, gaur, gorilla, chimpanzee, red kangaroo, wallabies, swan, cranes, storks, etc., are the other important species. White tiger and black panther along with their normal coloured ones, are exhibited in Mysore Zoo. Fifteen types of deer and antelopes are on display. Collection of birds, covering 86 species including white, green and blue peafowls is a treat to watch. While king cobra decorates the reptile unit, four species of crocodiles are an added attraction.

Animal Collection

The recognition of any zoo goes by the number of specimens of different species it supports; large number of rare and exotic collections would enhance the reputation of the institute. Most of the animals have found very comfortable environment here and this zoo has proved to be an ideal habitat for their successful breeding. Almost all the zoos in the country and quite a few abroad have received younglings of various species born in this zoo.

At present Mysore Zoo holds a strength of about 1250 specimens of about 170 species representing 25 countries mostly birds and mammals and also some species of reptiles.

Deletions

Similarly deletions from the stock of animals in a zoo is generally by deaths. Injuries from infighting and accidents in horned animals, are often fatal and may end up in deaths. Diseases like tuberculosis, gastroenteritis, cancer,

cardiac arrest, myiasis, worm infestation, etc., are also common in zoo animals. Old age is another cause of death. Infant deaths also boosts the casuality counts. Often injured and sick animals in an advanced condition, are brought to the Zoo Hospital from outside for treatment, and they mostly succumb to death. Disposal of animals on exchange basis is another feature.

Visitation

On an average two million people visit this zoo, peak period of visitation is positively correlated to different types of variables like season, students examinations and festivals.

Clinical Facilities

Mysore Zoo has a well equipped Veterinary Hospital located within the zoo premises as an independent unit supported by two senior veterinarians, an operation theatre, out-patient treatment yard, in-patient treatment yard, i.e., sick lane and a well stocked clinical laboratory. Samples like blood, urine, stool, saliva and visceral organs of dead ones, etc., of zoo animals are periodically examined to ensure the discase free condition of all animals.

By virtue of the good facilities made available in the hospital, this Zoo Hospital and its expertise personnel have the credit of conducting successful vasectomy and caesarian operations in lions and tigers respectively in the previous years.

This Zoo Hospital has the full fledged tranquilising kit and as and when the situation demands our expert personnel tranquilize and translocate the animals for treatment. Quite often our expert personnel go out on request to such salvage operations in the forest and elsewhere.

Always the zoo entertains the treatment of wild animals, which are injured, sick or deserted from the main population and relocate them to the nature in all such demanded emergency situations on priority. This Hospital has all the potentials to be developed as a Central Hospital to meet out any emergency needs either from forests or zoos of all southern states.

Diet and Nutrition

Feeding of animals in captivity is varied and complex. Food habit differs from animal to animal and species to species. Some species which are carnivorous consume food once a day. Sometimes they go without food for 3 - 4 days. Some species require food once a week and some animals require food for the whole day. Few of them such as nocturnal animals feed only on night time. Diet is to be modified with the physiological state of animal such as new born, adult, pregnant and lactating. From the beginning Mysore Zoo has given utmost importance for feeding and the opinion of experts about the display of healthy animals is a proof in this regard.

Zoo Education

Our beloved Maharaja had the vision that the zoo was not only the place of recreation, but of education as well. He ensured that brochures, guide books and animal picture cards were brought out giving information on each species so that the visitors would learn something about the wildlife of India and the world.

Realising the necessity of educating the people on the importance of wildlife and of zoo conservation itself, Mysore Zoo was the first in the country to carry out extensive education activities in the name of "Friends of Mysore Zoo". It was started in the year 1982, and headed by Ms. Sally Walker. In the beginning the organisation was limited to the Mysore Zoo, but later the name and objectives were changed. A new "Zoo Outreach Organisation" extended its activities to all the zoos in the country feeding all the latest technological informations in zoo management, highlighting the importance of zoos on wildlife conservation in India and of Indian zoos in international zoo community.

Presently the zoo is imparting information through organisation of Youth Club activities. Zoo outreach programmes and interpretation centre, general information pertaining to the zoo through literatures, sign boards, wayside boards, etc., are adequately provided. Computer with multi media and sound facility provided to the zoo visitors, can be used to see thousands of animals and also to hear and read more about them.

Zoo Vandalism

It is very unfortunate that still visitors have not learned how to behave themselves in a zoo set up, not only in this zoo, but all over the world. Zoo vandalism has become a real menace, poor animals caged for the benefit of the visitors are harassed to the maximum.

Quite often one come across incidents wherein people hurt animals by hitting, teasing and provoking the helpless animals with stones or sticks and offer food and other things that may be detrimental to the animal. This problem has to be overcome by educating the visitors, which is a continuous process and long term yielding result.

Research activities

As the resources for research are limited, the World Zoo Conservation Strategy calls for the establishment of research priorities on different levels.

Mysore Zoo was the first to conduct a number of research works successfully on :

i) Breeding behaviour of Indian elephant and

ii) Successful breeding of black rhino by administering hormones.

Mysore Zoo achieved successful breeding of numerous tigers in captivity and stood first in harvesting two litters from tigers within 12 months, though the usual interval between two litters is 4 to 5 years.

All these research works were published in the international journals and magazines.

Mysore Zoo has given importance involving non government organisations, universities and scientists, which could generate important information and will be quite useful for streamlining the zoo management strategies.

Animal Enclosures

A master plan was prepared on modern lines removing the barred and fenced enclosures and providing moated enclosures for all the animals. A first large apes enclosure was built in the country in 1977 where there were big trees,

bushes and lush grasses for the animals to enjoy. Enclosure for black rhino and Indian rhino were built on modern lines. Enclosures for African and Indian elephants, mandril, bear, tiger, deer, walk through reptiles, walk through aviary, etc., are unique and attractive.

Karanji Tank

The Karanji tank is another story in itself. The tank area comprising both water body and surrounding land was once an abandoned place for vagabonds, for washing vehicles, grazing buffaloes and cattle and even for taking one's own life. Thankfully this was converted into a wetland refuge for aquatic birds. Over a period of time 9 man-made islands were added to the tank and trees planted on them. Even before the trees were well grown, they attracted various species of aquatic birds such as painted storks, grey pelicans, cormorants, darters, spoon bills, ibis, jacana, coots, various ducks and other species of birds. They have made the Karanji tank their breeding ground and in the season, the area resources with their chirps, caws, whistles and cries. Thus it has become a miniature bird sanctuary right in the heart of Mysore city, where earlier not a single bird of this type could be seen.

Natural History Museum

The Mysore Zoo has always made education a priority. When the zoo authorities were approached by the Central Government, which wanted to start a Natural History Museum in the south, the Zoo Authority of Karanataka willingly gave four acres of prime land for the Museum. Settled now on the banks of the beautiful Karanji tank, the museum will enhance the educational potential of the zoo by offering people a rare opportunity to study natural history from a building with a view of wild animals, aquatic birds and tropical vegetation.

Conclusion

Mysore Zoo which is a century old was expanded and modernised and has achieved many outstanding works in the zoo field. Further it has laid down solid base for another 100 years to flourish and maintain the standards and strengthen the international reputation in zoo management.

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FROM MENAGERIES TO CONSERVATION CENTRES - INDIAN ZOOS AFTER INDEPENDENCE

Sally Walker

Introduction

The word "menagerie" is now a "bad" word in the organised or "conservation conscious" zoo community, conjuring up visions of small enclosures, stark iron bars, dingy concrete, congestion, bad smells and misery. Although the menageries of long ago probably fit that vision, the concept of "menagerie" - as opposed to that of the "zoological park" or "conservaion centre" -- goes beyond physical setting. A menagerie is a collection of animals with no purpose beyond education and/or entertainment. We can call many zoos of today "menageries with moats."

It is entirely possible, for example, to keep a "menagerie" on vast open spaces with large spacious enclosures. According to Bernard Harrison (1985) "The difference between a menagerie and a zoological garden is the original intention of the display. A menagerie displays its animals simply for public viewing, the enclosures being more for the convenience of the spectators than for the welfare of the animals. A zoological garden is more scientific in its approach to the display of animals, considering their physical and psychological comfort amongst other aspects."[1]

Although one may not think so, animals can be just as miserable in a large, naturalistic enclosure as in a small, artificial one, depending on the consciousness and care applied to the design, construction and use of the enclosure. The maharajas and zamindars of princely India constructed moated enclosures, some of them - ironically - with more concern for the animal's welfare than some we see today.[2] A great deal of thought combined with knowledge of the animal's behaviour and biology should go into the design even of large enclosures. It is not the case, as is sometimes assumed, that an animal will be content if it simply has lots of space and shrubs.

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Another irony connected with the word "menagerie" is the habit of thinking that menageries were all maintained for frivolous reasons. Here,we make a special point of emphasizing the educational and scientific as well as entertainment purpose of facilities defined as "menageries". Harrison's definition of menageries as "simply for public viewing" - enclosures more for visitor convenience than animal welfare - does not exclude the possibility of scientific study, particularly taxonomic, evolutionary, genetic, and other biological subjects. The old London Zoo is an example of this type of menagerie that almost everyone knows. Harriet Ritwik in her book The Animal Estate (1987) comments 'the animals at London Zoo were conceived of as part of an interrelated, graduated zoological series - as a living representation of the standard vertebrate taxonomical categories."[3]

Even the ancient private menageries had a purpose more profound than entertainment and egoistic satisfaction. Some of the very early collections of animals belonging to the Chinese, Egyptians, and other royals including some Indian collections had objectives other than pride of ownership and entertainment. Some of the collectors were genuinely interested in animals as zoological specimens. Those menageries, therefore, had a purpose of education and scientific investigation. Three examples (of several) immediately come to mind from India. The Emperor Jahingir kept many animals for the sake of his immense curiosity during the 17th century. He had them painted by an artist and he attempted to describe them scientifically. Some of these descriptions have elements of genuine scientific insight so long ago and by a man who was essentially untrained in science.[4] Another later example is the Rajah Sefogee, a young royal of Tanjore who also kept a menagerie for study during the 19th century. Sefogee's descriptions of the different animals are naïve but there is no question that he was genuinely interested and striving for understanding and that this intellectual purpose was the motivation behind his menagerie.[5]

Third, a little known but very significant "official" menagerie was established in 1803 near Calcutta which was intended as an ambitious attempt to catelogue all the fauna of India. The Indian Natural History Project at Barrackpore was probably the first systematic initiative of its kind in Asia and

maybe the world.[6] The details of this fascinating project must be left for another article but suffice it to say that, although the descriptions and drawings of birds, mammals and reptiles (nearly 250 animals) catelogued were lost for some time, they are soon to be published.[7] The Barrackpore Park Menagerie itself survived long after the project conclusion, albeit as a curiosity, up to 1975 when the remaining animals were given to Calcutta Zoo.[8]

The point is that it is not correct to think of a "menagerie" as being old, small and frivolous only, just as we can't automatically call a zoo that is large, well-vegetated, open and non-trivial a "conservation centre" or even a "zoological park".

In Indian history many of the elements of which we think as a "modern zoo" today, e.g. scientific investigation, open-moated enclosures, attention to welfare of animals, advanced husbandry and medical care, etc. were in place much before what is considered the "modern age" of zoos emerged. Jaipur Zoo, Mysore Zoo, the Lalbaug Botanical Gardens Menagerie, the zoo at Alwar, the Maharaja of Oude's collection and undoubtedly others had one or more open moated enclosures, large fenced enclosures and/or other modern devices.[9] These were occasional, it is true, but a model had been developed long before European and North American zoos began designing "open zoos." It is generally thought, perhaps by many Indians, even, that modern zoo design was imported to India from western countries but this is not necessarily the case. Some zoo historians are now beginning to think that the European zoos of scientific leaning, such as London Zoo, owe much to colonialists taking back what they saw in the east.[10] Sir Stamford Raffles, founder of the London Zoo, visited Barrackpore Park before he returned home.[11] Founder members of the London Zoo, some of whom were colonial surgeon-naturalists and civil servants in India visited various royal collections which were displayed in open grounds.[12]

Barrackpore Park had a large and beautifully landscaped area for its rhinoceroses, elephants, and even a tapir. The Indian Natural History Project was long since defunct when Raffles visited but the concept might well have provided some of the inspiration for his own project. Animal collections in Oude, Baroda (now Vadodara) and Jaipur would have provided plenty of

inspiration to colonial visitors. Indian and Southeast Asian botanical gardens of the 18th and 19th century sometimes kept wild animals for description, drawing, and undoubtedly display. Sarahanpur Botanical Gardens[13] is an example from India and Singapore Botanical Gardens, from Southeast Asia.[14]

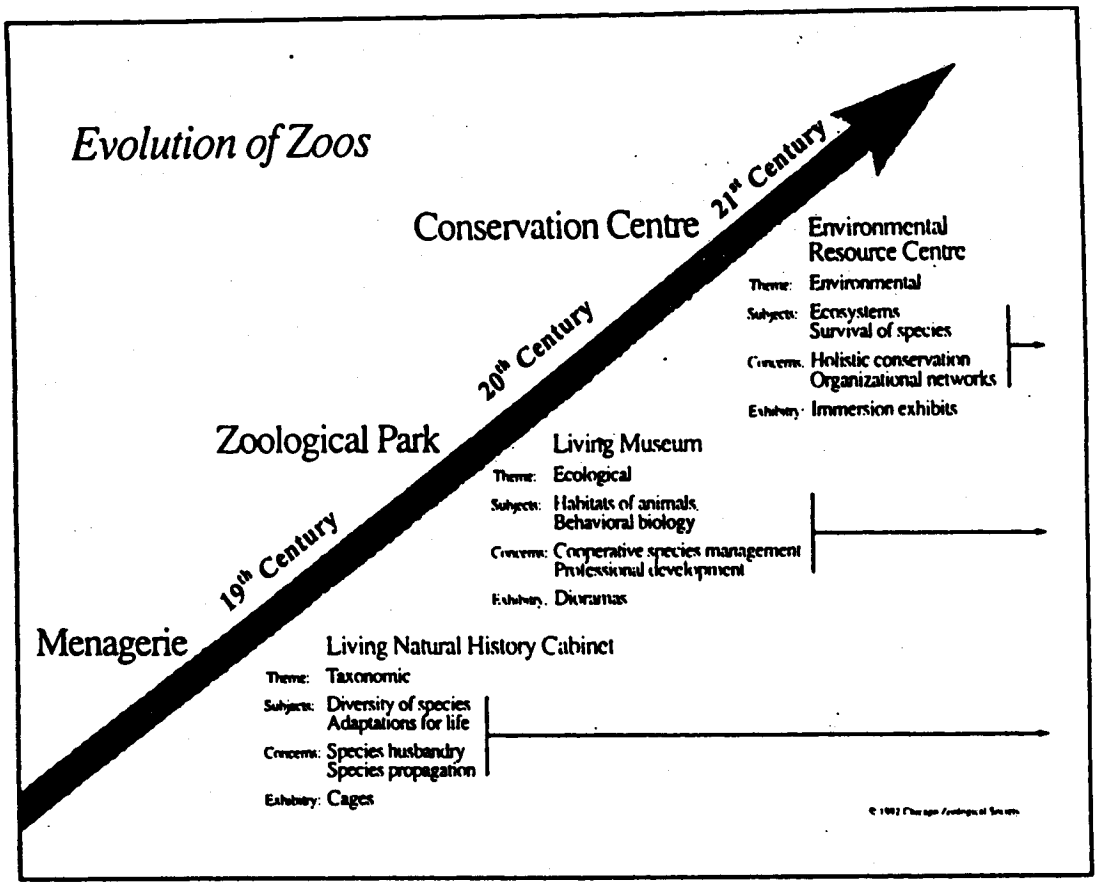
This elaborate background to a period which begin only in 1947 is for the purpose of establishing the fact that many of our ideas about zoos, particularly Indian zoos, may require revision. Indian zoos may be both better and worse than we might think. It will be all the more useful as we attempt to trace the trends of Indian zoos - both outmoded and modern -- from the time of Indian Independence to the present, and even into the future.

We also wish to underscore the fact that this institution of the animal facility which we now call "zoo" is a most complex phenomenon ... almost undefinable and full of contradictions. Therefore, anything said in this discussion is open to debate.

Evolution of Zoos

Dr. George Rabb, Director of Chicago Zoological Society and former Chairman of the Species Survival Commission, IUCN describes the "Evolution of Zoos" in a series of papers which attempt to diagram the basic trends and attitudes as reflected in the themes, major subject matter, and enclosure design of zoological institutions through history.[15] His hypothesis and discussion is illuminating as is the illustrative diagram which is reproduced in the next page. It will help us analyse the evolution of Indian zoos from what they were at the time of Independence (1947) to what they are today.

Rabb describes a "Menagerie" as a "living natural history cabinet" with its major theme as taxonomy and its primary subject matter as diversity of species and their adaptations for life. The major concerns of a menagerie would be species husbandry and propagation with the standard style of exhibit a cage. Menagerists or collectors want to study the taxonomy or physical characteristics of animals, so is important to them that they can see them up close. Therefore, a cage is practically the only form of exhibit which guarantees a close look at the animal, which is also satisfying to general visitors. The animal is genuinely



captive before their eyes. It cannot escape the scrutiny of the scientist or student or general visitor to the zoo. Moreover, people were fascinated by diversity - therefore, the older zoos, or menageries, tried to exhibit as many different kinds of animals as possible. Even modern and relatively new facilities that we call "zoological parks" have gone to some trouble to acquire and exhibit a variety of species and subspecies of a particular family, such as bears or cats, to demonstrate the diversity and variety of animal life. Species husbandry was a concern because it was desirable to keep the animals alive. Propagation, for the menagerist, would be more interesting from the point of view of studying gestation period and parturition than for supplying other facilities, or for use as a supplement to wild populations. Public menageries, of course, attract visitors if they can show babies and save money on exhibits by breeding.

Rabb describes the Zoological Park as a "Living Museum" with an ecological theme. Interest in animal habitats and behavioural biology is the major subject matter. The concerns paramount to the zoological park are cooperative species management (systematic and scientific planning in breeding and exchange of animals) and professional development (training and expertise). Zoological parks attempt to exhibit animals in a naturalistic setting, or a diorama, in which a forested area or some rockwork served as a backdrop instead of flat concrete. Many Indian zoos of today - in fact most of the better ones -- fit this model in terms of their interest and design .. but how many have viable cooperative species management as a primary concern ? It will be illuminating to analyse some of these concerns in more depth later in this discussion.

Dr. Rabb describes the latest stage of zoological institution development as the "Conservation Centre" which is an "ideal" facility, more of the future than just now. This is an environmental resource centre, with an environmental theme and its primary subject matter ecosystems and survival of species. Rabb portrays the major concerns of the Conservation Centre as holistic conservation and organised networks. Holistic conservation means taking up the entire spectrum of activities needed to achieve conservation goals - genetic and demographic management of species breeding, appropriate keeping and husbandry practices for avoiding human imprinting, etc. and eventual use for strengthening or supplementing wild populations. Organised networks refers to the activities of groups of people from different specialisations in or related to the conservation arena cooperating in *ex situ* and *in situ* management to achieve conservation goals. Immersion exhibits - exhibits in which the visitor is literally surrounded by elements of a particular ecosystem or habitat even including the human activities which are a part of it.

One risk being misunderstood when portraying trends of an institution as complex as a zoo. Dr. Rabb, of course, never said or even implied that every zoo should fit one of these modules perfectly, or passed judgement on what exists. He simply describes a sort of movement throughout the centuries and decades. It would be unfair to insist that every zoo could be perfectly matched with one of the three types. Many zoos today combine bits of all.

The menagerie loosely fits the 19th century facility and the zoological park, the 20th century, whereas the conservation centre is the "now" zoo of the 21st Century - the future. Probably no zoo is really a "conservation centre" - yet, although the term has already begun to appear in new zoo names. Dr. Rabb's diagram provides a method of evaluating our institutions, of deciding what they are doing ... what they should do ... what we want out of them.

What's wrong with menageries ?

In fact, all of the modules - menagerie, zoological park and conservation centre - have perfectly legitimate themes and concerns. All of the subject matter - even that characteristic of a menagerie (e.g. species diversity, adaptations, taxonomy) are grist for any zoo educator's mill. In zoos we have a unique opportunity to teach these otherwise dry subjects with the living animal as demonstration material. Likewise the concerns described as characteristic of zoological parks, e.g. animal habitats and behavioural biology are valid and will be required. All of these subjects are required to understand holistic conservation, both by zoo managers as well as visitors.

Furthermore, just as we need not be repelled by menageries, or to think that zoological parks are passe, it is not necessary or even advisable to be captivated by the concept of the "conservation centre". It is the ideal for which the bigger, richer and more organised zoos may aspire, but it is not the only thing a zoo is good for. Nor it is possible or even desirable for all facilities.

Two seemingly discontinuous points with regard to zoos as per Rabb's model will throw light on a method of coordinating the many different types of zoos in India

Just as we used to say that taking animals from the wild only for entertainment and exhibition is no longer justified, today we have to say that taking certain species of animals from the wild solely for education - OR for any purpose other than gene banking or reintroduction - probably is not justified. Further, a zoo education programme consisting only of strictly zoological and biological subject matter in the zoo , while adequate from the point of view of the school curriculum, may be a waste of the institution's potential. No doubt

zoos can and should help teachers with their task of imparting basic science, but in addition to this, zoos should also take on the responsibility of changing attitudes. It may be that only a zoo, with its unique living collection can make a sufficiently dramatic impact on the human mind to do so.

Conservation centres - with their environmental theme, their subjects of ecology and species survival and their immersion exhibits - can (and indeed are intended to) make a sufficiently dramatic impact on the visitor to change their attitudes. However, there is no reason why a small or medium sized zoo can't do so also. The menagerie and zoological park can expand their subject area to include ecology and survival of species and "graduate" to a higher status of institution even while remaining small in size and modest in objectives and exhibitry. They can teach about endangered species and conservation even though they may not exhibit them. This can be done by teaching about them in relation to the zoos' own common species. Visitors simply want to see some live animals - they can assimilate much about endangered species if the material is engagingly presented. All zoos have spotted deer; they can teach about tigers in relation to deer without even having the tiger.

No zoo can get away with telling untruths about it's role in conservation, however. Perhaps that is one reason why zoos are not more effective - they are not believable. The Indian public has demonstrated time and again that it can be fooled only up to a point. There is a innate intuition or wisdom which responds to truth, and fancy.

Zoos that are currently not very interesting would benefit tremendously if they had a genuine role in conservation and a story to tell about it. They do have a role, or can have, a genuine and important role.

The Central Zoo Authority registration logged more than 350 zoos of varying size, type and description, all keeping from a dozen to a few hundreds of animals and attracting a few hundreds to a few hundreds of thousands of visitors.[16]

Although many of these zoos did not pass the rigorous standards of inspection , rules and recognition, there are still about 300 zoos which did pass.

Of the 300 odd zoos, about 50 of them have been categorised as Large, Medium or Small. This categorisation is based on several factors other than size, e.g., number of visitors, number of animals, etc. These fifty facilities vary in quality but it is safe to say that they all have a substantial organisation behind them (such as a ministry, department, corporation, etc.) and a potential for being directly relevant to conservation. They are not, currently, living up to that potential in any measure for reasons which will be explained.

The vast majority of Indian zoos are mini-zoos and deer parks which, although they may be attached to the same organisations, do not have either space, infrastructure, or finance to be vital conservation facilities. They do not have a direction, a policy or a genuine role. They DO have the potential to be relevant to conservation, however, by helping the larger zoos overcome some of their burdensome problems.

In India many of the zoos which have the potential of becoming conservation centres or at least of being directly relevant to conservation action are being held back by serious problems which consume their time, energy, space and resources. One of the major problems is a surplus of animals, either from confiscations, rescues, mandatory gifts, poor planning, insufficient awareness and methodology, or change in policy, legislation and/or philosophy - in short for legislative or welfare reasons. Another surplus animal problem is scientific; it has to do with hybrid animals and mutants which are not appropriate for conservation programmes. Zoos may also be holding a number of animals which are threatened in the wild and important for conservation but are proven non-breeders for one reason or another, or are inbred. Another problem is the inability to obtain correctly sexed and aged pairs for breeding - some endangered animals are held singly in zoos in far flung areas. Moreover, unlike zoos in other countries, Indian culture and religion will not permit the use of euthanasia as a management tool, which complicates collection planning and population control enormously.

Mini-zoos and deer parks could play an important role in the conservation potential of the large zoos by taking on some of the surplus animals which are weighing down the more conservation-viable zoos. These zoos could devote

their attention and resources to the intricacies of genuine conservation programmes, which are far more elaborate than has been appreciated in India so far. These zoos could then tell their story to the public through education which would be a true story of how the Indian zoo community cooperates and organises its animal collection for genuine conservation. In the same context they can also explain the welfare policies of the Government of India which are exceptional in the entire world.

A great many ecological and environmental concepts could be explained in connection with this story. By the same token, the large zoos will have a story as well, to explain why they have fewer species and how it came about. Zoos, by fearing public criticism, continue to try and please the public by exhibiting all kinds of animals at the expense of their conservation goals, and depriving themselves of probably their best, and most believable, story of all.

Small zoos or Mini zoos and deer parks could function proudly as what we normally think of as menageries, or postage stamp collections, except they would be serving the greater zoo community in solving some of their greatest problems. They could proudly teach taxonomic themes and diversity of life along with a basic conservation pitch.

Why this probably won't happen

India is such a complex country that it provides a panorama of all history on a daily basis. The well-known Times of India photograph of a rocket ship being taken from laboratory to launching-site on a bullock cart, is an appropriate paradigm of India's zoos ! Despite its complexity, or perhaps because of it, today India is holding its own in the world - in innovation, in enclosure design, in legal controls, in animal welfare policy, in administration. India has the strongest Zoo legislation in the world and a National Zoo Policy as well. It is the only country to have a central authority with such powers as well as a large funding base. India has pioneered a new enclosure style (the biological park which will be described later). Indian zoos are closely associated with the forest and wildlife departments which are the implementing agencies for wildlife populations in the wild. Yet in the important areas of zoo conservation, education

and research, Indian zoos do not compare well with zoos in the rest of the world. Why is this so ?

The history of India's zoos from Independence to now tells an interesting tale of almost total inertia to mushroom growth and then to control. The history - in the light of the Rabb's Evolution of zoos and the above proposal - gives a clear indication of where Indian zoological facilities can go (or not) in the future.

A reading of official historical literature pertaining to Indian zoos is revealing. There are two outstanding aspects. The first of these outstanding and very interesting aspects of post-Independence Indian zoo history is that Indian foresters and wildlife enthusiasts were so far ahead of their time. Some of the suggestions and comments reflected in Minutes of the Indian Board for Wildlife, its Zoo Wing, and the Indian Zoo Superintendents meetings were perceptive, insightful and futuristic. Unfortunately, many of them remain as suggestions.

The second outstanding aspect of post-Independence zoo history is how many times the same excellent suggestions or relevant comments were mooted, approved, and recorded for action. An analysis of why this happens may give valuable direction for the next fifty years of Indian zoo management.

For example, in the Minutes of the First Meeting of the Zoo Wing of the Indian Board for Wildlife held at Mysore on 16 May 1956, the lack of movement of animals from zoo to zoo was discussed. A member expressed frustration and suggested that this be prioritised for action by the Government of India. The Inspector General of Forests explained to the committee that sufficiently high priority already existed in regard to the movement of the animals but despite this, the zoos might have experienced difficulties because of the "human element" in the administration of rules and regulations.[17]

Even today, some 40 odd years later, there are rules, policies, programmes, even directives in place to move animals from zoo to zoo. In some instances, such as the tiger breeding programme, there is a specific plan for every animal and even finance to underwrite the move. Yet few animals have moved. It is clear that the "human element" is as active today as it was forty years ago and

throughout and that it is throwing a spanner into many a good conservation initiative. One of the priorities for Indian zoo management in the coming years may well be how to control the "human element" in administration so that it works for positive and constructive action.

A Short History of Indian Zoos from Independence to Now

Preamble

Indian Zoo history can be catalogued conveniently according to the now familiar Rabb model of the Evolution of Zoo with additions of two periods for India before Rabb's Menagerie period.

Religious Park period : 400 BC-

During very ancient times, the rishis and saints are said to have maintained animals in natural parks attached to their ashramas. Indeed there is a reference in the Dhammacakkappavattana sutta that the Buddha's first discourse begins -- "Thus I have heard : at one time the Lord dwelt at Benaras at Isipatana in the Deer Park ....." [18]. Deer parks and open areas where all manner of gentle animals were kept are mentioned quite often in various texts and scriptures and, thus, seem to deserve a category of their own.[19] As will be discussed later, a peculiarly Indian style of zoo has emerged of late which represents, according to Bernard Harrison, a "quantum leap" in design direction. These zoos, called biological parks, are remindive of the natural deer parks of the rishis and it is as though India has come full circle with animals facilities since early times.

Collection period : 1600 - 1800. The Ancients, Moguls, and Maharajas can be "lumped" into a stage called the collection (or pre-menagerie) period because, although personal collections can be called also menageries, in terms of Rabb's model we are trying to describe zoos of a more recent vintage. Also many of these collections were kept for so many other purposes than viewing (e.g.hunting, fighting, protection, etc.)

Menagerie period : 19th century - 1803 -1950. From the time of Barrackpore Park and the Indian Natural History Project to the middle of the 20th century, the trend of Indian zoos was mostly toward menagerie, although there are notable exceptions.

Zoological Park period : 20th century -- 1950 - 2000. After Independence the official impetus was clearly towards forming open zoos on the western model of which the Delhi Zoo, later to become the National Zoological Park, is an example. Ironically, the great majority of zoos started which consist of mini-zoos, deer parks and travelling zoos have been clear examples of menageries.

Conservation Centre period : 21st century -- 2000 onwards. In the last five or ten years, innovative schemes for holistic biological facilities have been put up and in some instances begun. Although none of these has materialised as a genuine conservation centre in the sense described by Rabb clearly a beginning has been made and the next fifty years should mark the development of this trend in India as in other parts of the world.

Whether or not Rabb's Conservation Centre, or an equivalent but indigenous version of it, is achieveable within the current, very complex and complicated administrative, political, economic and social scenario in India will depend entirely on lessons learned in the Zoological Park Period. Since the best Indian zoos have not yet achieved even the status of a good zoological park with all its characteristics as described by Rabb, it is past time to take a hard look at administrative and political realities and investigate whether the obstacles which prevented zoos from achieving Zoological Park status can be overcome. This is similar to the steps of reintroduction of a species of animal which has died out of a particular habitat - you have to find out the reasons for its failure to survive and rectify them before hoping to succeed in reintroducing the species back to the same place !

Several zoos of significance were founded in India in the 150 years between 1800 and 1950, most of which are still open today.[20] Two of these are open in a completely different reincarnation but they have been left in the list because the old zoo was most probably an impetus to construct a later one. These are marked with an asterisk. Zoos which are no more and have no replacement are marked with two asterisks. These are also listed as Appendix I, along with other lists from different periods.

Indian Zoos from 1800 - 1950

1803 Barrackpore Park**

1854 Marble Palace Zoo, Calcutta (1854)

1855 People's Park, Madras * (1855) (now Chennai)

1855 Lalbaug Zoo, Bangalore (1855)

1857 Trivandrum Zoo, Trivandrum (now Thiruvananthapuram)

1863 Sakkarbaug Zoo, Junagadh

1865 Kota Zoo, Kota

1873 Veermata Jijibai Bhosle Udyan Zoo,Bombay (now Mumbai)

1875 Alipore Zoo, Calcutta

1877 Jaipur Zoo, Jaipur

1877 Hyderabad Zoo (old)*

1878 Udaipur Zoo, Udaipur

1879 Sayyajibaug Zoo, Baroda (now Vadodara)

1882 Shivaganga Gardens Mini Zoo, Tanjore (now Thanjavur)

1885 Trichur State Museum and Zoo, Trichur (now Thrissur)

1892 Sri Chamarajendra Zoological Gardens, Mysore

1893 Maharaja Shahaji Chhatrapati Zoo, Kolhapur

1894 Maharaj Baug Zoo, Nagpur

1921 Prince of Wales Zoo, Lucknow

1922 GandhiZoological Park, Gwalior

---- Bikaner Zoo, Bikaner

1936 Jodhpur Zoo, Jodhpur

1936 Shikardadi Deer Park, Udaipur

Central Zoo Authority records indicate that for 14 years between about 1936 and 1950, no new zoos were started in India.[21] Not surprisingly, when the country was in turmoil and busy acquiring independence, zoos were not a priority.

People in India were increasingly concerned about the decline in numbers

of wild animals even at that time however. In 1935 a conference was held in Delhi to discuss their concerns. The Delhi Conference and later the All India Conference for the Preservation of Wildlife was founded. An All India Convention was drawn up under the conference and referred to as the "Magna Charta (sic) of Wildlife in India. A journal ("Indian Wildlife, Official Organ of all-India Conference for the Preservation of Wildlife") was started as the mouthpiece of the conference and was edited by Jim Corbett. These activities were not the purveu of the British as it may seem. Indian royals and others were involved equally and seem to have provided much of the funding for the conference and later activities. The Convention and Association are significant because their objectives included provision of steps for encouraging individual states to take steps for preservation of fauna and flora in India. Establishing a library, popularising natural history in schools, establishing a National Park, assisting in establishment of sanctuaries and publishing books on Indian natural history and wildlife occupied the association for several years.[22] Although it has not been possible to establish this as a fact, the association may have provided a structure and a format when the new government was formed after Independence and an Indian Board for Wildlife was set up.

In the first number of the official organ of the Conference, zoos were mentioned only once - there is a photograph of a tiger in a cage with a heart rending poem by Major W. R.Lawrenson entitled "A Prisoner for Life" underneath. This attitude had changed considerably by the time of the first meetings of the Indian Board for Wildlife.

The Indian Board for Wildlife was formed in 1952 and from this time up to the time of the Indian Wildlife (Protection) Act, 1972, or two decades, about 56 zoos were set up. (Appendix II)

However, between the passage of the Wildlife Act in 1972 and the Amendments to the Act in 1991 which contained the Indian Zoo Rules, about 300 zoos were founded, at least this many, as they have registered with the Central Zoo Authority. (Appendix III) There may have been even more. It is beyond the scope of this paper to interpret this dramatic phenomenon but many reasons will be suggested. Perhaps people felt that since they could not hunt they must

at least have some animals to look at. Or perhaps it was felt that since animals were so well protected that a few could be spared for a zoo, or that since an Act was required wild animals were in danger and needed preserving in zoos. Or may be it was simply that the combination of the formation of the Indian Board for Wildlife, the passage of the Wildlife (Protection) Act and the not insignificant Wildlife Action Plan created a kind of organised interest that did not exist before. Whatever the reason, in the 50 years after Indian Independence, there was a quantum leap in the founding of zoos which proliferated without control until 1991 when the Zoo Rules was passed and the Central Zoo Authority formed.

Major Events and Trends since Independence

The Indian Board for Wildlife and other early legislation

Probably the first major wildlife and zoo event after Independence came a scant five years after the new nation began.In 1952, the Indian Board for Wildlife (IBWL) was set up.[23] Even before that, at the state level however, the Bombay Wild Animals and Birds (sic) Protection Act was passed and this act included provision for supervision over zoos and their licenses.[24] The first inspections were done by Sri K.S.Dharmakumarsinhji, a passionate conservationist with an interest in zoos. It is interesting to note that this was not the first zoo legislation in 20th Century India. In 1904, the state government of Mysore passed the Bangalore Forest Act which had a zoological management provision : the zoo director was given the power to fine visitors Rs. 100 for vandalism.[25]

The Indian Board for Wildlife was a prestigious government committee, although the Prime Minister of India did not become the Chairman until many decades later. In the early days of the Government, it seems this was not necessary to give the Board importance. From its beginning the Indian Board for Wildlife was very supportive of zoos; a few years after its formation, a Zoo Wing and a Bird Wing was set up and began to have regular meetings.[26]

All India Zoo Superintendents' Conference - 1955

About the same time, in 1955 the first All Indian Zoo Superintendents' Conference was held in the first week of May in Madras. The stated objectives were to discuss problems of zoo administration, find methods for improvement

of existing zoos, and to assess the scientific, educational, recreational and aesthetic value of zoos in the community life of the nation. The meeting was attended by all the superintendents of the then major zoos of India. Their resolutions and recommendations included (among many others) exchange of animals between zoos, formation of an All India Zoo Association, expansion of scope of zoos to include rehabilitation of "denuded areas" by rearing important species in zoos and introducing them into these areas; recognition of zoos, a training centre for zoo personnel in India; insectaria in zoos, etc. The need for a List of Zoos in India was quickly filled and appeared with the proceedings. At that time 20 zoos were listed in India.[27]

The "human factor" might have reared its ugly head for the first time in connection with the Zoo Superintendent's meeting, although it is not possible now to understand precisely what happened. There is a curious note in the Minutes of the IBWL meeting that" the Indian Board for Wild Life did not participate in the Centenary Celebrations (of Madras Zoo) as no invitation was extended to the Board".[28] That this fact was minuted indicates that it was taken somewhat seriously. Whether this was a genuine oversight, a case of petty politics, or a wise decision to avoid the central government has remained - so far - trapped in the ether of historical fantasy. One wonders why someone from the IBWL could not simply have advised the Madras Zoo that it would be better to extend a formal invitation to the Board. This type of communication gap occurs even today sometimes with disastrous results.

A review of the subject matter for discussion and resolutions passed by the first meeting of zoo superintendents in India, shows that the seeds of cooperative management, biodiversity, and holistic conservation had already germinated. The Recommendations of the Zoo Superintendent's Conference had a place on the agenda of the third meeting of the Executive Committee of the IBWL which was held about three weeks later at Ooty[29] and the Committee approved them. A review of the deliberations was also included in the Proceedings of the IVth Meeting of the Executive Committee of the IBWL held at Sasan Gir.[30] Such was the importance of zoos then in the minds of the top foresters in the country. Zoos do not command such attention from the Board today.

Zoo Wing of the Indian Board for wildlife -- 1956

In 1956 the Board had formed the aforementioned Zoo Wing of the IBWL which met seperately and then reported to the regular meetings of the Board. The Zoo Wing met for the first time on 16 May 1956. The deliberations of the members of the Zoo Wing were astute and up to date with the rest of the world. They were concerned with animal welfare including size and amenities of accommodation, and even the provision of company if not mates for social animals, with prevention of inbreeding, education with labels for enclosures and educational publications, adequate representation of indigenous as opposed to exotic animals, research, nutrition, inventory and records, transport, and even breeding rare species for reintroduction.[31]

A wealth of information exists in the Minutes of the early official meetings of the Indian Board for Wildlife and its Zoo Wing. In those days, the Minutes of meetings and symposia were taken down so precisely. Every idea and phrase had to be expressed, and in the dignified language of the meeting. A careful reading of these Minutes provides a great deal of insight, simply expressed, into the connundrums which still plague zoo managers and their ambitions for their institutions.

Some years later in 1973, the Zoo Wing was replaced by an Expert Committee which toured the zoos and made a Report which will be discussed subsequently.

A later iteration called the Expert Committee of the IBWL on Zoos met in the 1980's. All of the Minutes were not available for this paper but it is safe to say that the Expert Committee functioned as an early Zoo Authority, discussing matters of concern to all zoos such as exchange of animals, procurement of foreign animals, surplus populations in zoo, import of drugs, etc. It is significant that there has always been some high level body which made an attempt to contend with the problems of zoos in India.[32]

Introduction of Lions into Chandraprabha Sanctuary -- 1957

Although this project was ill-fated and involved zoos only peripherally, it serves to demonstrate the forward of thinking of the IBWL. The dangers of

a single population and its implications as well as the cultural importance of the lion was discussed in full at the IVth Meeting of the Executive Board in 1956. There were members present to warn of the pitfalls of such an undertaking should it fail as well.[33] In 1957 an early effort to introduce a major carnivore to an alternative habitat was made by the Government of Saurastra and of Vindhya (Uttar) Pradesh. Lions were taken from Gir Forest, held for some time at Sakkarbaug Zoo and finally transported 1400 hot and arduous miles through Rajasthan and kept into a holding area in Chandraprabha. They were officially released on 2 December 1957. For some time the lions bred and thrived and their number had increased to eleven at one time. However this experiment was not to succeed; the lions disappeared one by one and were not replaced.[34]

Now, 40 years later there is again a plan for a second home for lions, this time in an area of Palpo Kuno in the state of Madhya Pradesh. Much more is known today about how to carry out such delicate wildlife operations and a very careful and conservative approach is being taken.[35] Ironically, zoo managers have not been involved in the project. It could be argued that the lions will be translocated from one wild area to another, but this will not be without some transition period in captivity. Zoo managers know best about captivity yet they are rarely called at the appropriate time and level for such projects as have been done in India. There are many problems to be faced with this project and enormous expense. One of the issues to be analysed on facing the 2nd 50 years of zoo management in modern India is whether such mega-projects involving mega-vertebrates, which can be uncertain at best and disastrous at worst, are the best use of money, time, energy, public good will, etc. There are many Critically Endangered and Endangered animals that are small bodied and harmless to man which could probably be saved for the same cost as taking such a risk with this single mega-vertebrate. This will be taken up in more detail later in this discussion.

The National Zoo -- 1958

The IBWL wanted a good zoo to be founded on modern principles with open moated enclosures and naturalistic display to serve as a model for other zoos. There were already such enclosures in Indian zoos already but so far

no zoo had been planned from the beginning with only such enclosures in mind. Carl Hagenbeck was called to give the design for what was then called the "Delhi Zoological Park". What was later to become the national zoo of India was given a very typically western zoo design, with a continental theme that made it very difficult to maintain under Indian conditions. Acquiring and maintaining a reasonable number of species from all the major continents must have been an extremely difficult proposition and could not be kept up. The name was later changed to the National Zoological Park (National Zoo) to more correctly reflect the purpose of this institution. It was administered and financed directly by the central government. The scheme for establishing a zoo in Delhi was formulated in about 1952 and the zoo was inaugurated in 1959.[36]

As the years passed and the National Zoo evolved, more and more administrative duties devolved upon it. Being located in New Delhi and the child of a Ministry (first Agriculture then Environment) put additional, countless and time-consuming burdens on the zoo. Later the National Zoo was made the coordinator for all Indian Zoos. The Director of the zoo was expected to carry out this formidable task as well as serve the Ministry and run the zoo singlehandedly. Coordinating the zoos was intended to mean coordinating the exchange of animals and species breeding programmes, as well as tasks such as procuring drugs and equipment for all the zoos, organising training, initiating the association of zoos recommended by the first All Indian Zoo Superintendents meeting, and even publication of the national zoo bulletin. The National Zoo ultimately was unable to function as coordinator for all the zoos. The "human factor" had taken a solid hold by this time and some of the zoos resented the National Zoo and were suspicious of its role as coordinator.[37] There was very little cooperation and an early opportunity to move from menagerie to zoological park was lost.

In time, the difficult theme, increased duties, cumbersome procedures for getting repairs done as per dependence on PWD, administrative difficulties, etc. , took a great toll on the zoo and it began to deteriorate despite herculean efforts by various directors. Once the process of decline set in it seemed there was no way to turn it around except to change the administration from the

Ministry, which is a beastly bureaucracy unsuitable for managing live animals, to a private company with freedom to act as required for the good of the institution and its denizens. A proposal of this type was put up by the Central Zoo Authority[38] but it could not make its way through the molasses of the "human factor" which took issue with the implication that government can't run a zoo.

The Indian Wildlife (Protection) Act, 1972

The passage of the Indian Wildlife (Protection) Act in 1972 was the next significant event in wildlife and zoo history after Independence. The Act made some provisions for zoos and museums, capture of animals for zoos and keeping of skins and trophies for museums.[39] Between the passage of the Wildlife (Protection) Act and the present, more than 300 zoos were set up of which there is available record. On an average this is about 12 zoos per year. Even for a country to size of India, this is a formidable number for 24 states. These zoos were under many different administrative heads -- state forest department, municipal corporation, private, industry, trust, society, and central government.

The reasons for this phenomenal growth perhaps deserve a depth of analysis which is not possible here, but a few factors in the administration of wildlife or in Indian life can be mentioned which had an impact on the founding of zoos. One may begin with the supposition that public interest in wildlife increased naturally with the passage of strong wildlife legislation. There were other reasons as well.

Some zoos were outgrowths of animal holding centres constructed to keep the animals which were rescued or trapped for different reasons, or confiscated from persons holding them illegally. These holding areas naturally attracted the public and the step towards making them a zoo was short. Many other facilities were started simply because a politician or public servant such as a minister, a forest officer or district collector wanted to do something for the public or politician he served.

A number of the now listed zoos are privately run "travelling zoos" which go from village to village and earn a meagre living for their owners -

these might have been in existence for decades or even centuries as the family trade, along with animal trapping.

A few zoos were founded to replace old zoos or make use of royal collections. Some "specialist collections" such as snake parks were founded by individuals particularly interested in reptiles. Deer parks were started sometimes to "save" areas of land from other uses.

Finally, a few good zoos were initiated with foresight and care, out of a genuine conviction that zoos were a part of the conservation process and have been looked after very well by their state governments. In general, however, it is safe to say that most of the 300 odd zoos were set up for the wrong reasons. Time has proved this to be the case as most of them deteriorated without the personal interest of the individual who set them up and being totally dependent on the interest and financial position of the agency responsible.

Report of the Expert Committee : Management of Zoos in India -- 1975

In 1973, there was great concern over the proliferation and quality of zoos in India. An expert committee was formed[40] and toured the major zoos in India and came out with a comprehensive Report and recommendations.[41] This Report was truly excellent. The Committee pinpointed all of the major problems facing Indian zoos and suggested reasonable and effective solutions for these problems. As is the case when there is a special committee or task force, some of the suggestions were implemented straightaway, such as the resuscitation of the Indian Zoo Bulletin but unfortunately this energy could not be sustained at that time. Some of the more powerful suggestions languished on file for a long time, such as the National Zoo Policy and Central Coordinating Body for zoos, but could be implemented finally in the last five years. One truly convenient feature of strong bureaucracies is that, once something goes on record under the auspices of government, it is as if cast in stone. Bureaucrats in years to come can uncover these reports and files and use them to implement many projects which otherwise might never be achieved.

Official Visit of American Zoo Experts -- 1980

It is not the intention here to give undue importance to a visit from

American zoo experts in 1980 to evaluate the zoos of India and suggest methods for improvement. The visit was sponsored by the US Fish and Wildlife Service on the invitation of the Department of Environment. Several ranking zoo directors of the American Zoo Association were invited by the Government of India to come and give their comments on the state of Indian zoos. What is significant is that the experts were very impressed with the outer appearance - design and upkeep -- of most of the zoos they visited and with the dedication and knowledge of the directors they interviewed. It is interesting to note that many of their suggestions were precisely the same as the early meeting and expert report had made. They complimented the Expert Report lavishly. The visit is also significant in that the expert visitors put great emphasis on the need for coordination and cooperation between zoos and the development of a professional community.[42] It is possible that their recommendation led to the meeting of zoo directors held at Delhi in 1983 which was a very significant meeting.

Wildlife Action Plan -- 1983

The Wildlife Action Plan was brought out in 1983 as a 12 point plan for addressing various wildlife Issues in the country. The Wildlife Action Plan included several items pertinent to zoos, e.g. captive breeding, rehabilitation of endangered and threatened species, wildlife education and interpretation, research and monitoring, and collaboration with voluntary bodies.[43] At the same time a scheme for captive breeding in sanctuary areas under departmental protection was set up on a 50% matching grant with the state governments. The maximum grant from the Government of India share was Rs. 50,000 which, even when matched with an equal amount from the state did not cover the cost of a captive breeding programme. Several species programmes were begun but languished a few months or a couple of years after their inception. There was also a scheme for selected zoos for conservation items on the same 50% matching grant. The Wildlife Action Plan was considered a very progressive programme for wildlife conservation at that time.

Meeting of Zoo Directors at Delhi - 1983

The National Zoological Park with the backing of the Department of

Environment, Wildlife Wing, called a meeting of Directors of Indian Zoos on 24th and 25th May, 1983 at the National Zoo.[44]

This was the first time an All-India zoo directors meeting had been held since 1955 (more than 3 decades) at least according to available published records. In this meeting, important Agenda items were assigned to different working groups who formulated recommendations which were passed by the entire meeting. This meeting was of a very high level and could be considered an early Species Coordinators meeting. One of the very significant working groups concerned captive breeding of rare and threatened species. This group assigned different zoos to be responsible for certain rare species and these would be considered as "approved" breeding programmes to be implemented with 100 per cent funding from the central government. Other important items were Creation of a Zoo Service and conduct of workshops and seminars on important themes, etc.

One of the Agenda items dealt with the formation of an Association of Indian Zoo Directors which seems to have become combined with the concept of a central coordinating body which was described in some detail. It is clear from this discussion that the main purpose behind an Association and the distinction between an association and an authority was not given due weightage. The purpose of forming a professional association is far more profound than carrying out inspections and making decisions about animals - a professional association promotes a sort of "old boy network" through which much activity can take place in an informal way. Activities are carried out officially but the old boy network provides a sort of lubricant which eases the way. It also promotes the right sort of competition and as a result upgrades the professional standing of all members. Peer pressure, obtaining the approval or disapproval of our friends or persons we consider our equals, is a very strong tool - far stronger than rules and regulations. Professional associations should be completely autonomous, however. Also, professional associations rely heavily on long-term membership, experience and expertise which - as a result of the Indian transfer system - is in short supply. Only a few directors have been in place for more than five years.

In regard to the idea of forming a central coordinating body, it was noted that Indian zoos were managed by six different agencies such as central government, forest department, eduction and tourism departments of states, trusts and municipal corporations. It was decided that this body should be called the Zoo Authority of India and decide norms for important issues affecting zoos in India. It is interesting to note that when the Central Zoo Authority was formed some years later, the number of agencies running zoos in India was fourteen![45]

In the year 1982 the Department of Environment, Government of India brought a list of 44 zoos in India.[46] This was far less than actually existed. The official reply to queries about the rest of the zoos was that they were not "official" zoos, but as can be seen in the Central Zoo Authority List, by 1982, about 172 zoos had been founded, most of them by government agencies. It is another example of the growing tendency of government to provide a sort of "window dressing" which was not the same thing as genuine attention to zoos

Zoo Consultancy Project - 1988-91

In 1988, a Zoo Consultancy Project was initiated at the Wildlife Institute of India, the premier wildlife training and research institute in India. This Project was multifaceted and generally aimed to do all the tasks which had been set by the Zoo Superintendents meeting in 1955, the Report of the Expert Committee of 1975 and the resolutions of the several meetings of zoo directors held from 1982 until date. The former Director of the National Zoological Park was the author and Principal Investigator of the Project. The Zoo Consultancy Project was to have a profound influence on the pace and direction of the zoo movement in India. Under the project, a comprehensive Report on the status of zoos in India was to be prepared, standards and guidelines for management were to be evolved along with health care and disease control, master plans and management plans, education and interpretation programmes and research. The project was also to make recommendations for achieving the objectives of conservation breeding programmes and to suggest the structure, role and function of the proposed central coordinating body for zoos, the Zoo Authority of India. Finally the project was to develop and conduct training programmes for

professional and technical levels. Zoo directors with expertise in a particular area were called from time to time to discuss the various topics and help prepare the guidelines. Zoos were contacted and visited and data collected.[47]

No time was wasted in developing a Training Course for Zoo Personnel, the first of which was held at Nandankanan Biological Park in 1990.[48] Every year since that year a course for Directors or Supervisory and Technical Level zoo personnel has been conducted first by Wildlife Institute of India under the Zoo Consultancy Project and later by the Central Zoo Authority with assistance from the Wildlife Institute of India. Subsequently zoo keeper training in local language was organised annually on a regional basis at different zoos funded by the Central Zoo Authority. This training is ongoing and is the only systematic and regular, fully indigenous zoo management training course of any tropical country in the world.

Jt. Director for Zoo Affairs - 1988

A major catalyctic event for Indian zoos was the creation of an additional post of Jt. Director in the Ministry of Environment and Forests especially to look after zoo affairs. From this time, regular progress could be noted on behalf of the zoos in India. The combination of the Zoo Consultancy Project at Wildlife Institute providing hard information and an officer in the Ministry responsible for pushing ahead for high level changes was powerful and much was achieved as a result.

The Indian Zoo Directors' Association -- 1989

As previously mentioned, the recommendation for an Indian Zoo Association was mooted as early as 1955 at the First All India Zoo Superintendent's Meeting and this was approved by the Executive Committee of IBWL and the Zoo Wing of IBWL. The Association was again recommended in the Report of the Expert Committee in 1975 and discussed further in the meeting of zoo directors in 1983. Over the next few years and several meetings Objectives and By-laws were put up and modified as different persons came and went as Director of the National Zoological Park. Finally, at a meeting of Zoo Directors held in association with a Symposium on the Role of Zoos in Wildlife

Management at Sakkarbaug Zoo, a set of by-laws were approved and a President elected who would also be responsible for registering the Association which was completed about a year later.[49] The Indian Zoo Directors Association was duly registered and has met almost every year since either on its own or in association with the Central Zoo Authority since.

The Indian Zoo Director's Association brings out a quarterly newsletter, an annual volume called the Indian Zoo Yearbook and is in the process of bringing out a series of compendiums of research articles published by Indian Zoos from different journals throughout the world. Normally the Association is not represented at International Zoo meetings which is a great pity.

It may be very significant that the Indian Zoo Directors meetings organised by the directors themselves or, when it was formed, by the Indian Zoo Director's Association did not the same level of attention as meetings organised in association with the Department of Environment earlier and the Central Zoo Authority more recently. Also, meetings organised in association with a central body and which include very senior officers have a different atmosphere altogether. This is worthwhile to note because in evaluating the performance of Indian zoos and the Indian zoo community at this 50 year interval, it may be useful to question whether a surfeit of centralisation and bureaucracy is the best way to build up a professional community. There are multiple areas which can be handled only by the central government as represented by the Ministry and the Central Zoo Authority, and there are areas which may be best addressed by the people actually on the job of running a zoo; there is a possibility of a loss of both professionalism and fellowship if the Directors of Zoos are unable to have a genuine voice or to speak freely. There is no attempt at the joint meetings to control discussion; quite the opposite in fact. However, it is a fact of administrative life that senior officers, particularly in the services where there is a hierarchical organisational structure, have an inhibiting effect on free discussion.

National Zoo Policy

In the Expert Report, one of the recommendations was that India have a National Zoo Policy. In 1987, then Director of National Zoo, pushed for the

idea and approached the Joint Secretary in the Ministry for Environment who, together with the National Zoo Director, drafted a Policy. The Policy Draft was controversial; it contained strictures such as that no zoo should be founded within 100 km of a national park and on an area less than 500 acres, etc.[50] It was circulated to zoo directors and Chief Wildlife Wardens in all the states for comments and, finally, a meeting was convened of zoo directors, Chief Wildlife Wardens and non-governmental organisations so that a consensus could be reached on the Policy.[51] A Committee was formed to re-draft the National Zoo Policy on the basis of the meeting. The Committee brought out a Draft in just a week after the meeting, which was submitted to the Ministry[52] where it remained on file for quite some time. An enthusiastic Minister for Environment called for the file which was again reviewed by officials in the Ministry. Officials at this time felt that a Policy without legislation would not have any effect, so the Draft Policy was used as a basis for drafting a legislation to set up the central coordinating and monitoring body for zoos recommended so many years ago. Part of the structure proposed as part of the Zoo Consultancy Project was also incorporated. This had been approved by Zoo Directors at the Sakkarbaug Zoo meeting[53] and submitted to the Ministry in 1990. By this time, the Wildlife (Protection) Act required amendments which were about to be put before Parliament as the Wildlife (Protection) Amendments Act. The Zoo Act was incorporated into the Amendments Act at this stage which saved many years of red tape as it was passed in the same year, 1991.

The Zoo Act and Central Zoo Authority

The Indian Zoo Act may be the strongest piece of zoo legislation in the world to date. It provides for an autonomous Central Zoo Authority with a membership of 12 persons (half official and half non-official) chaired by the Minister for Environment. The objectives of the Authority concerned the following aspects of zoos 1) Minimum standards, 2) Evaluation and recognition, 3) Captive breeding management, 4) Training, professional development and research and 5) Public education.[54] The Central Zoo Authority has a generous budget the major portion of which it distributes to zoos on a 50% matching scheme with their administrative authority to improve their facilities for animals

and for visitor. An example of a priority project would be any proposal which involved setting right some aspect of the zoo that did not come up to standard during inspection.

Soon after the first Zoo Authority members were selected and the Authority set up, a committee was appointed to formulate the Recognition of Zoos Rules,[55] which laid down norms and standards by which zoos should be assessed. An Inspection Committee consisting of a minimum group of a manager, a veterinarian and educationist was set up and directed to systematically inspect the zoos of India. The zoo would be thoroughly inspected and assessed according to the legal norms and standards and recommendations given for bringing the zoo into line with the norms. The zoo, presuming it fell within a reasonable standard, would be given provisional recognition, time and funds as mentioned above to carry out the recommendations of the inspection committee. Then the institution would be re-inspected and full recognition for a three-year period granted. Zoos which were clearly unable to achieve any proximity to a decent standard, perhaps lacking a mechanism for improvement or administrative structure for acceptance and matching of funds, could be requested to close without provisional recognition. In this instant, the zoo would be given six months to "show cause" why it should not be closed. The zoo would be given time to dispose off the animals and some funds to compensate their workers. If the zoo could not dispose the animals, the Central Zoo Authority would find another zoo which would take them and also support them for their entire lifespan.

Much of India's zoo culture is governed by the country's religious, social and even political mores. The Hindu religion as well as some other sects honor life in such a way that precludes the taking of any life for any reason, even -- except in very extreme cases -- to end suffering. Therefore, the management practice of euthanasia or culling surplus animals is not an option. Moreover, most of the zoos do not want to take animals from the kind of zoos that have to be closed, as they are likely to be unfit, or at best very common species which any zoo has in plenty. Consequently, closing zoos cannot be undertaken lightly for many reasons, not the least of which is disposal of the animals. Yet, there

were plenty of zoos which were a disgrace to the Indian zoo community. It had to be done.

The Minister for Environment at the formation of the Zoo Authority suggested a methodology or philosophy for inspection of the zoos which was very wise. He said that the zoos should be evaluated not against an "ideal" standard but according to one which would make it possible for them to improve. In the second and subsequent phases of inspection they could be given a more rigourous scrutiny until a ideal appropriate for tropical conditions was reached. This way of thinking was followed during inspections.

In the Zoo Act the definition of "zoo" was deliberately contrived so that it would include practically any animal facility for the public, even (one could say, especially) travelling menageries, the tiny zoos in travelling cages which move from village to village with no respite from the tiny cage or proximity to visitors for the animals. In several other countries, zoo is legally defined as a "stationary" institution. In the case of the Indian Zoo Act however, it was desirable to insure that the Act could be applied to all substandard facilities which, if the definition excluded movable zoos, it could not.[56] Now even the travelling menageries, which number in dozens, can be inspected, found wanting and requested to close. In practice, this has proved to be very complicated due to a variety of social, economic and political factors.

Now, at the time of the 50 years of Indian Independence virtually all the zoos have been inspected and given an improvement programme. Many of them have been given financial assistance as well as extensive technical advice. In the process many things have been learned

Many of the zoos have carried out some of the improvements and brought their institution up to a better standard but some have been unable to do so. In some cases this inability has been due to the "human factor" by which interference from the centre may have been resented, or obstruction has been practiced for its own sake or out of inertia, or simply conclusions not agreed. In other instances, it seems simply beyond the administrative capacity of the zoo and their government to coordinate the work appropriately and in time. It may

be that in some situations the old bugger-bear of Indian zoo administration, transfer of officials, might have delayed, diverted or destructed the process.

Whatever the rate or degree of consumation of improvements of zoos, one major achievement outshines any lacunae, and that is the fact of having a clear picture or inventory of the state of all the zoos in India. Before the Central Zoo Authority (CZA), there was almost total darkness about more than 3/4 of the country's zoos. It was not even know how many zoos there were, much less what their condition. Now there is a list of zoos with all their features, the species, sex and number of animals, staff pattern, visitation and so on. A wealth of information now exists in the Central Zoo Authority data base from which researchers and analysts can pull a great variety of useful conclusions. This achievement alone puts Indian ahead of many countries.

One of the major reasons for formation of a central coordinating body given in the past such as the 1975 Expert report was the concept of creating a separate Zoo Service so that the transfer of officials would be from zoo to zoo and a professional community could build up. However, as a result of the diversity of organisational patterns and the complications arising from this, no one so far has been able to think of a way this could be done. Some of the State Forest Departments have evolved a policy of allowing individuals trained and experienced in wildlife or zoo management to stay in these fields. This is not an ideal or final solution but if the state government is truly interested in their zoos and maintains the policy, it is far better than haphazard transfer of officials. In the opinion of this discussant, it is this factor, more than any other, that has prevented the growth of a genuine professional community and excellence in zoological institutions in India.

State of the animals

The animals in the zoos of India consist of both indigenous as well as exotic species. For the most part the exotic species are not Threatened species and India is not a participant in any international species breeding programme involving exotic species. It has been the policy of the Government of India for some years to focus on indigenous species and this is an appropriate policy. In

fact it should probably be more rigorously applied until breeding programmes for Indian animals are established and well organised.

Unfortunately, India participates in only one international species breeding programme involving Indian species. There is a Red Panda breeding programme in which animals have been sent from European zoos to the Himalayan Zoological Park, Darjeeling which coordinates the Red Panda programme involving several zoos in Himalayan region.[57] A great many zoos in the world hold endangered Indian animals which they have bred with careful attention to genetic and demographic principles. They are willing and even anxious to part with animals for the sake of conservation programmes but this aspect of zoo activity is moving very slowly in India. The reasons are many - communication difficulties, legal and administrative constraints, policy and philosophical differences ... and probably the ubiquitous "human factor".

Even within India it has been almost impossible to move animals from zoo to zoo, except for very dramatic exchanges in which the zoos get dramatic new animals. The Indian Tiger Breeding Programme languished for more than a year before even one animal was moved to the designated zoo. The anomalies of the Indian administrative system are surely at fault here. Unless some of these problems are rectified, however, it is difficult to see how there can be a coordinated breeding programme for any animal in the Indian zoo scenario. Without this, conservation action with respect to zoos has no meaning at all.

Threatened v.v. Non-threatened Species and Individuals

Another very big problem is the dramatic anomaly between the number of threatened and non-threatened animals which are kept in Indian zoos. Today zoos have to husband their space and resources carefully so that they will have the ability to maintain and breed threatened species in sufficient numbers with appropriate genetic and demographic configuration. Threatened species with dynamic conservation potential obviously should be priority species in any collection policy or plan.

Recently a series of workshops assessed the conservation status of most Indian vertebrates according to the IUCN Red List Criteria. An analysis of the

CZA animal data base for Indian mammals shows that the zoos are overwhelmed with species of wild animals which have been categorised as Lower Risk and are not threatened, at the expense of Critically Endangered, Endangered and Vulnerable (Threatened) species. Systematic, conservation oriented collection-planning principles (as well as common sense) suggest that zoos devote more space to Threatened species which may require active intervention (reintroduction, strengthening, etc.) to prevent extinction, and less to Non-threatened species which are, for the present in any case, safe in the wild without human support.[58]

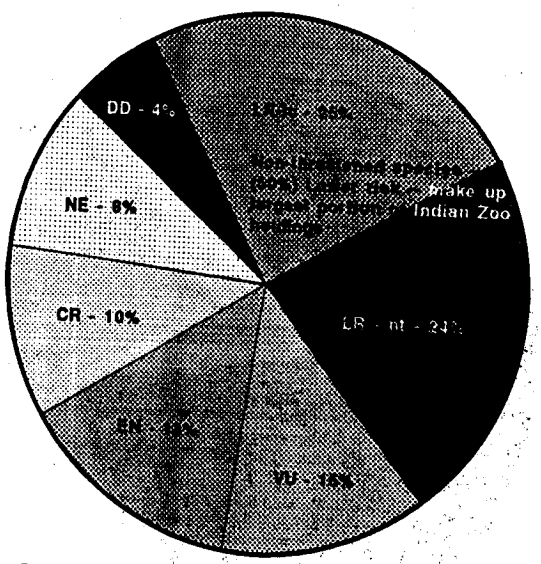
As illustrated by the Charts below, the number of "Non-threatened" taxa (Lower Risk near threatened and Lower Risk least concern), listed both by species and by individual numbers far outweighs "Threatened" taxa (Critically Endangered, Endangered, Vulnerable). If conservation is the highest priority for all zoos, these percentages should be reversed.

This is not new information. It is well known in India that zoos are burdened with surplus stock of common and non-viable animals. It may be the first time the information has been quantified according to a systematic and scientific methodology, however. In addition to the thousands of Lower Risk - least concern individuals (such as spotted deer [which number almost 7000 alone], nilgai, sambar, etc.) there are also hundreds of hybrid lions and even other large mammals of questionable linage and genetic makeup..[59] Large-bodied mammals utilise an enormous amount of zoo space as well as resources such as food and attention from the zoo staff. If they are common animals this is a total waste of conservation energy. If they are meaningful in terms of conservation, e.g. Threatened in the wild, they need to be correctly managed for genetic viability and demographic stability or there will be wastage in maintaining them also. These comments, it should be emphaised, are made in the context of conservation of endangered species, only, without regard to welfare consideration. In India, with its vast space and number of zoos, it is possible to reconcile conservation and welfare, but not without very careful planning, as described in the introductory part of this discussion

The Chart I, illustrating the species-wise number of Indian mammals in Indian zoos shows that nearly half the number of species fall in Non-threatened

Chart I

Indian Mammals in Indian Zoos according to Conservation Status of Species number (vis a vis individual numbers) CZA Data Base and BCPP CAMP, August 1997



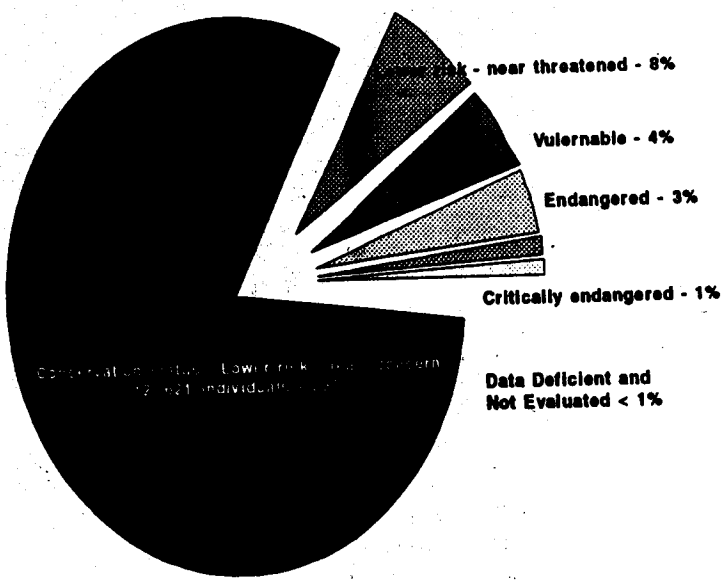
CR Critically endangered - 10%
EN Endangered - 13%
VU Vulnerable - 15%
LRnt Lower risk - near threatened - 24%
LRlc Lower risk - least concern - 25%
DD Data deficient - 5% -
NE Not evaluated - 8%
Total number of species : 82%

categories (LR-nt and LR-lc). For a variety of reasons (education, expertise, etc.) one might regard this as an acceptable spread, taking Indian conditions into consideration. However Chart II (below) gives an alarming picture.

Chart II illustrates the number of individual mammals in zoos, which is indicative of how resources (space, finance, energy) are being utilised. It shows that a whopping 83% of Indian captive mammal individuals are from the Lower-risk least concern category. If Lower Risk - near threatened individuals (also a Non-threatened category) are amalgamated with Lower Risk least concern, the percentage is significantly higher at 91%. Regardless of which of these percentage is used, according to any national or international guideline or policy, this is far too many common animals.

This analysis has been made using data from the Central Zoo Authority

Chart II
Indian Mammals in Indian Zoos according to Conservation Status of Individuals according to CZA Data Base and BCPP CAMP, August 1997



data base and the BCPP Mammal CAMP both dated August 1997.[60] During the nearly one year since this data was current, dozens and hundreds of additional spotted deer, nilgai, blackbuck, as well as other common species would have been born which would skew this percentage even more. Unfortunately, it seems that the rate of growth of these common species in Indian zoos far exceeds the rate of growth of endangered species. This is an observation only and needs to be quantified.

It should be noted that these figures are only for Indian mammals. Exotic species of mammals in Indian zoos are - as mentioned earlier - surplus to any international conservation programme and, for the most part, not even endangered. Moreover these do not include hybrid lions. If these figures were added to the above, the percentage of non-conservation relevant individuals would again increase.

It is hoped that these figures would clarify the very serious problems in the Indian zoo conservation scenario and reinforce the earlier suggestion that different types of zoos take responsibility for different types of animals with the

larger , more experienced and better resourced zoos focusing on Threatened species and viable (genetically, demographically, and physiologically) individuals.

Small bodied animals

If we speak in terms of biodiversity conservation, zoos all over the world give the public a very misleading picture of the Earth's wealth of organisms. A zoo visitor, if he had no other educational input except the zoo, would be justified in thinking that the majority of organisms in the world were large mammals, followed by birds and reptiles and - only in some western zoos - amphibians, fish and invertebrates. The genuine picture is almost the converse of this with invertebrates dominating the scene utterly.

This discussion will be limited to mammals. The most recent checklist of Indian mammals as corrected at the BCPP CAMP Workshop contains more than 400 mammals of which 372 were assessed by the workshop. Of mammals, the small bodied species, three Orders Chiroptera, Rodentia and Insectivora (bats, rats and insectivores -- shrews, hedgehogs) make up more than 60% of the total mammalian biodiversity in India. There is, incidentally, no published scientific guideline for "small". Here these three orders have been used because they are unarguably small as compared to all other medium and large bodied mammals and, for the most part, not a threat to man. As a further means of both limiting this discussion and focusing on importance, we speak only of endemic mammals in this section.

Endemism is one of the high values used when prioritising species for conservation action, including captive propagation. In the BCPP Mammal CAMP, 54 of the 372 mammals assessed were endemic, meaning that they are found in India and no where else. The percentage of endemism for other groups such as amphibians and reptiles was considerably higher. For this discussion mammals will be used for the sake of simplicity as well as brevity and also because amphibians and reptiles are all - with perhaps a dozen exceptions - small bodied and non-dangerous to man.

Of the 54 endemic mammals assessed at the workshop only 11 are not small-bodied. Therefore, approximately 80% of endemic species are small. This

is more than the 60% overall representation of the selected orders.

In terms of endangerment, many small bodied Indian mammals are threatened with extinction. Of the endemic mammals listed, exactly 50% come into a threatened category. The number may be even higher in fact, but these Orders are difficult to study - 8 of the 43 small-bodied, endemic species were assessed as Data Deficient and required further studies to supply information for deriving conservation status.

Visitors and zoo managers alike enjoy the size and beauty and sheer drama of the large bodied mammals, what the conservation community calls the "charismatic megavertebrates". However, it has been demonstrated that large bodied mammals are more difficult and expensive (both in space as well as resources) to keep.[61] Moreover, many of the large bodied mammals provoke large problems when returned to the wild in reintroduction programmes, problems like man-eating, cattle-lifting, crop destruction, etc. Many such reintroductions could be non-starters as the habitat and conditions which cause the extinction or reduction of population of such large animals in the first place may be difficult or impossible to rectify for them.

Moreover, research on zoo visitors has revealed that although visitors may come to the zoo with the expectation of seeing a large animal in mind, small bodied creatures, if they are well-displayed, are equally attractive and popular.[62]

Therefore, since there are numbers of small bodied mammals which carry very high conservation value, e.g. being both endemic and Threatened, and since small bodied mammals may be easier, cheaper and less controversial to breed and reintroduce, and since visitors will not mind seeing small bodied animals if effectively displayed and interpreted, Indian zoos may think of re-orienting their priorities around some of the small-bodied mammals which are currently being ignored.

The principles of systematic and scientific breeding, care and preparation for almost any animal are the same. The sciences of population dynamics, genetics, demography and the technology and discipline connected with it could

be learned more quickly and effectively using smaller bodied mammals as their breeding cycle is shorter. Non-threatened and non-endemic species, of which there are plenty, could be used in the initial stages and Threatened species after techniques were perfected. Results - and reinforcement, a necessary part of learning a new skill - would be forthcoming relatively quickly.

In the introductory part of this discussion we proposed that every zoo of every size be made conservation-relevant by using the mini-zoos and deer parks as holding areas for surplus animals from Large, Medium and Small zoos. In the same manner, some of the good Small zoos which are short on acreage, could specialize in small-bodied animals, not just mammals but invertebrates and amphibians which are totally neglected in Indian zoos, as well as reptiles. In the first Indian zoo superintendents meeting in 1955, the idea of displaying insects was brought up which was a very new concept for zoos in those days. A couple of zoos have set up butterfly displays (Arignar Anna Zoo and Guindy Park) but they are not breeding or self-sustaining; only one zoo has attempted to breed amphibians (Madras Crocodile Bank).

The discussant is fully aware of the torment zoo directors endure from visitors complaining over the lack of diversity and drama of their zoo collection. Sometimes the visitor complaining is a politician or senior bureaucrat which can be a serious matter for the zoo. The Central Zoo Authority can solve this problem by creating, with the help of respresentatives in the zoo and wildlife community, a national zoo conservation action plan which includes a blueprint for what zoos can keep. The zoo and wildlife community can be included in making this plan after becoming sensitised to the implications of NOT bringing about a complete transformation in the way Indian zoos manage their animals. This may be the only way to set the situation on a more positive course.

Such strong decisions and actions can be taken only by an Authority which has the powers, if it will exercise them, to bring about such a transformation. The key to such a plan will involve educating policy makers and decision makers at the national and particular the state level. This will require a massive and sustained initiative of its own.

These are "ideal" methods which may be totally impracticable. In the past, however, compromise - trying to please everybody - has not worked in the interests of zoo conservation. There needs to be a full recognition that we are merely "talking" conservation, without a single genuine achievement to back up our claims. So far, no endangered species has been reintroduced successfully or genuinely strengthened by zoo efforts. There will be no achievement without full recognition of the flaws and lacunaes and a strong determination to set it right, whatever the cost.

International Cooperation

While this paper has been extremely forthright in describing the lack of activity in terms of international species breeding programmes, it would be extremely unfair to fail to mention the tremendous improvement which has taken place in international cooperation since the formation of Central Zoo Authority. Previously it was almost impossible for an Indian zoo manager or official to attend one of the important international zoo meetings which are held annually under the auspices of the Conservation Breeding Specialist Group of SSC, IUCN and the World Zoo Organisation, formerly IUDZG. Since the formation of Central Zoo Authority, India has been represented by an official almost every year. The degree of participation has been universally appreciated and the India representative has been asked to serve on committees and participate in strategic planning workshops. The Indian zoo community has achieved tremendous stature in the international community as a result of the regular attendance, presentation of reports and performance of the Central Zoo Authority official.[63]

The "return" for an investment of sending officials to such meetings is enormous, both in upholding the country's image and prestige as well as keeping up with the most modern scientific concepts and making contacts which can provide both (Indian) animals and expertise for the Indian zoo community. The Central Zoo Authority would do well to send more representatives to these meetings, e.g. the President or a representative of the Indian Zoo Directors' Association, a representative of the veterinary community employed in a zoo and the Addl. Inspector General of Forests (Wildlife) in addition to the Member

Secretary, CZA, representatives of the state Chief Wildlife Wardens and other Members. (If this suggestion seems excessive, it may be useful to note that both China and Japan send from 3 - 8 official representatives to the Annual Meeting of the Conservation Breeding Specialist Group every year. The expense of doing so would be offset a thousand-fold in improvements to the collection, planning and species coordination in the Indian zoo scenario which is the source of conservation success.

Evolution of Indian Zoos

Returning to the model Dr. Rabb has suggested in his Evolution of Zoos diagram, and overlaying events and trends in Indian zoo history in the last 50 years, it is clear that officialdom in the central government as well as the zoo directors acting as a group have been thinking of and reaching for a zoo ideology which is as current and correct as any in the world. There is nothing wrong with the thinking, planning, administration or legislation. However, when it comes to implementation - particularly when implementation involves several departments of government even in the same service and even in the same state, what seemed straight forward and emminently "do-able", becomes transformed into a hopeless tangle of obstruction, delays, obfuscation and - ultimately - utter perversion of the original plan. While this may sound like bureaucracy anywhere, and it is so to a great extent, in many other places in the world, things get done ... and in a reasonable period of time, whereas here in India the footdragging can go on for years, or forever. This must be examined in relation to the zoo subject and a means to overcome it or get around it found out.

Let us review the Evolution of Zoos model with regard to Indian zoos.

Themes

With regard to Themes, it has been stated that all the themes of all trends are valid - taxonomy, ecology, and environment with regard to education, but that the role of zoos today should encompass all, particularly in regard to changing attitudes of visitors. Indian zoos of any size can teach a more holistic view of the world even if they don't have all species of animals or all manner of trappings to illustrate it.

Subjects

We can say the same of Subjects : all are valid to teach and to learn, e.g. diversity of species, adaptations for life, habitats for animals, behavioural biology, ecosystems and survival of species. Modern zoos would want to incorporate the strictly biological, such as species diversity and animal adaptations into a larger framework of habitats, ecosystems, and environmental protection.

Concerns

It is in the area of Concerns that the most rigourous analysis of Indian zoo performance must focus. First, Species husbandry is probably not an issue with some of the better zoos which have three veterinarians and modern facilities to match almost any in the world, although very subtle aspects of nutrition and its effect on propagation could still be assimilated with better result. Many Indian zoos still need much improvement in basic animal care. Most of the zoos have bred animals, in fact they have overbred some species to the point of causing a problem. Careful attention to sustained breeding of endangered and delicate species still needs to be improved; although many zoos have bred animals, only a few have bred past the second or third generation (except for animals like deer, which are inbred for lack of infusion of fresh genetic material). In the area of Concerns, therefore, most of the zoos in India are still in the menagerie phase.

Cooperative species management --

In Rabb's model, cooperative species management and professional development became major concerns during the Zoological Park phase when skills in husbandry and propagation had been mastered. In several instances in this discussion it has been pointed out that Indian zoos have failed completely failed to adhere to any sustained programme of cooperative species management. In several zoo meetings list of priority species have been enumerated and assigned to appropriate zoos for responsibility, yet there is not a single species that has been systematically managed by any group of Indian zoos. Individual zoo directors have made serious efforts to put those plans into effect but have been stymied by the inability of other zoos (for whatever reason) to cooperate and

These exhibits, as beautiful as they are, are not appropriate for India where the number of visitors is so much that control is out of question. Wear and tear on such exhibits with such climatic conditions as we have in India and visitor pressure would exceed the ability of the zoo to keep it up.

India has developed its own, indigenous form of the immersion exhibit which is fully as appropriate for the Conservation Centre phase. Harrison, has described and named this exhibit and singled it out as a "quantum leap in zoo planning on par with Hagenbeck's tierpark, safari parks, and marine parks."[64]

Harrison refers to it as the "Biological Park". It has been developed by the Indian Forest Service. According to Harrison, "the most recent developmental phase of zoos, still in process, is a type of facility called the 'biological park, which in fact are very large, naturally vegetated, naturalistic designs, the essence of which is a ' total ecological display of animals'.[64]

Indian "Biological Parks" are very large zoos, showing animals in enormous display areas which are suffused with natural vegetation. When we say "natural vegetation" we don't mean plants were brought in from far away and cultivated at great expense but plants which naturally grew in the area. Most of the true biological parks formerly were degraded areas of forest which, when allowed to regenerate, turn into lush forested areas again.[65]

Normally Biological Parks are stocked with animals which well might have ranged the very same area in the past. Indian Biological Parks normally keep an Indian focus. Some of them specialise in animals of their own state, e.g. the Van Vihar National Park (Zoo) of Madhya Pradesh. An upcoming park intends specialising in animals and plants native to the Nilgiri Biosphere Reserve in which it is sited. Most have very innovative features, such as the underground aviary at the Visakhapatnam Zoo or Indira Gandhi Zoological Park and the aviaries which mimic the various bird sanctuaries of Tamil Nadu State at their Arignar Anna Zoological Park. There are others; the discussant hesitates to list them as the line between a biological park and a zoological park can be thin.

Also, not every genuine Biological Park in Harrison's sense is named "biological park", and some zoos which have the term as part of their name do not actually belong to the genre.

Having access to large tracts of land has made such parks possible and may, indeed, have been the inspiration for them. In some instances it was nearly the only way to salvage the land from being developed as a shopping mall or housing complex.[65] These parks could provide a heretofore missing link between captive conditions and wild, if organised properly. The enclosures size can vary from a quarter or half acre to as large as 50 acres as in the case of Van Vihar. While 50 acres may not come close to the actual "territory" of a large carnivore, it is without doubt a better replica of its habitat than a traditional zoo enclosure. Probably only a few countries have such land to spare for such facilities. India may be in a better position to experiment with large carnivore releases as a result.

There are problems with biological parks, however, such as that the enclosures are so large that the public can't always see the animals and special arrangements have to be made. Also, the concept of humankind upon which these biological parks is founded presumes a far more active interest and motivation than most visitors actually have. People are expected to look at these beautiful forested areas and learn to appreciate nature. While this is a laudable objective and noble in theory, it has been demonstrated that most visitors need a great deal of interpretation provided in order to be affected in the way we want them to be.

Moreover, no zoo so far has used the vast area of their biological park appropriately for conservation. While the bear enclosure at Van Vihar is 30 acres, only two or three animals can be out at the same time while perhaps half dozen or a dozen more (confiscated from street performers perhaps) languish in tiny cells off exhibit. There are very formidable management problems also, such as convincing the animals to come in at night. The animals have to be fed in the afternoon in front of the public since that is the only chance they are

guaranteed a look at the animal, so when closing time come, there is nothing to tempt the animal into its holding cage !

These problems notwithstanding, the biological park is still evolving and is a magnificent experience for those who can and will appreciate it. It is a credit to the Indian zoo community.

The Human factor

The "human factor" has been mentioned often in this discussion. What, precisely, is the "human factor"? Is it possible to describe it ? The "human factor" can be summed up in the following contrivance which the discussant calls the "three E's of Extinction", e.g. egoism, envy and elitism.[66] These defects of character afflict every human being and life is, or should be, a constant battle to overcome them. If one looks hard enough at every conservation connundrum within the administration of zoo and wildlife affairs, one or a combination of all of these characteristics will be found at the bottom of every problem. These characteristics afflict both individuals and institutions, because institutions take on a "personality" which is the sum of its members.

What we require in order to make conservation work in India (and in the rest of the world as well) is for every individual and institution to make an effort to rid themselves of the three E's. The first step is the hardest and that is simply to admit one has them.

Getting rid of the three E's won't leave a vaccuum - there is plenty to fill the void. For a start we suggest the three C's of Conservation - communication, cooperation and collaboration. The three C's are the engine which drives the international zoo community and makes zoo conservation possible..

In this discussion, we have twice or more indulged in projection of what might be a more better (and in the long term, more practical) way of organising conservation priorities, animal collections and zoos themselves. We have suggested focusing more attention on smaller bodied animals (small mammals such as rodents and bats), amphibians, reptiles, invertebrates, despite the fact that the public is already crying for zebras, giraffes and gorillas. We

have suggested that different size zoos be given different priorities , despite the fact of the tremendous difficulties CZA has faced in establishing even basic priorities for the better zoos.

We have suggested that zoos of different sizes and resouces maintain animals appropriate to their ability with threatened species being kept by better resourced zoos and common animals (particularly surplus) being kept by less-well-resourced zoos. This, despite the fact that zoos have been unable to move highly threatened animals from non-breeding to potential breeding situations. The discussant is fully aware of the difficulties, and of the seeming impossibility of these suggestions. It is not impossible, however. It is a matter of the zoo community becoming a genuine professional community and agreeing on a vision and honest definition for itself.

Having a vision of some version of perfection or "utopia" is extremely important -- perhaps crucial -- to the ability of individuals, associations of individuals, and even societies to maximise the "human possible". In his article, "Positive Image, Positive Action: the Affirmative Basis of Organising", David L. Copperrider reviews recent research on positive thinking or image on performance. Research has demonstrated that individuals and associations of individuals perform better - in the workplace, in the family, and even in their own body (personal health) when they internalise a positive image of themselves. Copperrider also discusses the positive image as a dynamic force in culture, postulating that "the underlying images held by a civilization or culture have an enormous influence on its fate." Referring also to Dutch sociologist Fred Polack's conclusions, he sums up "almost without exception, everything society has considered a social advance has been prefigured first in some utopian writing" While the word "utopia" is used sometimes in a contemptuous manner, historical analysis shows utopia - in Polak's words "a powerhouse ... Scientific management, full employment, and social security were all once figments of a utopia-writer's imagination."[67] Other western world examples are given but India has its own examples, of the which most obvious - and appropriate for this volume of Indian Zoo Year Book.

This discussant has been very hard on Indian zoos in this paper and readers will have to trust that the critical remarks were made in a positive and constructive spirit. It is crucial to honestly admit where you are in order to move forward in the right direction. Without that, without admitting that all is not well, movement is not possible. If people had been happy, or dishonest about realities, Independence would never have happened.

Indians live all over the world today and, along with other Asians, outstrip every other culture in academic and business success. India has all the raw materials for success in zoo keeping, zoo education and zoo conservation. More effort to bring the materials together -- to form a genuine professional community with a utopian vision -- could result in the best zoos and the most successful conservation programmes in the world. The Central Zoo Authority is the result of a long and hard effort to make a coordinating body for zoos. This unique and powerful organisation can play the major role in leading the Indian zoo community into the 21st Century and its own version of the Conservation Centre.

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Appendices

Appendix I
List of Indian Zoos from 1800 up to Independence and starting of IBWL

	Name of Zoo	Starting date
1.	Barrackpore Park, Barrackpore	1801 (Closed 1878)
2.	Marble Palace Zoo, Calcutta	1854
3.	People's Park, Madras (Chennai)	1855
4.	Lalbaug Zoo, Bangalore	1855
5.	Trivandrum Zoo, Thiruvananthapuram	1857
6.	Sakkarbaug Zoo, Junagadh	1863
7.	Kota Zoo, Kota	1865
8.	VJB Udyan Zoo,Mumbai	1873
9.	Alipur Zoo, Calcutta	1875
10.	Jaipur Zoo, Jaipur	1877
11.	Hyderabad Zoo (old)	1877
12.	Udaipur zoo, Udaipur	1878
13.	Sayaji Baug Zoo, Baroda (Vadodara)	1879
14.	Shivaganga Gardens Mini Zoo, Tanjore (Thanjavur)	1882
15.	Trichur State Museum and Zoo, Trichur (Thrissur)	1885
16.	Sri Chamarajendra Zoological Gardens, Mysore	1892
17.	M.S. Chhatrapati Zoo, Kolhapur	1893
18.	Maharaj Baug Zoo, Nagpur	1894
19.	Prince of Wales Zoo, Lucknow	1921
20.	Gandhi Zoological Park, Gwalior	1922
21.	Bikaner Zoo, Bikaner	--
22.	Jodhpur Zoo, Jodhpur	1936

Some zoos have two or more "starting dates" . Because these dates come from equally reliable references it is not possible to ascertain which is correct. Possibly the earlier reference is the date of starting and the later is the date of opening. Here the earlier date has been given.

Appendix II
List of Zoos from Independence (and IBWL appx.) to the Passage of the Wildlife Act, 1972

	Name of Zoo	Starting date
1.	Montford School Mini Zoo, Yercaud	1950
2.	Kamala Nehru Zoological Garden, Ahmedabad	1951
3.	Children's Park, Guindy, Madras	1952

4.	Peshwe Park Zoological Garden, Pune	1953
5.	Municipal Council Beawar Zoo, Beawar	1954
6.	Diamond Tourist Zoo, Patna	1955
7.	Bharat Zoo, Patna	
8.	Sarnath Deer Park, Varanasi	1956
9.	Bal Bhavan Children's Dreamland, Rajkot	
10.	Tutikanid Zoo, Shimla	1958
11.	Renuka Zoo, Sirmur	
12.	Tourist Janta Zoo, Patna	
13.	Maithon Dam Deer Park, Hazaribagh	
14.	Maharaja Fatesingh Zoo Trust, Baroda (Vadodara)	
15.	P.N. Himalayan Zoological Park, Darjeeling	
16.	Assam Zoo and Botanical Garden, Guwahati	
17.	Nehru Zoological Park, Hyderabad	1959
18.	BITM Animalorium, Calcutta	
19.	National Zoological Park, New Delhi	
20.	Municipal Deer Park, Rajahmundry	1960
21.	Indira Gandhi Park Zoo, Rourkela	
22.	Nandankanan Biological Park, Orissa	1960
23.	Satsang Zoo, Satsang	
24.	Ramond Tourist Zoo, Patna	
25.	New Ramond Tourist Zoo, Patna	1962
26.	Tailaiya Chacha Nehru Island, Hazaribagh	
27.	Rustomji Deer Park, Gangtok	
28.	Safari Park, Udaipur	1963
29.	Amar Tourist Zoo, Patna	1964
30.	Seminary Hills Deer Park, Nagpur	1965
31.	V.O.C. Park Mini Zoo, Coimbatore	
32.	Snake Park, Shikshan Mandal, Kolhapur	1966
33.	Amirdhi Zoo, Vellore	1967
34.	Jaya Mobile Zoo, Howrah	
35.	Ramakrishna Mission Mini Zoo, Narendrapur	
36.	Panchwati Deer Park, Pilani	
37.	Tura Zoo, Tura	
38.	Bir Moti Bagh Deer Park, Patiala	1968
39.	Gemini Tourist Zoo, Patna	
40.	Famous Mobile Zoo, Howrah	
41.	Deepak Mitra's Snake House, Calcutta	
42.	Krishna Giri Upwan, Borivali	1969
43.	Bondla Zoo, Panaji	

44.	Indira Gandhi Zoological Park, Visakhapatnam	1970
45.	Manjunatha Mini Zoo (Mobile), Chennai	
46.	Ajanta Tourist Zoo, Patna	
47.	Lalbaug Deer Park, Bangalore	
48.	Sir Peter Scott Nature Park, Jamnagar	
49.	Mrig Van, Chitorgarh, Udaipur	
50.	A.N. Jha Deer Park, Delhi	
51.	Deer Breeding Farm, Warangal	1971
52.	Kanpur Zoological Park, Kanpur	
53.	Deer Park, Hissar	
54.	Chennai Snake Park Trust, Chennai	
55.	Harishankar Deer Park, Balangir	
56.	Anitha Mobile Zoo, Baruipur	

Appendix III

List of Zoos from the Passage of the Wildlife Act up to Passage of Zoo Act

	Name of Zoo	Starting date
1.	Yadavanda Garden Tourist Complex Mini Zoo, Pinzore,	1972
2.	Navegaon Bandh Wildlife Orphanage, Nagpur	
3.	Gandhamardan Deer Park, Balangir	
4.	Children's Park, Sirsi, Karnataka	
5.	Childrens' Park and Zoo, Gadag, Karnataka	
6.	State Zoological Park, Kohima, Nagaland	
7.	Maitri Baug Zoo, Bhilai, Madhya Pradesh	
8.	Mini Zoo, Chandigarh	1973
9.	Neelan Deer Park, Ludhiana, Punjab	
10.	Kukrail Deer Park, Lucknow	
11.	Pal Wild Animal Orphanage, Jalgaon, Maharastra	
12.	Sanjay Gandhi Biological Park, Patna	
13.	Lady Hydari Park and Animal Land, Shillong, Meghalaya	
14.	Sepahijala Zoological Park, Sepahijala, Tripura	
15.	Kinnerasari Deer Park, Kinnersari, Andhra Pradesh	1974
16.	Cheetal Grand Motels Pvt. Ltd., Muzaffarnagar	
17.	Amte's Orphanage cum Rescue House, Gadchiroli	
18.	Children's Mini Zoo, Dharwad	
19.	Children's Park Mini Zoo, Shimoga	
20.	Bannerghatta National Park and Zoological Garden, Bangalore	
21.	Calcutta Snake Park and Zoological Garden, Alipore	
22.	Deer Research Centre, Calcutta	
23.	Kamala Nehru Prani Sangrahalaya, Indore	

24.	Chilkanna Bharat Mini Zoo, Saharanpur	1975
25.	Mahavir Harina Vanasthali Deer Park, Vanasthalipuram	
26.	Sitapur Pardesi Chirya Ghar, Avodh	
27.	Gharial Research & Conservation Unit, Tikarapara, Angul	
28.	Indira Udyan, Bilaspur	
29.	Kanan Pendari Zoo, Bilaspur	
30.	Pillalamarri Deer Park, Mahabub Nagar, Andhra Pradesh	1976
31.	Malsi Deer Park, Dehra Dun	
32.	Gangaikondam Deer Park, Kattabomman	
33.	Gharial Rehabilitation Centre, Kukrail, Lucknow	
34.	Hutatmabag Prani Sangrahalaya, Sholapur	
35.	Madras Crocodile Bank Trust, Chennai	
36.	Hogainakkal Mini Zoo, Dharmapuri	
37.	Panthanivas Deer Park, Balasore	
38.	Manipur Zoological Garden, Imphal	
39.	Mini zoo, Silvasa, Dadra & Nagar Haveli	
40.	Rambagh Mini Zoo, Amritsar	1977
41.	Mahendra Chaudhury Zoological Park, Chhat Bir	
42.	Hindalco Industries Deer Park, Sonbhadra	
43.	Ramgarh Vinod Van Mini Zoo, Gorakhpur	
44.	Neyyar Dam Crocodile Farm, Thiruvananthapuram	
45.	Peruvamymuzha (Crocodile Farm) at Kozhikode	
46.	Mahatma Gandhi Rastriya Udyan Zoo, Sholapur	
47.	Shantiniketan Student Nature Club and Zoo, Sangli	
48.	Tadoba Crocodile Centre, Chandrapur	
49.	Aizwal Zoo, Aizwal, Mizoram	
50.	Jawahar Lake Tourist Complex, Shamirpet	1978
51.	Bir Talab Deer Park, Bhantida, Punjab	
52.	Sanghi Municipal Council Zoo, Sanghi,	
53.	Joseph's Mini Zoo, Coonoor	
54.	Kurunpatti Zoological Park, Salem	
55.	Municipality Deer Park, Cuttack	
56.	Jaiprakash Park, Bodhgaya	
57.	Indroda Nature Park, Gandhinagar	
58.	Udaipur Zoo, Udaipur	
59.	Mrignayni Deer Park, Pachamarhi	
60.	Miao Mini Zoo, Miao	
61.	Vansarbagh Mini Zoo, Sangrur, Panjab	1979
62.	Nawab Tank Mrig Vihar, Banda, Uttar Pradesh	
63.	Katerniaghat Gharial Rehabilitation Center, Bahraich	

64.	Royal Kennel Charity Trust, Bombay (Mumbai)	
65.	HAL Deer Park, Koraput	
66.	Kapilash Zoo, Dhenkanal	
67.	Jaiprakash Udyan, Bhagalpur Town	
68.	Sundervan Nature Discovery Centre, Ahmedabad	
69.	Nandan Van, Raipur, MP	
70.	Gharial Breeding Centre, Deori, Morena	
71.	Mrugayani Chilkur Deer Park, Chilkur, Andhra Pradesh	1980
72.	Rose Garden Mini Zoo, Ludhiana, Punjab	
73.	Kanchula Kharak Musk Deer Breeding Centre, Chamoli	
74.	New Pardesi Touring Zoo, Hardoi	
75.	Kodanadu Mini Zoo, Kodanadu	
76.	Rani Baug Zoo, Buldhana	
77.	Chilka Deer Park, Chilka	
78.	Kudremukh Mini Zoo, Kudremukh	
79.	S. I. Works Quarry Pvt. Ltd., Baroda	
80.	West Bengal Snake Park and Laboratory, Badu	
81.	Dow Hill Deer Park, Kurseong	
82.	Deer Park and Mini Zoo, Jhargram	
83.	Zoological Park, Itanagar	
84.	Vijay Vihar Deer Park, Nargarjun Sagar	1981
85.	Deer Park, Tirumala Hills, Chitoor, Andhra Pradesh	
86.	Chitoor Deer Park, Chitoor, Andhra Pradesh	
87.	Narain Tewari Deer Park, Almora	
88.	Vivekanand Vidhya Mandir Zoo, Buldana	
89.	Sri Gajanan Vatika, Buldana	
90.	New Janta Travelling Zoo, Patna	
91.	Bellary Children's Park Mini Zoo, Bellary	
92.	Kondaji Deer Park and Mini Zoo, Chitradurga	
93.	Mini Zoo, Hassan	
94.	Baguwa Pheasant Farm, Jorethary	
95.	Van Vihar National Park, Bhopal	
96.	Vikram Vatika, Ujjain	
97.	Deer Park Research Station, Sirpur	1982
98.	Indira Park, Bijnor	
99.	Amaltas Mrigdav, Kalpi, Orai	
100.	Van Chetna Kendra, Agra	
101.	Mini Zoo, Bhiwani	
102.	Deer Park, Gangapur	
103.	Motijharan Deer Park, Sambalpur	

104. Muta Mugger Breeding Centre, Ranchi
105. Prakruti Vana Mini Zoo, Mandya
106. Kumari Kangsabuti Deer Park, Bankura
107. Himabindu Deer Park, Kurnool, Andhra Pradesh 1983
108. Van Chetna Kendra, Musoorie, Uttar Pradesh
109. Small collection of Animals, Anarparthi, Andhra Pradesh
110. Van Manoranjan Kendra, Rampur
111. Rewalsar Wildlife Zoo, Mandi
112. Tikuji Ni-wadi Zoo, Thane
113. Shivaji Udyan, Nasik, Maharastra
114. Baharpur Runkun Vihar Zoo, Gaya
115. Kadri Hill Deer, Children and Snake Park, Mangalore
116. Silver Oak Happy Zoo, Ahmedabad
117. Tata Export Ltd. Deer Park, Dewas
118. Bijni Park cum Zoo, Bijni, Assam
119. Sanjay Gandhi Mrig Vatika, Haridwar
120. Mrig Vihar Van Chetna Kendra Math, Jhansi
121. Brindavan Van Chetna Kendra, Mathura
122. Nawab ganj Deer Park, Unnao
123. Van Vihar, Jaunpur
124. I.V.R.I. Van Prani Udyan, Izatnagar, Bareilly
125. Nehru Pheasantry, Manali
126. Lion Safari, Sirmur
127. Malampuzha Snake Park, Palakkad
128. Sorakayalahalli Children's Zoo and Deer Park, Kolar
129. Antharagange Children's Park, Kolar
130. Fertilizer Nagar Deer Park, Vadodara
131. Surat Municipal Zoo, Surat
132. Chitra Touring Zoo, Calcutta
133. Laxman Pahari Mrig Vihar, Banda 1985
134. Alisagar Deer Park, Alisagar
135. Vana Vigyan Kendra, Hanamkonda
136. Bina Kamal Golden Zoo, Bulandshahar
137. NFL. Campus Deer Park, Panipat
138. Neyyar Dam Lion Safari, Thiruvananthapuram
139. Municipal Zoo, Aurangabad
140. Somnath Prakalpa Zoo, Chandrapur
141. Arignar Anna Zoological Park, Chennai
142. Papadahandi Deer Park, Navarangpur
143. Golpalpur-on-Sea Palm Beach Zoo, Gopalpur

144. Bannerghatta Lion and Tiger Safari, Bangalore
145. Narmada Wildlife Complex, Bharuch
146. Mansar Mini Zoo, Mansar
147. S.F.I. Zoo, Jabalpur
148. Wyndhum Fall Mini Zoo, Mirzapur — 1986
149. Deer Park, Chandimandir,
150. Dilya Tourist Complex Mini Zoo, Rohtak
151. Kairu Chinkara Breeding Centre, Biwani
152. Mini zoo, Dharamsala
153. Ponmudi Deer Park, Thiruvananthapuram
154. Coimbatore Zoological Park, Combatore
155. Kuanria Deer Park, Nayagarh
156. Taptapani Deer Park, Parlakhemundi
157. Mini Deer Park, Chickmagalur
158. Namadachilume Deer Park, Tumkur
159. Srinagar Deer Park cum Zoo, Srinagar
160. Manda Mini Zoo, Ramnagar, J & K
161. Azad Chiryaghar, Varnasi, UP — 1987
162. Shri Venkateshwara Zoological Park, Tirupati
163. Mini Zoo and Breeding Farm, Meerut Cantt.
164. Kumarganj V.C. Kendra, Faizabad
165. Pheasant Breeding Centre, Sarahan Bushahar
166. Ranchi Biological Park, Ranchi
167. Kalamati Birsa Mrig Vihar, Ranchi
168. Sri Pramod Tourist Zoo, Muzaffarpur, Bihar
169. Kenpambudi Deer Park, Bangalore
170. Bhutanal Deer Park, Bijapur
171. A.M. Gudi Balavana Mini Zoo, Chitradurga
172. Rajkot Municipal Zoo, Rajkot
173. Mini Zoo, Roing, Arunachal Pradesh
174. Satmaliya Deer Park, Silvassa
175. M.I. Manoranjan Van, Lakhimpur Kheri — 1988
176. Aranya Bhawan, Bulandshahar
177. Tiger Safari, Ludhiana
178. Mini Zoo, Pipli, Haryana
179. Indira Gandhi Deer Park, Rourkela
180. H.A.P. Mini Zoo, Madhuban
181. Bal Bhavan Science Corner, Bhubaneswar
182. Mini Zoo cum Children's Park, Gulbarga
183. Thyavarekoppa Tiger and Lion Safari, Shimoga

184.	Khanvel Deer Park, Silvassa	
185.	Air Force Deer Park, Memaura	1989
186.	Nature Park, Bhatinda Military Station, Bhatinda	
187.	Thermal Colony Guest House Mini Deer Park, Bhatinda	
188.	Van Chetna Kendra, Narora, Bulandshahar	
189.	Deer Park, Moradabad	
190.	Brook Land Estate Van Chetna Kendra, Musoorie	
191.	Dak Pathra Vanya Jantu Vihar, Dehra Dun	
192.	Mini Zoo, Jind, Haryana	
193.	Snake Park and Aviary, Pune	
194.	Bhanja Vihar Deer Park, Berhampur	
195.	Jawaharlal Nehru Biological Park, Bokaro	
196.	Chandrapur Deer Park, Hazaribagh	
197.	Kittur Rani Chennamma Mini Zoo, Nesargadhama	
198.	Nature Education Centre, Jamnagar	
199.	Kesoram Cement Deer Park, Basant Nagar	1990
200.	Rampur Mandi Deer Park and Aviary, Kalsi, Uttar Pradesh	
201.	Nehru Van Chetna Kendra, Etah, Uttar Pradesh	
202.	Shukratal Cheetal Park, Muzaffarnagar	
203.	Deer Park, Meham	
204.	Mini Zoo, Abubshahar	
205.	Gandhimurdan Hooghly Zilla Parashad, Hooghly	
206.	Himalayan Zoological Park, Gangtok,	
207.	Patichari Deer Park, Patichari	
208.	Orai Van Chetna Kendra, Jalaun	1991
209.	Mukandpur Van Chetnan Kendra, Agra	
210.	Kempe Gowda Panadhana, Savanadurga	
211.	Dilshad Garden Deer Park, Delhi	

Appendix IV

Zoos established after the Passage of the Zoo Act

	Name of Zoo	Starting date
1.	Khatauli Cheetal Park, Muzaffarnagar	1992
2.	Bandevi Recreation Park, Mau	
3.	Pheasant Breeding Centre, Morni	
4.	Hill Palace Zoo, Thiruvananthapuram	
5.	Dhauladhar Nature Park, Gopalpur	
6.	Vasanth Smruti Mrig Vihar, Yeotmal	
7.	Samir Udyan Zoo, Amadnagar	
8.	Aviculture and Captive Breeding,Thane	

9.	VOC Park Mini Zoo, Erode	
10.	Tribal Museum at Koraput, Koraput	
11.	Bajrang Zoo, Darbhanga	
12.	TISCO Zoo, Jamshedpur	
13.	Kaiwara Tapowana, Kolar	
14.	Jhilmil Phase II Deer Park, Delhi	1993
15.	Mrig Evan Pakshi Vihar, Jhansi, Uttar Pradesh	
16.	Bajrang Touring Zoo, Varanasi, Uttar Pradesh	
17.	Vayusenanagar Zoo, Nagpur	
18.	Jawaharlal Nehru Van Udyan, Pandavlene, Nasik	
19.	Snake Park, Nagpur	
20.	Konark Deer Park, Konark	
21.	Minakenagurkai Mini Zoo, Kolar	
22.	Life Science Corner, Burdwan	
23.	Anath Ashram Banya Prani Bikash Udyan, Bishalaxmipur	
24.	Digha Snake Park, Midnapore	
25.	Nagaland Zoological Park, Dimapur	
26.	Deer Park, Daman	
27.	Agarsar Athanva Nature Park, Patiala Cantt, Punjab	1994
28.	Suryavan Zoo, Raigad	
29.	Aranyak Zoological Park, Asansol	
30.	Satyan Technology Centre, Deer Park, Bahadurpally	1996

Appendix V

Zoos for which Date of Establishment was not given

	Name of Zoo
1.	Sakaligattu Deer Park, Nargarjun Sagar
2.	Deer Park, N.F.C.L. Green Belt, Kakinada
3.	Ridhani Range Chetna Kendra, Meerut
4.	Chail Pheasantry, Solan
5.	Himalayan Nature Park, Kufri
6.	Deer Park and Zoo, Chandrapur
7.	Amida Zoo and Breeding Farm, Mumbai
8.	Dadasahab Vagre Snake Park, Yavatmal, Maharastra
9.	Amusement and Picnic Resorts, Pvt. Ltd. Chennai
10.	Mini Deer Park, Birla Tyres, Balasore, Orissa
11.	Tungabhadra Dam Mini Zoo, Hospet, Karnataka
12.	Nehru Garden, Sangamner, Gujarat
13.	Corporation Park, Howrah
14.	Krishna Sayar Snake Park, Burdwan

15. Haddo Mini Zoo, Portblair
16. Deer Park, Diu, Damam & Diu
17. Malhar Smruti Mandir Zoo, Dewas, Madhya Pradesh
18. Regional Science Centre, Tirupati, Andhra Pradesh

Appendix VI

Zoos Proposed but not yet established

	Name of Zoo
1.	Nilgiri Biosphere Conservation Park, Coimbatore
2.	Sanghi Deer Park, Sanghi Nagar, Andhra Pradesh
3.	Bhel Deer Park, Bhel, Andhra Pradesh
4.	Deer Park, Country Club, Hyderabad
5.	Govind Ballabh Pant High Altitude Zoo, Nainital, Uttar Pradesh
6.	Nagal Van Chetna Kendra, Saharanpur, Uttar Pradesh
7.	Indira Priyadarshini Sangrahalaya, Dhavangere
8.	Sri Kshetra Sogal Deer Park, Soundatti, Karnataka
9.	Nature Park, Raichur, Karnataka
10.	Mayakole Bahadurpur Environmental Park, Near Krishnanagore
11.	IISCO Deer Park, Burdwan
12.	Deer Park, Ghatgaon, Keonjhar
13.	Veera Deer Park, Aurangabad
14.	Karadigudda Deer Park, Karjagi, Dharwad
15.	Deer Park, Badaga Bettu, Manipal
16.	Deer Park, G.V.K. Industries, Rajahmundry
17.	Pilikula Wildlife Safari, Mangalore
18.	Maanas Sarovar, VGT Urban Development Authority, Guntur

Total number of zoos established since 1800 in India - 355

Appendix VII

List of zoos (continuous) without historical divisions

	Name of Zoo	Date of Establishment
1.	Barrackpore Park, Barrackpore	1801 (Closed 1878)
2.	Marble Palace Zoo, Calcutta	1854
3.	People's Park, Madras (Chennai)	1855
4.	Lalbaug Zoo, Bangalore	1855
5.	Trivandrum Zoo, Thiruvananthapuram	1857
6.	Sakkarbaug Zoo, Junagadh	1863
7.	Kota Zoo, Kota	1865
8.	VJB Udyan Zoo,Mumbai	1873
9.	Alipore Zoo, Calcutta	1875
10.	Jaipur Zoo, Jaipur	1877

11.	Hyderabad Zoo (old)	1877
12.	Udaipur zoo, Udaipur	1878
13.	Sayajibaug Zoo, Vadodara	1879
14.	Shivaganga Gardens Mini Zoo, Tanjore (Thanjavur)	1882
15.	Trichur State Museum and Zoo, Thrissur	1885
16.	Sri Chamarajendra Zoological Gardens, Mysore	1892
17.	M.S. Chhatrapati Zoo, Kolhapur	1893
18.	Maharaj Baug Zoo, Nagpur	1894
19.	Prince of Wales Zoo, Lucknow	1921
20.	Gandhi Zoological Park, Gwalior	1922
21.	Bikaner Zoo, Bikaner	
22.	Jodhpur Zoo, Jodhpur	1936
23.	Montford School Mini Zoo, Yercaud	1950
24.	Kamala Nehra Zoological Garden, Ahmedabad	1951
25.	Children's Park, Guindy, Chennai	1952
26.	Peshwe Park Zoological Garden, Pune	1953
27.	Municipal Council Beawar Zoo, Beawar	1954
28.	Diamond Tourist Zoo, Patna	1955
29.	Bharat Zoo, Patna	
30.	Sarnath Deer Park, Varanasi	1956
31.	Bal Bhavan Children's Dreamland, Rajkot	
32.	Tuttikandi Zoo, Shimla	1958
33.	Renuka Zoo, Sirmur, Himachal Pradesh	
34.	Tourist Janta Zoo, Patna	
35.	Maithon Dam Deer Park, Hazaribagh	
36.	Maharaja Fatesingh Zoo Trust, Vadodara	
37.	P.N. Himalayan Zoological Park, Darjeeling	
38.	Assam Zoo and Botanical Garden, Guwahati	
39.	Nehru Zoological Park, Hyderabad	1959
40.	BITM Animalorium, Calcutta	
41.	National Zoological Park, New Delhi	
42.	Municipal Deer Park, Rajahmundry	1960
43.	Indira Gandhi Park Zoo, Rourkela	
44.	Nandankanan Biological Park, Orissa	1960
45.	Satsang Zoo, Satsang	
46.	Ramond Tourist Zoo, Patna	
47.	New Ramond Tourist Zoo, Patna	1962
48.	Tailaiya Chacha Nehru Island, Hazaribagh	
49.	Rustomji Deer Park, Gangtok	
50.	Safari Park, Udaipur	1963

51.	Amar Tourist Zoo, Patna	1964
52.	Seminary Hills Deer Park, Nagpur	1965
53.	V.O.C. Park Mini Zoo, Coimbatore	
54.	Snake Park, Shikshan Mandal, Kolhapur	1966
55.	Amirdhi Zoo, Vellore	1967
56.	Jaya Mobile Zoo, Howrah	
57.	Ramakrishna Mission Mini Zoo, Narendrapur	
58.	Panchwati Deer Park, Pilani	
59.	Tura Zoo, Tura	
60.	Bir Moti Bagh Deer Park, Patiala	1968
61.	Gemini Tourist Zoo, Patna	
62.	Famous Mobile Zoo, Howrah	
63.	Deepak Mitra's Snake House, Calcutta	
64.	Krishna Giri Udyan, Borivali	1969
65.	Bondla Zoo, Panaji	
66.	Indira Gandhi Zoological Park, Visakhapatanam	1970
67.	Manjunatha Mini Zoo (Mobile), Chennai	
68.	Ajanta Tourist Zoo, Patna	
69.	Lalbaug Deer Park, Bangalore	
70.	Sir Peter Scott Nature Park, Jamnagar	
71.	Mrig Van, Chitorgarh, Udaipur	
72.	A.N. Jha Deer Park, Delhi	
73.	Deer Breeding Farm, Warangal	1971
74.	Kanpur Zoological Park, Kanpur	
75.	Deer Park, Hissar	
76.	Chennai Snake Park Trust, Chennai	
77.	Harishankar Deer Park, Balangir	
78.	Anitha Mobile Zoo, Baruipur	
79.	Yadavanda Garden Tourist Complex Mini Zoo, Pinzore,	1972
80.	Navegaon Bandh Wildlife Orphanage, Nagpur, Maharastra	
81.	Gandhamardan Deer Park, Balangir, Orissa	
82.	Children's Park, Sirsi, Karnataka	
83.	Childrens' Park and Zoo, Gadag, Karnataka	
84.	State Zoological Park, Kohima, Nagaland	
85.	Maitri Baug Zoo, Bhilai, Madhya Pradesh	
86.	Mini Zoo, Chandigarh	1973
87.	Neelon Deer Park, Ludhiana, Punjab	
88.	Kukrail Deer Park, Lucknow	
89.	Pal Wild Animal Orphanage, Jalgaon, Maharastra	
90.	Sanjay Gandhi Biological Park, Patna	

91.	Lady Hydari Park and Animal Land, Shillong, Meghalaya	
92.	Sepahijala Zoological Park, Sepahijala, Tripura	
93.	Kinnerasari Deer Park, Kinnersari, Andhra Pradesh	1974
94.	Cheetal Grand Motels Pvt. Ltd., Muzaffarnagar	
95.	Amte's Orphanage cum Rescue House, Gadchiroli	
96.	Children's Mini Zoo, Dharwad	
97.	Children's Park Mini Zoo, Shimoga	
98.	Bannerghatta National Park and Zoological Garden, Bangalore	
99.	Calcutta Snake Park and Zoological Garden, Alipore	
100.	Deer Research Centre, Calcutta	
101.	Kamala Nehru Prani Sangrahalaya, Indore	
102.	Chilkana Bharat Mini Zoo, Saharanpur	1975
103.	Mahavir Harina Vanasthali Deer Park, Vanasthalipuram	
104.	Sitapur Pardesi Chiryaghar, Avodh	
105.	Gharial Research & Conservation Unit, Tikarapara, Angul	
106.	Indira Udyan, Bilaspur	
107.	Kanan Pendari Zoo, Bilaspur	
108.	Pillalamarri Deer Park, Mahabub Nagar	1976
109.	Malsi Deer Park, Dehra Dun	
110.	Gangaikondan Deer Park, Kattabomman	
111.	Gharial Rehabilitation Centre, Kukrail, Lucknow	
112.	Hutatma Bag Prani Sangrahalaya, Sholapur	
113.	Madras Crocodile Bank Trust, Chennai	
114.	Hogainakkal Mini Zoo, Dharmapuri	
115.	Panthanivas Deer Park, Balasore	
116.	Manipur Zoological Garden, Imphal	
117.	Mini Zoo, Silvasa, Dadar & Nagar Haveli	
118.	Rambagh Mini Zoo, Amritsar	1977
119.	Mahendra Chaudhury Zoological Park, Chhat Bir	
120.	Hindalco Industries Deer Park, Sonbhadra, Uttar Pradesh	
121.	Ramgarh Vinod Van Mini Zoo, Gorakhpur	
122.	Neyyar Dam Crocodile Farm, Thiruvananthapuram	
123.	Peruvamymuzha (Crocodile Farm), Kozhikode	
124.	Mahatma Gandhi Rastriya Udyan Zoo, Sholapur	
125.	Shantiniketan Student Nature Club and Zoo, Sangli, Maharastra	
126.	Tadoba Crocodile Centre, Chandrapur, Maharastra	
127.	Aizwal Zoo, Aizwal, Mizoram	
128.	Jawahar Lake Tourist Complex, Shamirpet, Andhra Pradesh	1978
129.	Bir Talab Deer Park, Bhatinda, Punjab	
130.	Sanghi Municipal Council Zoo, Sanghi	

131. Joseph's Mini Zoo, Coonoor
132. Kurunpatti Zool. Park, Salem
133. Municipality Deer Park, Cuttack
134. Jaiprakash Park, Bodhgaya
135. Indroda Nature Park, Gandhinagar
136. Udaipur Zoo, Udaipur
137. Mrignayni Deer Park, Panchmarhi
138. Miao Mini Zoo, Miao
139. Bansarbagh Mini Zoo, Sangrur 1979
140. Nawab Tank Mrig Vihar, Banda, UP
141. Gharial Rehabilitation Center, Katerniaghat, Lucknow
142. Royal Kennel Charity Trust, Mumbai
143. HAL Deer Park, Koraput, Orissa
144. Kapilash Zoo, Dhenkanal, Orissa
145. Bhogalpur Town Jaiprakash Udyan, Patna
146. Sundervan Nature Discovery Centre, Ahmedabad
147. Nandan Van, Raipur, Madhya Pradesh
148. Gharial Breeding Centre, Deori, Morena, Madhya Pradesh
149. Mrugayani Chilkur Deer Park, Chilkur, Andhra Pradesh 1980
150. Rose Garden Mini Zoo, Ludhiana, Punjab
151. Kanchula Kharak Musk Deer Breeding Centre, Chamoli
152. New Pardesi Touring Zoo, Hardoi
153. Kodanadu Mini Zoo, Kodanadu
154. Rani Baug Zoo, Buldana
155. Chilka Deer Park, Chilka, Orissa
156. Kudremukh Mini Zoo, Kudremukh
157. S. I. Works Quarry Pvt. Ltd., Vadodara
158. West Bengal Snake Park and Laboratory, Badu
159. Dow Hill Deer Park, Kurseong
160. Deer Park and Mini Zoo, Jhargram
161. Zoological Park, Itanagar
162. Vijay Vihar Deer Park, Nagarjun Sagar 1981
163. Deer Park, Tirumala Hills, Chitoor, Andhra Pradesh
164. Chitoor Deer Park, Chitoor,Andhra Pradesh
165. Narain Tewari Deer Park, Almora, Uttar Pradesh
166. Vivekanand Vidya Mandir Zoo, Buldana, Uttar Pradesh
167. Sri Gajanan Vatika, Buldana, Uttar Pradesh
168. New Janta Travelling Zoo, Patna
169. Bellary Children's Park Mini Zoo, Bellary
170. Kondaji Deer Park and Mini Zoo, Chitradurga

171.	Mini Zoo, Hasan	
172.	Baguwa Pheasant Farm, Jorethang	
173.	Van Vihar National Park, Bhopal	
174.	Vikram Vatika, Ujain	
175.	Deer Park Research Station, Sirpur	1982
176.	Indira Park, Bijnor	
177.	Amaltas Mrigdav, Kalpi, Orai	
178.	Van Chetnan Kendran, Agra	
179.	Mini Zoo, Bhiwani	
180.	Deer Park, Gangapur	
181.	Motijharan Deer Park, Sambalpur	
182.	Muta Mugger Breeding Centre, Ranchi	
183.	Prakruthi Vana Mini Zoo, Mandya	
184.	Kumari Kangsabuti Deer Park, Bankura	
185.	Himabindu Deer Park, Kurnool, Andhra Pradesh	1983
186.	Van Chetna Kendra, Musoorie, Uttar Pradesh	
187.	Small Collection of Animals, Anarparti, Andhra Pradesh	
188.	Van Manoranjan Kendra, Rampur	
189.	Rewalsar Wildlife Zoo, Mandi	
190.	Tikuji Ni-wadi Zoo, Thane	
191.	Shivaji Udyan, Nasik	
192.	Paharpur Runkun Vihar Zoo, Gaya	
193.	Kadri Hill Deer, Children and Snake Park, Managalore	
194.	Silver Oak Happy Zoo, Ahmedabad	
195.	Tata Export Ltd. Deer Park, Dewas	
196.	Bijni Park cum Zoo, Bijni, Assam	
197.	Sanjay Gandhi Mrig Vatika, Haridwar	
198.	Mrig Vihar Van Chetna Kendra Math, Jhansi	
199.	Brindavan Van Chetna Kendra, Mathura	
200.	Nawab ganj Deer Park, Unnao	
201.	Van Vihar, Jaunpur	
202.	I.V.R.I. Van Prani Udyan, Izatnagar, Bareilly	
203.	Nehru Pheasantry, Manali	
204.	Lion Safari, Sirmur	
205.	Malampuzha Snake Park, Palakkad	
206.	Sorakayalahalli Children's Zoo and Deer Park, Kolar	
207.	Antharagange Children's Park, Kolar	
208.	Fertilizer Nagar Deer Park, Vadodara	
209.	Surat Municipal Zoo, Surat	
210.	Chitra Touring Zoo, Calcutta	

211.	Laxman Pahari Mrig Vihar, Banda	1985
212.	Alisagar Deer Park, Alisagar	
213.	Vanavigyan Kendra, Hanamkonda	
214.	Bina Kamal Golden Zoo, Bulandshahar	
215.	NFL. Campus Deer Park, Panipet	
216.	Neyyar Dam Lion Safari, Thiruvananthapuram	
217.	Municipal Zoo, Aurangabad	
218.	Somnath Prakalpa Zoo, Chandrapur	
219.	Arignar Anna Zoological Park, Chennai	
220.	Papadahandi Deer Park, Navarangpur, Orissa	
221.	Golpalpur-on-Sea Palm Beach Zoo, Gopalpur, Orissa	
222.	Bannerghatta Lion and Tiger Safari, Bangalore	
223.	Narmada Wildlife Complex, Bharuch, Gujarat	
224.	Mansar Mini Zoo, Mansar	
225.	S.F.I. Zoo, Jabalpur	
226.	Wyndhun Fall Mini Zoo, Mirzapur	1986
227.	Deer Park, Chandi Mandir	
228.	Dilya Tourist Complex Mini Zoo, Rohtak	
229.	Kairu Chinkara Breeding Centre, Biwani	
230.	Mini zoo, Dharamsala	
231.	Ponmudi Deer Park, Thiruvananthapuram	
232.	Coimbatore Zoological Park, Combatore	
233.	Kuanria Deer Park, Nayagarh, Orissa	
234.	Taptapani Deer Park, Parlakhemundi, Orissa	
235.	Mini Deer Park, Chickmagalur	
236.	Namadachilume Deer Park, Tumkur	
237.	Srinagar Deer Park cum Zoo, Srinagar	
238.	Manda Mini Zoo, Ramnagar, Jammu & Kashmir	
239.	Azad Chiryaghar, Varanasi, Uttar Pradesh	1987
240.	Shri Venkateshwara Zoological Park, Tirupati	
241.	Mini Zoo and Breeding Farm, Meerut	
242.	Kumarganj V.C. Kendra, Faizabad	
243.	Pheasant Breeding Centre, Sarahan Bushahar	
244.	Ranchi Biological Park, Ranchi	
245.	Birsa Mrig Vihar, Kalamati, Ranchi	
246.	Sri Pramod Tourist Zoo, Muzaffarpur, Bihar	
247.	Kenpambudi Deer Park, Bangalore	
248.	Bhutanal Deer Park, Bijapur	
249.	A.M. Gudi Balavana Mini Zoo, Chitradurga	
250.	Rajkot Municipal Zoo, Rajkot	

251. Mini Zoo, Roing, Arunachal Pradesh
252. Satmaliya Deer Park, Silvassa
253. M.I. Manoranjan Van, Lakhimpur-Kheri — 1988
254. Aranya Bhawan, Bulandshahar
255. Tiger Safari, Ludhiana
256. Mini Zoo, Pipli
257. Indira Gandhi Deer Park, Rourkela
258. H.A.P. Mini Zoo, Madhuban
259. Bal Bhavan Science Corner, Bhubaneswar
260. Mini Zoo cum Children's Park, Gulbarga
261. Thyavarekoppa Tiger and Lion Safari, Shimoga
262. Khanvel Deer Park, Silvassa
263. Air Force Deer Park, Memaura — 1989
264. Bhatinda Military Station Nature Park
265. Guest House Mini Deer Park, Thermal Colony, Bhatinda
266. Narora Van Chetna Kendra, Bulanshahar
267. Deer Park, Moradabad
268. Brookland Estate Van Chetna Kendra, Musoorie
269. Dak Pathra Vanya Jantu Vihar, Dehra Dun
270. Mini Zoo, Jind
271. Snake Park and Aviary, Pune
272. Bhanja Bihar Deer Park, Berhampur, Orissa
273. Jawaharlal Nehru Biological Park, Bokaro
274. Chandrapur Deer Park, Hazaribagh
275. Kittur Rani Chennamma Mini Zoo, Nesargadhama
276. Nature Education Centre, Jamnagar
277. Kesoram Cement Deer Park, Basant Nagar — 1990
278. Rampur Mandi Deer Park and Aviary, Kalsi
279. Nehru Van Chetna Kendra, Etah
280. Shukratal Cheetal Park, Muzaffarnagar
281. Deer Park, Meham
282. Mini Zoo, Abubsharhar
283. Gandhimurdan Hooghly Zilla Parashad, Hooghly
284. Himalayan Zoological Park, Gangtok,
285. Patichari Deer Park, Patichari
286. Orai Van Chetna Kendra, Jalaun — 1991
287. Mukandpur Van Chetna Kendra, Agra
288. Kempe Gowda Panadhana, Savanadurga
289. Dilshad Garden Deer Park, Delhi
290. Khatauli Cheetal Park, Muzaffarnagar — 1992

291. Bandevi Recreation Park, Mau
292. Pheasant Breeding Centre, Morni
293. Hill Palace Zoo, Thiruvananthapuram
294. Dhauladhar Nature Park, Gopalpur
295. Vasanth Smruti Mrig Vihar, Yavatmal
296. Sameer Udyan Zoo, Ahmednagar
297. Aviculture and Captive Breeding, Thane
298. VOC Park Mini Zoo, Erode
299. Tribal Museum, Koraput, Orissa
300. Bajrang Zoo, Darbhanga
301. TISCO Zoo, Jamshedpur
302. Kaiwara Tapowana, Kolar
303. Jhilmil Phase II Deer Park, Delhi
304. Sabari Mini Zoo, Minerva Nagar 1993
305. Mrig Evan Pakshi Vihar, Jhansi
306. Bajrang Touring Zoo, Varanasi
307. Vayusenanagar Zoo, Nagpur
308. Jawaharlal Nehru Van Udyan, Pandavlene, Nasik
309. Snake Park, Nagpur
310. Konark Deer Park, Konark
311. Minakenagurkai Mini Zoo, Kolar
312. Life Science Corner, Burdwan
313. Anath Ashram Banya Prani Bikash Udyan, Bishalaxmipur
314. Digha Snake Park, Midnapore
315. Nagaland Zoological Park, Dimapur
316. Deer Park, Daman
317. Agarsar Athanve Nature Park, Patiala Cantt 1994
318. Suryavan Zoo, Bombay (Mumbai)
319. Aranyak Zoological Park, Asansol, West Bengal
320. Satyan Technology Centre, Deer Park, Bahadurpally 1996
321. Sakaligattu Deer Park, Nagarjun Sagar
322. Deer Park, N.F.C.L. Green Belt, Kakinada
323. Ridhani Range Chetna Kendra, Meerut
324. Chail Pheasantry, Solon
325. Himalayan Nature Park, Kufri
326. Deer Park and Zoo, Chandrapur
327. Amida Zoo and Breeding Farm, Bombay (Mumbai)
328. Dadasahab Vagre Snake Park, Yavatmal, Maharastra
329. Amusement and Picnic Resorts Pvt. Ltd., Chennai
330. Birla Mini Deer Park, Birla Tyres, Balasore, Orissa

331. Tungabadra Dam Mini Zoo, Hospet, Karnataka
332. Nehru Garden, Sangamner, Gujarat
333. Corporation Park, Howrah
334. Krishna Sayar Snake Park, Burdwan
335. Haddo Mini Zoo Portblair, Haddo
336. Deer Park, Diu, Daman & Diu
337. Malhar Smruti Mandir Zoo, Dewas, Madhya Pradesh
338. Regional Science Centre, Tirupati
339. Sanghi Deer Park, Sanghi Nagar, Andhra Pradesh — Proposed
340. Bhel Deer Park, Bhel, Andhra Pradesh
341. Deer Park, Country Club, Hyderabad
342. Govind Ballabh Pant High Altitude Zoo, Nainital, Uttar Pradesh
343. Nagal Van Chetna Kendra, Saharanpur, Uttar Pradesh
344. Indira Priyadarshini Sangrahalaya, Davangere
345. Sri Kshetra Sogal Deer Park, Soundatti, Karnakata
346. Nature Park, Raichur, Karnakata
347. Mayakole Bahadurpur Environmental Park, Near Krishnanagore
348. IISCO Deer Park, Burdwan
349. Deer Park, Ghatgaon, Keonjhar, Orissa
350 Veera Deer Park, Aurangabad
351 Karadigudda Deer Park, Karajgi, Dharwad
352 Deer Park, Badaga Bettu, Manipal
353 Deer Park, G.V.K. Industries, Rajahmundry, Hyderabad
354 Pilikula Wildlife Safari, Mangalore
355 Manas Sarovar, VGT Urban Development Authority, Guntur

Ministry of Environment and Forests

Resolution

New Delhi, the 28th October, 1998

NATIONAL ZOO POLICY, 1998

(Published in Part II-Section 3 — Sub-Section (ii) of the Gazette of India—Extra Ordinary No. 708 dated 29th October, 1998)

S.O. 936 (E)—1. PREAMBLE

1.1 The growing awareness for nature & wildlife conservation has made zoos a popular institution. Estimates indicate that 10% of the world's population visit zoos every year. There are about 350 animal collections in India, which are visited by more than 50 million people annually.

1.2 While there is a history of scientific interest, conservation and welfare of captive wild animals in the country, many zoos have evolved from menageries and private collections and most zoos until the last two decades were set up mainly for entertainment and recreation. As wildlife resources were abundant in the past, scientific knowledge about the behavioural and biological requirements of animals did not receive adequate attention, with the result that scientific management of wild animals in captivity has evolved slowly.

1.3 The need for making conservation as one of the main objectives of management of zoos was realised by Government of India soon after independence and the Indian Board for Wildlife made important recommendations in this regard. The Government set up an Expert Committee on Management of Zoos in November, 1972 and its recommendations were accepted in June, 1973. The recommendations are relevant even now for improving the management of zoos. The National Wildlife Action Plan of 1983 again emphasised the role of *ex-situ* conservation in national conservation efforts. However, because of varied ownership patterns and divergent nature of animal collections not much was achieved.

1.4 Today when wildlife habitats are under severe pressure and a large number

of species of wild fauna have become endangered, the zoos have not only to sustain their own populations but also augment the depleting populations of endangered species in the wild. This new role has been acknowledged by the global conservaion community and Article 9 of the Convention on Biological Diversity.

1.5 As zoos are visited by a large number of visitors, zoos are a potent tool for educating people about the close linkage between protection of natural areas and maintaining the life supporting processes of nature. Well-planned and appropriately designed zoos can sensitize visitors to the dangers of a hostile or indifferent attitude towards nature.

1.6 In India, many well designed zoos were set up in some of the States but for the most part, zoos have not been able to meet the challenges imposed by the changing scenario and still continue with the legacy of past i.e. displaying animals under conditions which are neither congenial to the animals nor educative and rewarding to the visitors.

1.7 The amendment of the Wildlife (Protection) Act, in 1991, provided for the enforcement of mandatory standards and norms for management of zoos through the Central Zoo Authority. However, it is realised that the objectives of the Act can be achieved only through co-operation and participation of various government agencies, non-governmental organisations and people at large.

1.8 The National Zoo Policy aims at giving proper direction and thrust to the management of zoos by mustering co-operation and participation of all concerned.

2. OBJECTIVES

2.1 The main objective of the zoos shall be to complement and strengthen the national efforts in conservation of the rich biodiversity of the country, particularly the wild fauna. This objective can be achieved through the following protocol :

2.1.1 Supporting the conservation of endangered species by giving species, which have no chance of survival in wild, a last chance of survival through coordinated breeding under *ex-situ* conditions and raise stocks for rehabilitating them in wild as and when it is appropriate and desirable.

2.1.2 To inspire amongst zoo visitors empathy for wild animals, an understanding and awareness about the need for conservation of natural resources and for maintaining the ecological balance.

2.1.3 Providing opportunities for scientific studies useful for conservation in general and creation of data base for sharing between the agencies involved in *in-situ* and *ex-situ* conservation.

2.1.4 Besides the aforesaid objectives, the zoos shall continue to function as rescue centres for orphaned wild animals, subject to the availability of appropriate housing and upkeep infrastructure. Where appropriate housing and upkeep is not available, State Governments and the Central Government would ascertain setting up rescue facilities in off-the - display areas of the zoo, subject to the availablility of land.

3. STRATEGY FOR ACHIEVING THE OBJECTIVES

3.1 General Policy About Zoos

3.1.1 Since zoos require a significant amount of resources in the form of land, water, energy and money, no new zoo shall be set up unless a sustained supply of resources including finance and technical support are guaranteed.

3.1.2 Zoos shall prepare a long-term masterplan for development to ensure optimum utilisation of the land, water, energy and finance.

3.1.3 Every Zoo shall maintain a healthy, hygienic and natural environment in the zoo, so that the visitors get an adequate opportunity to experience a natural environment.

3.1.4 Zoos shall give priority to endangered species in their collection and breeding plans. The order of preference for selection of species shall be (in descending order) locality, region, country and other areas.

3.1.5 Zoos shall regulate the number of animals of various species in their collection in such a way that each animal serves the objectives of the zoo. For achieving this objective, a detailed management plan of every species in the zoo shall be prepared.

3.1.6 Every zoo shall endeavour to avoid keeping single animals of non-viable sex ratios of any species. They shall cooperate in pooling such animals into genetically, demographically and socially viable groups at zoos identified for the purpose.

3.1.7 Zoos shall avoid keeping surplus animals of prolifically breeding species and if required, appropriate population control measures shall be adopted.

3.2 Acquisition of Animals

3.2.1 Except for obtaining founder animals for approved breeding programme and infusion of new blood into inbred groups, no zoo shall collect animals from the wild.

3.2.2 Zoos shall not enter into any transaction involving violation of the law and provisions of international conventions on wildlife conservation.

3.2.3 Zoos shall not enter into any transaction in respect of their surplus animals with any commercial establishment. Even the animal products should not be utilised for commercial purposes. The trophies of the animals could, however, be used for educational or scientific purposes.

3.3 Animal Housing

3.3.1 Every animal in a zoo shall be provided housing, upkeep and health care that can ensure a quality of life and longevity to enable the zoo population sustain itself through procreation.

3.3.2 The enclosure for all the species displayed or kept in a zoo shall be of such size that all animals get adequate space for free movement and exercise and no animal is unduly dominated or harassed by any other animal.

3.3.3 Each animal enclosure in a zoo shall have appropriate shelters, perches, withdrawal areas, wallows, pools, drinking water points and such other facilities which can provide the animals a chance to display the wide range of their natural behaviour as well as protect them from extremes of climate.

3.4 Upkeep of animal Collections

3.4.1 Zoos shall provide diet to each species which is similar to its feed in

nature. Where for unavoidable reasons any ingredients have to be substituted, due care will be taken to ensure that the substitute fulfills the nutritional requirement of the species.

3.4.2 For the well-being of the animals, round the clock suply of potable drinking water shall be made available to all animals kept in the zoo.

3.4.3 With the objective of avoiding human imprinting and domestication of animals, zoos shall prevent physical handling of animals by the staff to the extent possible.

3.4.4 Zoos shall not allow any animal to be provoked or tortured for the purpose of extracting any performance or tricks for the benefit of the visitors or for any other reason.

3.5 Health Care

3.5.1 Zoos shall ensure availability of the highest standards of veterinary care to all the animals in their collection.

3.5.2 Adequate measures shall be taken by every zoo for implementing wildlife health and quarantine rules and regulations. Appropriate vaccination programmes shall also be taken up for safeguarding against infectious diseases. Timely action to isolate infected animals from the zoo population shall also be taken to avoid further spread of disease.

3.6 Research and Training

3.6.1 The zoos shall encourage research on the biology, behaviour, nutrition and veterinary aspects of animals in their collection. They shall also endeavour for creation of expertise on zoo architecture and landscape designing, cooperation of recognised institutions already working in relevant fields in this regard shall be taken.

3.6.2 Zoos shall endeavour for transfer of technical skills available in the field for zoo personnel. The Central Government, Central Zoo Authority and State Governments shall provide due support to zoos in these efforts. Assistance of Wildlife Insitute of India (WII), Indian Veterinary Research Institute (IVRI) and other institutions within India and abroad, having appropriate expertise

shall be taken in this regard.

3.6.3 Zoos shall also endeavour for dissemination of information on scientific aspects of management through publication of periodicals, journals, news letters and special bulletins. Help of non-governmental organisations (NGOs) and government institutions shall also be availed in such efforts. The Central Zoo Authority shall provide technical and financial support to the Indian Zoo Directors' Association (IZDA) and other institutions in this regard.

3.7 Breeding Programme for Species

3.7.1 Before taking up breeding programme of any species, zoos shall clearly identify the objectives for which the breeding programme is being taken up. The targeted numbers for the programme would be decided keeping in view the identified objectives.

3.7.2 All zoos shall cooperate in successful implementaion of identified breeding programmes by way of loaning, pooling or exchanging animals for the programme and help creation of socially, genetically and demographically viable groups even at the cost of reducing the number of animals or number of species displayed in individual zoos.

3.7.3 Breeding programme shall be taken up by zoos after collection of adequate data like biology, behaviour and other demographic factors affecting the programme, including the minimum number of founder animals and the quantum of housing facilities available.

3.7.4 Programmes for breeding of zoo animals for re-introduction in the wild shall be taken up after getting approval of the State Government, the Central Zoo Authority and the Central Government as the case may be.

3.7.5 Zoos shall give priority in their breeding programmes to endangered species representing the zoo-geographic zones in which they are located.

3.7.6 For carrying out breeding programmes in a scientific and planned manner the zoo shall mark every individual animal involved in the programme in an appropriate manner and maintain appropriate records.

3.7.7 Zoos shall take utmost precaution to prevent inbreeding. They shall avoid

artificial selection of traits and make no explicit or implicit attempts to interbreed various genera, species and sub-species.

3.7.8 Special efforts shall be made to avoid human imprinting of the stocks raised for reintroduction purposes by providing off exhibit breeding facilities.

3.8 Education and Outreach Activity

3.8.1 Each zoo should have a well drawn-up plan for educating the visitors as well as others in the community. Zoos shall keep a close liasion with other *ex-situ* facilities in this regard.

3.8.2 The central theme of the zoo education programme being the linkage between the survival of various species and protection of their natural habitat, enclosures which allow the animals to display natural behaviour are crucial to zoo education. Zoo shall, therefore, display animals in such enclosures only where the animals do not suffer physiological and psychological restraint.

3.8.3 Attractive and effective signage methods and interactive displays to explain activities of various species to visitors, published education material and audio-visual devices are proven methods for driving home the conservation message. A formal education programme should also be persued for strengthening the education message.

3.8.4 Besides signage, the zoos shall also use guided tours, talks by knowledgeable persons and audio-visual shows for effectively communicating the message of conservation to the visitors.

3.8.5 The help of universities, colleges and non-governmental organisations shall be taken to educate the students about the benefits of supporting nature conservation programmes.

3.9 Extension Activities

3.9.1 To provide the urban population with a window to nature and to serve as green lungs for the polluting environment, zoos shall extend their expertise and help to State Governments and local authorities to create nature parks extending over extensive areas near big cities.

3.10 Amenities to Visitors

3.10.1 Zoos shall provide basic civic amenities to the visitors like toilets, drinking water points, shelters and first-aid facilities. Ramps shall also be provided for the benefit of visitors in wheel chairs for approach to animal enclosure and other civic amenities.

3.10.2 Zoos shall not provide any infrastructure for recreation/entertainment of visirots that is inconsistent with the stated objective of zoos.

Vishwanath Anand
Secretary to the Government of India

ZOOS-INSTRUMENT OF CONSERVATION

RECOMMENDATIONS OF THE WORKSHOP ON NATIONAL ZOO POLICY HELD FROM 4TH TO 6TH APRIL 1999 AT KANPUR ORGANISED BY KANPUR ZOOLOGICAL PARK & CENTRAL ZOO AUTHORITY

CONSERVATION BREEDING

1. Planned breeding of any species should have clear objective with target number of the species to be raised based on the objective. The priority will be on critically endangered species, species with single population or which has become extinct in the wild very recently.

2. The stock of planned breeding should be selected from wider genetic groups of healthy species of suitable breeding age. All modern knowledge and techniques available from related scientific organisations and institutions should be pooled and utilised wherever possible.

3. Procurement of animals for breeding should aim at creation of a viable sex ratio. To avoid inbreeding depression, all animals are to be marked and stud book maintained.

4. Expertise available, past history of upkeep of a species and environmental condition of the zoo has to be taken into account in launching any breeding programme.

5. In deciding planned breeding programme all zoo-geographic regions should be covered. Within each zone, adequate consultation should be made between zoos, research/scientific institutions and species specialist groups.

6. Population control measures be adopted for prolifically breeding species to deal with stock not required for scientific and management purpose. All

critically ill and wounded species beyond recovery should be euthanised on proper certification from a board of doctors.

RE-INTRODUCTION OF SPECIES IN THE WILD :

7. State Government and other related organisations and institutions should be fully involved in deciding programmes of planned breeding for reintroduction.

8. No such programme should be undertaken without preparation of both short and long term plan with commitment for financial support till the objective is met.

9. Stock raised for re-introduction must not be imprinted and a multidisciplinary team with expertise from all related sectors to be created, for which manpower has to be selected carefully.

10. Site for re-introduction has to be selected with due care. Past history of extinction has to be studied and addressed and favourable conditions created before launching actual re-introduction.

11. It should also be proper public relation (P.R.) work to be done to involve local people, pressure lobbies and political groups in the process and their support obtained.

12. There should be periodic monitoring and evaluation for taking any corrective measure needed based on observation and experience.

ANIMAL HOUSING

13. Zoo planning and designing being of great importance in the success or failure of any zoo, there is need to identify short term and long term goals involving individuals and institutions in this field, as well as imparting training to a cadre of personnel.

14. In order to evolve proper housing facilities for animals, which are the prime objects of zoos, it is essential that zoos draw up a triennial programme in keeping with master plan for construction of animal facilities. These should be got vetted by Central Zoo Authority (CZA) atleast six months

in advance, so that the needs of the animals are adequately met and taken care of.

15. Designs of new facilities and/or renovation should take into account the advances in behavioural sciences and technology. They should be species specific.

16. In providing animal facilities the enclosure floor should be kuchha/unpaved to provide naturalistic conditions for the animals. However the feeding cubical should have properly paved flooring and good drainage.

    Housing facilities and enclosure should be natural and avoid use of sophisticated materials or energy intensive or technologically complex exhibits. Locally available material may be used.

17. When new zoos are set up, besides ensuring its proper management in future, site selection as per sound criteria is necessary. A long-term master plan and management plan should be drawn up to avoid future management problems, which could prove to be costly in the long run.

ADMINISTRATION AND MANAGEMENT

18. New zoos should be started only after initial building and subsequent maintenance expenditure sanctioned and guaranteed, a zoo advisory committee set up, giving it full financial powers.

19. To ensure good house keeping, trained zoo keepers with minimum high school qualification are required.

20. Detailed feed charts should be prepared region wise for each species. To provide clean and potable water adequate number of tube wells should be bored, where this is not feasible other sources should be tapped.

21. For highest standards of veterinary care, services of two good zoo veterinarians for large zoos and one for medium and small zoos, should be provided. Also a well equipped Veterinary Hospital with clinical pathology and radiological facilitites, for large and medium zoos is necessary. Vaccination programmes should be carried out according to a schedule, drawn up by CZA by providing quality vaccines to the zoos and it should

be monitored.

22. Zoos lacking necessary civic amenities should be admonished by CZA by suspending temporarily the financial aid till the malady is corrected. Inconsistent recreational/entertainment facilities should be clearly spelt out by CZA.

PERSONNEL POLICY

23. Officer incharge of large and medium zoos should be designated as Director. At least 3 promotions should be made available to subordinate field staff. Risk allowance to keepers, sweepers, Non Practicing Allowance (NPA) and flexible component to veterinarians and special pay for Directors should be given.

24. At present there is no separate cadre for zoos. Therefore, before creating separate zoo cadre following pros and cons should be weighed carefully :

1. Continuity in the same post will benefit zoo management.
2. Cooperation between zoos will improve.

However the disadvantages will be :

3. Talented officers from forest service may not like to join the service.
4. Co-operation from the state forest depertment will be adversely affected.
5. Promotional avenues will be adversely affected.
6. Bringing the establishment of all the zoos under one cadre/service will be difficult because at present the zoo staff are employees of various services like Central Government, State Government, Municipal Corporation, Trusts, Societies and Private Organisations with variable educational background and different scales of pay.
7. Transfer of officers on all India basis will also entail difficulties.

Taking into consideration aforesaid advantages and disadvantages, creation of separate zoo cadre does not seem to be feasible at this time.

VETERINARY AND HEALTH CARE

25. Housing and Nutrition

In order to keep the animals healthy, appropriate housing and feeding regime be devised keeping in view the veterinary requirements. The zoo veterinarian should be involved in these.

26. Preventive Medicine

Sanitary measures including use of approved disinfectant, immunoprophylaxsis measures, disposal of the animal waste, be practiced uniformly and appropriate guidelines should be circulated.

27. Treatment

Provision of inbuilt squeeze cage for all the large carnivores, well-equipped diagnostic facility (including X-ray unit) with necessary supporting staff, laboratory technician, field veterinary assistant, sanitation staff etc be provided.

28. Linkages

Every large and medium zoo shall maintain strong linkages with regional Veterinary Institutions for expertise and research. The annual screening of all staff connected with animal management may be made mandatory and such persons be treated accordingly. Quarantine procedure be followed rigorously as per quarantine rules and animal exchange must be accompanied with prescribed animal information, transportation and health certificate duly signed by veterinarian.

Education & Training

In order to keep pace with latest advancement in zoo medicine, deputation of veterinarian in national, international workshop/training should be ensured.

EDUCATION AND AWARENESS

29. Each zoo should develop an education programme based on proper evaluation of local needs.

30. An education officer or a trained officer should be entrusted the task of implementation of the programme.

31. Zoo should have linkages with existing eco clubs/nature clubs for promotion of educational material and programmes in comprehensive manner.

32. Evaluation and Monitoring should be built in each programme for its continuous upgradation.

33. Zoos shoud develop mechanism of exchanging ideas, information, outputs and products with all zoos.

34. Each zoo should create mechanism for capacity building of the zoo staff in organising educational programmes.

RESCUE CENTRES

35. Broad based 5-6 zonal rescue centres to accommodate a number of species should be set up under the state forest department or other competent body.

36. Rescue centres should have independent identity and should function under the overall guidance of Ministry of Environment and Forests/CZA.

37. Rescue Centres should have the necessary upkeep, handling facility, maintenance and veterinary expertise.

38. Non Government Organisation (NGO) participation should be encouraged in this area to facilitate proper functioning of rescue centres.

39. Follow up actions of rehabilitation of rescued animals can be decided in each case on merit.

40. Temporary holding facility may however be set up adjunct to zoos or protected areas depending upon expertise and space available.

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