Papers for presentation in the Workshop

WORKSHOP ON INDIRA GANDHI'S VISION ON WILDLIFE CONSERVATION-SCIENTIFIC ZOO MANAGEMENT AS ONE SUCH INSTRUMENT

AT
VIGYAN BHAVAN
29TH OCTOBER, 1994

CENTRAL ZOO AUTHORITY OF INDIA
NEW DELHI

WORKSHOP ON "SCIENTIFIC ZOO MANAGEMENT AS AN INSTRUMENT FOR CONSERVATION OF WILDLIFE"

SATURDAY, 29th Oct 1994

0800-0930 REGISTRATION AT VIGYAN BHAVAN

0930-1030 INAUGURAL SESSION

1030-1100 COFFEE BREAK

1100 SCIENTIFIC SESSION - I

Planning & Development of zoos for conservation of endangered species of wild animals.

Papers would be presented on -

1. Changing role of zoos-A historical perspective.
   Shri N.D. Bachkheti
2. Effective utilasation of resources available to zoos for achieving the conservation goals.
   Shri Pushp Kumar
3. Better health care for zoo animals.
   Dr. L.N.Acharjyo
4. Diet selection for zoo animals.
   Dr. D.D. Majramkar
5. Population control measures for prolifically breeding species.
   Dr. P.O.George
6. Population control measures in zoo animals.
   Dr. G.P.Talwar

1300-1400 LUNCH

1400 SCIENTIFIC SESSION-II

7. Planned breeding of endangered species.
   Dr. A.K.Roy Choudhary
8. Assisted reproduction in endangered species.
   Dr. Shivaji Singh
   CCMB, Hyderabad
9. Breeding Biology & assisted reproduction including genomme banking.
   Dr. Dharmeswar Das
10. Ensuring genetic purity of animals.
    Dr. Lalji Singh

11. Techniques for differentiating pure strains and hybrid strains, including DNA finger printing.
Dr. N.V.Giridharan

12. Role of Environmental Enrichment in better Management of Zoos.
Shri S.C.Sharma

13. Role of Environmental Enrichment in better Management Of Zoos.
Shri R.Sundararaju,

* 14. Reintroduction of captive bred stocks in wild.
Shri S.C.Dey

1600 SCIENTIFIC SESSION - III

Developing public perceptions on wild life conservation.

Papers would be presented on -

* 1. Education & interpretation programmes in zoos.
Ms. Sally Walker

2. Role of "Friends of Zoos" programme in creating public awareness about Wildlife Conservation.
Miss Latha Thampi

3. Role of "Friends of Zoos" programme in creating public awareness about Wildlife Conservation.
Shri P.C.Mishra

4. Role of "Friends of zoos" programme in creating public awareness about wildlife conservation.
Dr.(Sister) Doris D'Souza A.C.

5. Providing guide services for zoo visitors.
Shri S.K.Patnaik

* Papers would be circulated during the Workshop.

SUNDAY, 30th Oct 1994

0930 GROUP DISCUSSIONS

1. Effective utilisation of the available resources by zoo, including master planning, preparation of management plans and population control measures for prolifically breeding species.

Group Coordinator- Shri Pushp Kumar

2. Better health care for animals.

Group Coordinator- Dr. J.V. Cheeran and Dr. J.H. Desai

3. Planned breeding of endangered species including identification of genetic purity, assisted reproduction and genome banking.

Group Coordinator- Dr. Shivaji Singh, CCMB Hyderabad.
Shri Vinod Rishi, Addl.Director (Wl),MEF

4. Education awareness.

Group Coordinator- Ms.Sally Walker and Shri R. Sundararju.

5. Reintroduction of captive bred stocks in wild.

Group Coordinator- Shri S.C. Dey, Addl. I.G.F.(Wl)

1300-1400 LUNCH

1400 PRACTICAL DEMONSTRATION AT NATIONAL ZOOLOGICAL PARK, NEW DELHI. Dr. B.M. Arora (IVRI, Izzatnagar); Dr. Sunil Chabra, NII

MONDAY, 31ST Oct 1994

0930 Presentation of group reports & finalisation of recommendations.

1300-1400 LUNCH

1400 VALEDICTORY SESSION

29th October, 1994
Saturday

SCIENTIFIC SESSION

Planning & Development of Zoos for conservation of endangered species of wild animals.

BETTER HEALTH CARE FOR ZOO ANIMALS

L. N. ACHARJYO
B H U B A N E S W A R

R E S U M E

Health of animals and birds in zoos is directly or indirectly dependant on several factors such as housing, feeding, sanitation and disease management . Therefore, a constant effort has to be made to improve upon these management practices to prevent or lessen the occurrence of diseases among zoo animals and to keep them in perfect health .

This paper deals in brief the impact of different requirements of housing , feeding , sanitation and disease management practices on health of zoo animals and various remedial measures to overcome such problems .

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BETTER HEALTH CARE FOR ZOO ANIMALS

by

L.N. ACHARJYO

The maintenance of Zoo animals in proper health is one of the important and difficult problems of any Zoo. Still more difficult problem is detection of illness, diagnosis, restraint and treatment of Zoo animals once they fall sick. Health of animals and birds in Zoos is directly or indirectly dependent on several factors such as housing, feeding, sanitation and disease management. It is well known that prevention of diseases is always better than cure. Therefore, all attempts have to be made to ensure better housing, feeding, sanitation and disease management to lessen the desease problems among zoo animals and to keep them in perfect health.

Fortunately with the advancement of our knowledge on housing, feeding, sanitation and disease management of captive animals, it is now possible to exhibit them in zoos with better health for more number of years than even before and once they fall sick, they stand much better chances now of being brought back to health.

HOUSING: Adequate nature simulating living space as per the need of the species under display for free movement and exercise with provision for protecting from extremes of weather conditions is one of the basic needs for the welfare of zoo animals. While designing the enclosure the biological needs, behaviour and physical capabilities (like jumping distance, climbing, swimming etc) of the particular species to be displayed should be considered. For this purpose the Zoo animals can be 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, lizards 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
(swimming, diving etc)
e.g. otter, crocodiles etc.

The impact of improper housing on disease conditions among zoo animals can be eliminated or minimised by providing suitable housing facilities meeting all the biological needs of the species. For example the ground should be hard for hopfed animals like deer, antelopes etc. otherwise there will be abnormal growth of hooves due to insufficient wearing. Similarly for soft footed animals like cats the ground should be soft, otherwise sore paws may develop. If suitable trees or logs are not found inside the enclosure of big cats for sharpening their claws, the claws may over grow in a curved-in condition and thus can injure the foot pad. Rubbing the bodies against tree trunks by some of the animals like Rhinoceros, Elephants etc, has a beneficial effect on the hair and skin similar to combing and brushing of domestic animals besides producing the feeling of pleasure. Therefore, the enclosures of such animals should have suitable trees.

The bird enclosures should have plenty of perches which should correspond more or less to the size of their feet. Reptiles are very sensitive to extreme floctuations in atmosphereic temperature affecting their health and mortality as they are exothermic animals. Enclosure of reptiles should have special provision for protecting them from extreme heat and cold. To avoid undue stress and strain and for longer life the nocturnal animals have to be kept in nocturnal house only.

Many species of animals tend to hide temporarily from visitors while the solitary animals like to avoid each other. For meeting such behavioural needs and to overcome undue stress from the fear/disturbances of visitors there should

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be sufficient hiding places for zoo animals like dens, rock caves, holes, bushes, trees etc. where the animal can escape and take rest.

FEEDING : The quality, quantity and kind of food has a direct bearing on health of the species and so the food selected should be as close to the natural diet of the species as in the wild. As it is practically not possible to provide the exact diet in captivity as in the wild, suitable substitute food available in the locality has to be found out. The food provided should be hygienic, palatable, nutritious and meet the physiological needs of the animals. Hygienic storage and distribution, regularity of timely supply of clean, fresh and nutritious food is important for good health. This can be ensured by daily examination of all food items just before feeding to the animals by the zoo veterinarian. Clean water from protected water supply system may be ensured for all zoo animals daily to help in prevention of many diseases.

It is a common practice to provide vitamin and mineral supplements in the diet of many species to avoid their deficiency. A bland and monotonous diet over a long period is neither desirable nor suitable for good health. Therefore, suitable variations have to be made at times in the diet of animals. The zoo animals have to be fed on the optimum but not on the minimum scale.

Quantity of food of an invidividual animal depends on its age, size, sex and condition of the animal like pregnant and nurshing mothers, young growing animals, sick animals etc. It may be remembered that young animals consume greater quantities of feed, they can utilise the food more efficiently and have higher requirement of proteins, vitamins, minerals and energy producing food. They are more susceptible to nutritional deficiency diseases. It may be ensured that the new-born animals receive colostrum (initial milk secretion with high proportions of proteins, vitamins and antibodies) as it is highly nutritious, easily digestable and helps in disease resistance.

Salt licks are always made available to some of the animals like Ruminants for licking to avoid salt deficiency. Similarly grits must always be made available to certain group of birds like parrots, peafowls etc. to assist in proper digestion.

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 two soft, they may have excessive tooth/beak growth due to absence or insufficient abrasion.

Presentation of food to zoo animals is as important as the quality and quantity of food as it effects the intake of food. For example the flamingoes are adopted to strain fine food particles out of water and they are unable to take dry food. Similarly when several animals are housed together, a number of places for feeding should be provided to avoid fighting over food. Giraffes should not be fed on the ground and their feeding troughs should be placed in such a way that it can reach easily.

The health and mortality of zoo animals is also influenced by accidental intake of foreigh bodies such a nails, wire, glass, keys, plastic, rubber etc. which are found inside the enclosure due to defective construction/ repair or due to negligence of visitors/workers. Similarly, special precautions are to be taken from ingestion of toxic paints and poisonous insecticides used for pest control in the zoo premises.

SANITATION : It is well known that infectious agents remain in highly attenuated form in nature but in highly concentrated form in captivity. Therefore, general sanitation and hygiene of the animal enclosures and surrounding areas are of utmost importance for good health of zoo animals. For this the excreta and left over food items of all enclosures should be systematically collected and dumped at the appropriate places far away from the enclosures. Similarly all sorts of litters left behind by the visitors and dying and decaying vegetation in the zoo premises have to be collected and transported to a

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far off place daily. All other places of the zoo such as picnic spots, drinking water points, toilets, restaurants, kiosks, parking places etc which are in constant use by the public have to be throughly cleaned and disinfected.

The floor of the animal houses should be cleaned throughly and this can be achieved better if the floor is chack free. The drainage should be good enough for keeping surroundings clean. The enclosure and their surroundings are to be disinfected regualrly.

The pools, water tanks and both dry and wet moats should be cleaned at frequent intervals and disinfected. The utensils and feed and water troughs shall have to be throughly cleaned and disinfected before serving food and water to the animals. The disinfectants containing carbolic acid are not indicated for feline enclosures.

The post-mortem room has to be cleaned and disinfected after each post-mortem examination. The dead animals after the post-mortem examination have to be burried deep with lime and salt in specified burial ground which should be enclosed by a suitable wall to prevent the entry of predators like dogs, foxes, jackals etc. or the same can be burnt preferably with the help of an incinarator at the quickest possible time to prevent the spread of infection.

Periodical operations to prevent the spread of mosquitoes, flies, snails, rodents, crows, stray dogs etc. have to be carried out to prevent the spread of disease. Feed has to be stored away from the rodents insects, crows etc. Periodical removal of 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.

The accumulation of garbage in the zoo premises acts as a breeding ground for the disease causing microbes and the disease causing vectors. Therefore, there should be

arrangement for quick removal and proper disposal of the garbage from the zoo premises daily.

DISEASE MANAGEMENT : The zoo animals like their domestic counterparts suffer from various diseases i.e. from common cold to diseases like avitominosis, cancer etc. But the diagnosis, restraint and treatment of sick zoo animals are more difficult than that of domestic, animals. But whether is is wild or domestic, the disease process is almost the same. Since informations on wildlife diseases are scanty and scattered, all attempts have to be made to prevent or lessen the incidence of diseases in the zoo. Many wild animals have their domestic counterparts which should be kept in mind along with their habits, behaviour, body weight and size while managing the disease problems in a zoo. Some of the examples are as follow.

Cattle and Buffaloes	:	Sambar, spotted deer, Nilgai, gaur, wild Buffalo etc.
Sheep and Goats	:	Blackbuck, Chowsingha, Wild sheep and goat, Chinkara etc.
Horse and Ass	:	Wild ass, Zebra etc.
Pig	:	Wild pig, warthog, Giant Forest hog, peccaries etc.
Dog	:	Dhole, Fox, Jackal, Wolf etc.
Cat	:	Tiger, lion, panther, lesser cats etc.
Poulty	:	Peafowl, Jungle-fowl, Spur-fowl, Pheasants etc.
Duck	:	Geese, Swan and Wild ducks.

The following management practices are usually recommended for effective diseases control programmes in a zoo.

QUARANTINE : Any newly procured wild animal and bird for a zoo can be a potential source of pathogenic micro-organisms or parasites to the healthy inhabitants.

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of that zoo. Therefore, quarantine is a valuable method in preventing the entry of infectious diseases or parasites into the premises of a zoo where the animals might have been free from these infections. All newly received animals should be kept in a specially constructed quarantine enclosure suitable for the species away from animal display areas and zoo veterinary Hospital. They should be kept in the quarantine for atleast 30 days (the incubation period of a large number of infectious diseases are within 30 days) before they are shifted to display enclosures. Quarantine helps the animal to adjust to the new environment, builds up strength and effset the effects of trapping, crating and transporation. Besides, screening for any probable diseases can also be carried out. Detailed clinical examination and te-stScan be carried out to eliminate the sickness if any, present in sub-clinical stage. Many of the clinical examinations can be done simultaneously to avoid frequent handling of the animal. If any positive cases of disease are detected during quarantine they are to be suitablely treated before releasing them in their enclosure. Prophylactic vaccination like giving Feline enteritis vaccine to all the newly received wild cats can also be taken up. Special attention has to be paid for hygiene and sanitation of quarantine enclosure, equipments and utensils used for the animals and for animal keepers.

ISOLATION WARD : This ward has to be kept away from quarantine, zoo veterinary Hospital and animal display area to house and treat the animals suffering from infectious diseases. All measures of sanitation and hygiene are to be adopted when the animals are in this ward to prevent the spread of infection to other areas of the zoo.

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ZOO VETERIANRY HOSPITAL : Every Zoo should have a well equiped zoo veterinary hospital under the charge of specially qualified and experienced veterinarian (s) and the required number of trained supporting staff. Facilities for controlling the zoo animal by providing squeeze, cages, blow pipes/ capture gun with required equipments and chemicals etc., a labroratory for carrying out some of the disease diagnostic tests, operation theatre with surgical equipements for performing operations and indoor wards to house seriously sick animals for treatment should be available. Suffieient quantities of medicines, laboratory reagents, disinfectants etc.have to be placed at the disposal of the zoo veterinary hospital for day to day work.

POST-MORTEM ROOM AND CARCASS DISPOSAL AREA : A Zoo should have a post-mortem room with proper equipments away from the zoo veterinary hospital, quarantine area, isolation ward and animal display areas for conducting post-mortem examination of dead animals. No dead zoo animal should be disposed off without post-mortem examination unless other-wise specifically required as in the case of Anthrax etc. This may reveal many interesting unrecorded disease conditions enriching our knowledge of captive wildlife diseases. After the post-mortem examination the carcass should be properly disposed off as stated earlier. This area should preferably be adjacent to the post-mortem room.

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 on different aspects of animal management and detection of illness so that they will be in a position to detect the illness among zoo animals easily on time and report to the concerned authorities. An investigation can be carried out immediately to detect the cause of sickness and appropriate action can be taken up either by improving the management practices or through suitable therapeutic measures or both. For achieving better results the animal enclosures of a zoo can be divided into different units and a daily reporting system which is already in practice in some of the

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Indian zoos can be implemented .

Inspite of taking all the practically possible preventive meaures, the problem of disease among zoo animals do exists because of confinement, captivity stress, lack of sufficient knowledge on the management of such a varied species of zoo animals, congregation of a large number of visitors of unknown health status etc. So a constant effort has to be made to improve all the aspects of management of animals in zoos.

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DIET SELECTION FOR ZOO ANIMALS

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ABSTRACT

The nature has great variety of flora and fauna which almost balances all the requirements of the creatures living in it but whereas in zoos, it is almost impracticable to provide feed to zoo animals that eats exactly the same as in the wild. Apart from this, different animals have different food habits, different foraging behaviour in the wild which offers ample choice for their own selection of food but whereas in zoos, they have to depend upon the diet which is offered. This may perhaps affect their maintenance as well as production. Therefore, a knowledge of feeding preference and nutritive requirements becomes important in planning for diet selection. In zoo, where the animals are kept in captivity or in semi-natural environment, attempts should be made to translate the needs of the animals by feeding concentrated rations which supply all the essential ingredients. It is therefore essential to acquire a thorough knowledge of all feedstuffs, combined with an understanding of the physiological requirements of the animals and provide mixed diets composed of many ingredients which supplement one another. While planning an appropriate diet and feeding schedule, the palatability, bulk requirement, specific and special needs during maintenance, sickness, pregnancy, lactation and growth should also be taken care off.

To meet all the requirements in a nutshell as well as to bear the financial burden for maintenance of zoo animals, steps towards gradual substitution to the natural diet and efficient use of agricultural byproducts including slaughter house byproducts are necessary.

CHANGING ROLE OF ZOOS - A HISTORICAL PERSPECTIVE

Resume

Though there is evidence of animals kept by the Egyptian rulers as long back as 2500 BC yet the first animal collection maintained as zoo dates back to about 2000 BC in China as "Garden of Intelligence" established by Emperor Wen Wang. In the fourteenth century rulers kept a variety of wild animals. Animal collections were kept by great rulers in the renaissance period.

The oldest existing zoo, Schonbrun, Austria, was built in 1759. The principal royalties established zoos for royal entertainment and as symbol of status and power. An important event was the establishment of London Zoological Society in 1826. Barless, moated enclosures were initiated in 1907 by Carl Hagenbeck. The concept was rapidly adopted in the later zoos. Few decades later, the objectives of zoo management also included captive breeding of the rare and endangered species and conservation, education and research.

In India the first zoo to be set up was the private collection of a variety of birds at the Marble Palace, Calcutta in 1854. Madras zoo was set up in 1855. Several other zoos were established by enthusiasts, mainly the rulers. The zoo movement got an impetus after independence when the Central and the State Governments took up the establishment of several large zoos. Even some public and private sector undertakings established zoos, though smaller.

Realising the importance of zoos Govt. of India set up a Zoo Expert Committee in 1973 which laid clearly the objectives and means to achieve these. A a Central Zoo Authority of India was established in 1992.

Captive breeding of endangered species has become an important function of the zoos. Artificial insemination and embryo transfer have been successfully adopted in this respect and are bound to play an important role in future.

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CHANGING ROLE OF ZOOS - A HISTORICAL PERSPECTIVE

N.D. BACHKHETI & J.H. DESAI

In the chronology of ascent of man as gatherer, hunter, farmer, conqueror and finally as the modifier of his environment, animals have been worshipped, domesticated, hunted and decimated. No one knows when prehistoric humans first began to capture wild animals, but archaeologists have found a fossilized skeleton of a dog like creature in about ten thousand years old human settlement. There is no evidence, however, of collection of wild animals for display by any hunter - gatherer culture or primitive, agrarian society.

Archaeological excavations in Egypt unearthed pictographic records of pet monkeys, antelopes, mongooses, hyaenas, oryx, ibex, addaxes and gazelles. These records, dating back to 2500 BC, represent probably the first known zoo-type collection. Thutmose III an Egyptian ruler in fifteenth century BC, kept exotic plants, birds and mammals in his temple gardens at Karnak. Ashurbanipal, king of Assyria, had a zoological garden in the sixth century BC.

According to Confucius around 2000 BC in China, an Empress Tanki built a marble "House of deer". Later, around 1100 BC, Emperor Wen Wang established a 'Garden of Intelligence' in an area of fifteen hundred acres which housed a variety of fauna including the Giant panda from his vast Chinese Empire.

By seventh Century BC, in Greece, monkeys and birds were kept in the gardens of rulers and nobles. Two centuries later, the Greeks built aviaries for finches, nightingales, jackdaws, magpies, pheasants, quails, flamingoes and peacocks which became so popular that owners could charge admission fees to see them. Alexander the Great kept diversified fauna in his menageries which helped Aristotle to compile his encyclopedia "The History of Animals" which described about three hundred vertebrates in fourth century BC. Ptolemy I, whom Alexander had appointed as ruler of Egypt,

founded probably the largest and most spectacular ancient zoo in Alexandria. The zoo was expanded by Ptolemy II who sent expeditions for animal collection as far as Ethiopia. This was perhaps the first zoo which exhibited chimpanzee in captivity around 285 BC and other animals such as ostriches, pheasants, parrots, guinea fowl, Ethiopian birds, wild asses, oryx, lions, leopards, cheetahs, a white bear, giraffe, rhinoceros and snakes.

Likewise, the Roman Emperors and nobles also kept wild animals in their estates, however, the primary purpose for keeping these animals was provision of stock for public blood-sport events and not for simple display. The brutality abated with the fall of the Roman Empire but animal collections were maintained during the middle ages by royalty.

During the renaissance period, western travellers and adventurers found 'zoos' in different parts of the world. Marco Polo saw a great zoo at the palace of Kublai Khan where elephants, hippos, big cats, bears, deer, asses, monkeys, fish and falcons were exhibited. In 1519, Hornado Cortes visited Montezuma's zoo in Mexico, which included large aviaries with colourful birds and falcons, eagles, condors. Large cats such as jaguars and pumas were kept in bronze cages. The zoo also displayed iguanas, giant turtles, rattle snakes, monkeys, bears, armadillos and water birds. In sixteenth century, large urban zoos in Cairo, Karlsburg, Constantinople, Dresden, Prague and Versailles were established.

The oldest existing zoo, Schonbrunn, was built in 1759 by Holy Roman Emperor Francis I as a present for his wife, Maria Theresa, Queen of Hungary and Bohemia and arch duchess of Austria.

In India, elephants were used for transport of cargo and human passengers by 2500 BC. Indian mythology and culture is replete with accounts of animals kept by Kings and Emperors for work, warfare, hunt and entertainment.

Zoos, therefore, are not recent phenomena but they existed in urban areas during different civilisations since time immemorial. Throughout this entire period of zoo keeping, however, zoos were established by powerful royalty and the animal collections were maintained for the sole purpose of royal entertainment and as symbols of status and

power. Historically, zoos began as places where animals were exhibited as objects of curiosity and for their entertainment value. Zoos in general were neither noticeably concerned about the natural requirements of animals nor particularly interested in their propagation in captivity. With the formation of the Zoological Society of London in 1826, the utility of zoos for scientific studies was realised, however, animals continued to be kept in small cages, pits or cramped compounds. In 1907, Carl Hagenbeck, an animal dealer from Hamburg, developed the concept of barless, moated enclosures which radically changed the concept of display of animals in zoos. Small cages, pits and closed houses gradually gave way to spacious, open-air enclosures with simulated near natural conditions without any visible barrier between the viewer and the viewed. The new concept of display of animals also brought improvement in the health, especially behavioural health, of animals and their chances of breeding in captivity. During the last fifty years, well established zoos all over the world adopted the new design concept and suitably modified, renovated or replaced old type enclosures.

In the 1960s, zoologists and naturalists around the world were faced with the reality of the alarming rate of extinction of wild animal species largely due to the direct or indirect intervention of man. In the overall strategy to arrest the rapid decline and decimation of wild fauna, zoos were looked upon to fulfil an important role in the conservation movement. This role envisaged four basic objectives as follows:

(a) Conservation : To act as repositories for species threatened with extinction.

(b) Captive breeding : To evolve and carry out breeding programmes for the propagation of rare and endangered species.

(c) Education : To interpret animals and conservation to the visiting public for better understanding and appreciation of animal life. To act as central clearing house for dissemination of biological information, and to evolve educational programmes for visitors, schools, biology teachers in order to create an awareness for wildlife conservation.

(d) Research : To conduct research on behaviour, reproduction, nutrition, diseases and to co-operate with various institutes in research endeavours.

Many zoos in the world have made considerable progress in attainment of these objectives since then. Some have made significant contributions in these fields, e.g., the Jersey zoo (Wildlife Preservation Trust, Jersey) specializes in breeding rare and endangered species; the Bronx zoo is engaged in propagation of rare/endangered species through the technique of embryo transfer; the San Diego zoo has established a 'frozen zoo' of gametes of rare and endangered species; the National zoo at Washington has established a satellite center for breeding of wild species at Front Royal and conducts educational programmes catering to all age groups; the Berlin zoo in Germany runs special educational programmes for schools; the Lipzieg zoo and the Basle zoo maintain up to date stud books on tigers and one-horned Indian rhinoceros respectively. There are many more zoos doing excellent work all over the world.

At a time when some two thousand species of vertebrates are in danger of extinction, the zoos may be the only salvation for a large number of species in the next century. Considering the extent to which zoos are involved with animals, it is of utmost importance that the zoos should be better organised to accept the challenge and responsibilities in the coming decades.

Even though the history of zoos in India dates back to over hundred and forty years and there are more than 300 captive wildlife facilities at present, they have not been able to make any appreciable impact so far. This is probably due to the fact that their management and development suffer from various constraints such as paucity of financial resources, dearth of adequate and qualified staff, lack of coordination, cooperation and communication between zoos, multiplicity of authorities controlling the various zoos and the consequent absence of clear cut policy, standards and guidelines.

The first zoo in India dates back to 1854 when the first aviary/zoo was opened by Raja Rajendra Mullick Bahadur in his private residential mansion called 'Marble Palace' in the center of Calcutta. The Marble Palace was constructed around 1840 and is one of

the oldest mansions of Calcutta today. A unique collection of originals and copies of art work of renowned sculptors and arists from all over the world are now housed inn the building while rare species of parrots, macaws, and cockatoos along with a few species of mammals are exhibited within the compound of the building which is open to public free of charge.

The following year, in 1855, the Madras municipality established a zoo in an area of 20 acres/8 hectares, behind the Moor market, near the Madras railway station. The zoo was closed down in 1980 and shifted to a new site in 1985 in an area of 510 hectares. The new Zoological Park known as the Arignar Anna Zoological Park, is being built at Vandalur near Madras on modern concept of zoo design and is one of the finest zoos in the country. The zoo at Trivandrum was established in 1857 and was followed by zoos at Bombay (1863) and Junagadh (1863) and later by Jaipur, Calcutta (1875), Baroda (1879) and Mysore (1892). During the first half of the present century only six zoos were established, Nagpur (1905), Lucknow and Gwalior (1921), Udaipur (1935), Bikaner and Jodhpur (1936).

The zoo management received an impetus after independence. The Central Government decided to set up a major zoo at the Capital. The main features conceived were large enclosures with natural setup in which the animals could live in semi-natural conditions and, as far as possible, with invisible barriers between the animals and the visitors. The Delhi Zoological Park (later named as National Zoological Park) was started in 1954 and inaugurated in 1959. At the same time and subsequently in several states also modern zoos were set up such as Smt. Padmaja Naidu Himalayan Zoological Park, Darjeeling (1958), Assam State Zoo-cum-Botanical Garden, Gauhati (1959), Nandankanan Biological Park, Bhubaneswar (1960), Nehru Zoological Park, Hyderabad (1963), Kanpur Zoological Park (1968), M.C. Zoological Park, Chhatbir, Chandigarh (1977) and Arignar Anna Zoological Park, Vandalur, Madras (1985). In addition to these, large number of mini zoos were set up by various state authorities in the post independence period. In some public and private sector establishment at Bokaro, Bhilai and Tata Steel at Jamshedpur also set up zoos of small and medium sizes. The Tata Steel zoo was inaugurated late as 1994.

Since the zoos were established at different times, beginning from the last century to the present, their objectives reflect the philosophy prevalent at the time of their establishment. Zoos set up in the last century were meant, mainly to exhibit different types of animals. The accent was on amusement and entertainment rather than conservation or education. After independence, the zoos have become aware of their important role in conservation, breeding and education. In the absence of any accepted norms or standards for the zoos in the country, the quality of management of captive animals differ very widely from institution to institution.

While it had been recognised for many years that the zoos can play an important role in the conservation of wildlife, it was not until June, 1973 that the Government of India, on the recommendations of the Indian Board for Wildlife, set up an Expert Committee to study the maintenance, management and breeding of wild animals, administrative set up and working of zoos in India; and suggest ways and means of management of wild animals in captivity.

The Expert Committee, in its report published in 1975, in addition to other recommendations, advised for the creation for breeding rare species, research programmes, capital works, capital cost for procurement of exotic animals, books, drugs and equipment, arranging technical expertise, dissemination and exchange of information through seminars, symposia, exchange, visits of zoo personnel within and outside the country and training programmes. Although in 1980, it was mooted to set up a "Zoo Authority of India" in the Ministry of Agriculture under the Central Government, the move did not materialise. Subsequently, the matter was discussed in various meetings of directors of Indian zoos where it was widely held that setting up of a central agency would help the zoos in their overall development.

Since 1980, the Central Government and the Indian Board for Wildlife have been concerned about the status of management and the condition of wild animals in captivity in the country. It is felt that due to lack of attention being given to improve the condition of zoos, their development has been thwarted and, if the zoos in India are to play a significant role, they will have to transform themselves to be able to make positive contribution. Zoos in India vary to a great extent in their methods of display of

animals, success in breeding rare species, administrative patterns, management practices, educational activities, area and objectives. As many as fourteen different authorities control hundred and five zoos which vary from isolated collections of a few species to modern zoological parks covering more than a hundred hectares and maintaining over a hundred species in large open air enclosures. In most of the zoos visitor education programme, animal breeding programmes and research activities are either non-existent or sporadic. Lack of motivation, resources and infrastructure to conduct these activities are the bane of the zoos in India. Proliferation of small zoos without adequate means (technical and financial) for development has been an important adverse factor. To control this tendency and to assist the developing zoos technically and financially a legally backed Central Zoo Authority has been constituted in 1992. Another significant development has been formation of a Zoo Management Consultancy Unit in the Wildlife Institute of India with the twin objective of providing technical assistance and conducting of training programmes for zoo managers. These steps are likely to orient the zoos in the proper direction and to prepare tham for the important role that they will have to play in ex-situ conservation and breeding, education and research.

The concept of zoo management has changed radically during the last thirty years. There has been a phenomenal qualitative and quantitative development of management techniques. It is this gap in technology and zoo philosophy that needs to be bridged if the zoos in India are to complement the field conservation effort.

Local extermination of species is going on apace. Although zoos have achieved notable success in breeding endangered species, their efforts have been confined to the preservation of a small number. In order to accelerate the breeding rate new techniques have been evolved by zoos in advanced countries. These techniques are (i) artificial insemination and (ii) Embryo transfer.

Artificial insemination has became an essential part of the livestock management during this century, particularly since 1936. Within the last fifteen years the procedure of A.I. and the use of frozen semen have also proved beneficial to medical science. In 1979 the first human resulting from embryo transfer was born. Zoo interest in A.I. has gathered momentum in the last decade. This technique is advantageous to natural

breeding animals which are single maintaining genetical diversity, accelerating reproduction rate and treatment of infertility. The technique involves detection of oestrus, semen collection by electro ejaculator, semen storage, artificial insemination, embryo recovery and preservation and embryo transfer.

Till now the A.I. technique has been successful in several wild species such as Guanaco, Llama, Blackbuck, Reindeer, Red Deer, Giant Panda, Fox, Wolf, Leopard, Puma, Macaques, Baboons Chimpanzee, Gorilla, Cranes, Waterfowl, Pheasant and tortoises.

The Embryo transfer technique in which the embryos are transferred to a surrogate mother of the same species or closely related domestic species. The embryo transfer can increase the size of a population of endangered species in a short time by implanting several embryos in different surrogate mothers and thereby improve the chances of survival of the species. Successful embryo transfers have resulted in the case of Bongo, Gaur, Mouflon Sheep, Squirrel Monkey, Baboon, Water Buffalo, Eland (1983). In vitro fertilization has been successful in case of primates only.

The Indian zoo scenario has shown an improving trend during the last couple of years. The decision makers are becoming aware of the potential of good zoos for conservation and for stimulating public opinion to support conservation efforts. Recently, the Indian zoo directors have formed an association for better coordination, cooperation and communication. The government of India has passed a Zoo Act (Sept. 1991) and constituted a Central Authority for zoos to help in procurement of medicines, animals equipment, financial assistance for educational and captive breeding programmes and to act as a coordinating agency for all Indian zoos. The zoo management training programmes developed by the Wildlife Institute is a step in this direction.

In view of this changing scenario, it is hoped that the zoos in India will start to play a significant role in conservation, captive breeding programmes, education and research in near future.

POPULATION CONTROL MEASURES FOR PROLIFICALLY BREEDING SPECIES

Dr.P.O.GEORGE

Survival of the fittest is the law of nature. Procreation is one of the distinctions of the 'live'from the'lifeless'. What are the necessities for the proliferation of the species ?

a) Good health
b) Plane of nutrition and
c) Proper environment.

These three factors may be considered as the sides ~~of~~ of an eqilateral triangle.

a) Good health: 'Apparently healthy and free from any infectious or contageous disease, is a very safe term 'legally'. Many monkeys continue to enjoy apparently good health, even though they might be suffering from tuberculosis. Snakes are very ~~major~~ curious creatures , they may not feed for days together, will not feed during the moulting stage i.e when the epidermis is being shed and during illness. Sudden death might occur in rarely reported cases, such as Anthrax, as it happened at the Trichur Zoo. Merely looking at an animal, it is not possible to conclude the status of health of any animal.

b) Plane of nutrition: An animal in its natural way of life, will eat when it is necessary and by instinct, choose the essential items to meet the requirements of minerals and other trace elements. When stall fed, these items are to be incorporated in the feed or supplemented in Zoo animal nutrition is in a state of infancy in our country.

c) Environmental effects: Many factors are conducive for breeding viz. daylight, temperature, surroundings, proper area for sexplay so and so forth. Will it be possible to provide all these facilities for an animal in captivity.

Problems of prolific breeding in a zoo:

(i) Lack of space { - Feed
- Territory and dominance

(ii)Chances for the spread of diseases

(iii)Fighting

(iv)Inbreeding

(v) Hybrids

(i) Most of the zoos in our country have very limited space, with no scope for expansion by aquisition of additional land from the adjacent area, with the result, the animals are crowded.

Feed becomes a problem. A variety of foodstuffs are required, eg ratsnake for the king cobra, ants for the pangolins, fresh fish for the otters and gariels etc and etc. Procuring different items/ ingredients of feed, becomes a real headache for the administrator.

When the number increases, the area for the individual animal naturally decreases, with the result the territory occupied previously had been adversely affected, and leads on to conflicts within the herd.

(ii) Chances for the spread of diseases:

Chances for the spread of the diseases, both parasitic and infectious, are more. Quarentine facilities being almost nil, this problem becomes all the more a serious one.

(iii) Fighting.

Fights for establishing dominance and heirarchy in a herd of animals is very common. When the number is increased, there will not be enough space for the attacked animal to escape.

(iv) Inbreeding:

This is one of the most important problems. There may not be any possibility of introducing fresh germplasm into the herd and hence after few generations, they deteriorate and may perish.

(v) Hybrids:

When a new animal is brought, may be from any of the zoos or ~~captured~~ seized, its genetic constitution is not known. Most of the large cats maintained in our zoos are hybrids. ~~Many of the pure~~ Many of them are not included in the ~~herd~~ stud book for that particular species. Hybrid animals are not required by anybody for purchase. At least with respect to the large cat population, breeding is between the hybrids and unless this is prevented, the increase in the hybrid population can never be controlled.

How to tackle this problem of increase in the population ?

The nature's way is death of the animal. But is it worthwhile to wait upto that ?.

Sale of excess number of animals from the zoo. It is easily said, but in practice, this is a very difficult proposition. The procedure for procuring a licence to maintain an animal which is included in the schedule of the Wildlife Act, is very cumbersome. If anybody is curious enough to go through the list of animals included in the schedule, almost all the animals(which are not used for agricutural purposes) except mice, rats and some more of the like, are mentioned in the schedule.

Sale of excess animals to other zoos in India or abroad. We have so many restrictions in this regard.

Why not leave these animals free in the forest area, so that they will have free living? ~~Is it worthwhile~~ Apart from public resistance, will these animals be able to survive from the predators and poachers?

An easy method, as is practiced in many zoos abroad, is to shoot the excess number and feed it as meat for the carnivores.

If venison is to be fed to a zoo animal, why not it be sold at an exhorbitant cost to the public and thus increase the revenue. Is it essantial that venison should be fed to a lion or tiger?

At this juncture, it is worth examining the possibility of 'mercy killing' in zoo animal practice. All will agree that a mutilated animal should not be exhibited. On very many occasions, the veterinary surgeon will be sure that the survival of a particular animal will not be possible. At least on humanitarian considerations mercy killing would have been better, rather than prolonging the perpetual suffering of that animal. With all these, in how many instances, had there been any 'mercy killing' in our zoo animal practice.

The only possible solution appears to be sterilisation of the/male animals, thereby preventing their breeding. This can be achieved by removal of the testicles, or making them functionless, or by preventing the transfer of sperms through the vas deferens. In females, the procedure is to remove the ovaries or prevent the transfer of ovum through the oviduct. The procedure in the female animals is more difficult than in the male animals.

excess number

In male animals:

a) Injection of irritant solution such as one percent cadmium chloride, or perchloride of mercury, intratesticularly. The inflammatory reaction consequent on the injection of the irritant will result in fibrosis of the testicular tissue thus impairing sperm production. When done, the results are not satisfactory. At times, complete degeneration and aseptic necrosis of the testicular tissue would ~~be~~ result. This technique is almost abandoned nowadays.

↑ Calcium chloride, Isopropyl alcohol etc

b) Orchiectomy. This is a very efficient technique i.e. surgical removal of the testicles. After inducing general anaesthesia, an incision cutting through the skin, dartos and tunica vaginalis is made to expose the gland. After ligation of the blood vessals, the testicles are excised. The skin wound is not sutured and it heals up quickly as an open wound. Dressing the wounds with neem oil may be necessary for about a week. Antibiotics should be administered.

The disadvantage of this technique is that, if it is a lion, it starts looding its mane within about six months and in about one year, feminisation syndrome will appear i.e. the male animal will appear as a female animal, much to the pubic criticism.

c) Vasectomy. This is a very popular technique. The animal is capable of exhibiting all the potentialities and the propensities of the male, will mate but will not procreate. After anaesthesia, a skin incision is made at the neck of the scrotum and the tunic is incised to expose the vas deferens. One cm length of the vas deferens is cut and removed, so as to prevent the chance of recanalisation. The skin incision is closed with catgut sutures so that it need not be removed. Dressing of the wound and administration of antibiotics should be done in this case also.

Caudectomy- Another approach on the sane lines, is to cut and remove a small portion of the cauda epididymus by incising at the base of the scrotum after holding the testicles tensed to the lowermost. In species, where the cauda epididymus is prominant this technique is very simple and easier than vasectomy.

d) Implantation of synthetic polymer into the vas deferens had also been reported to prevent the transfer of sperms through the ejaculate.

e) Vaccination programme, to sterilise the male animals, had been advocated. The trials conducted at the Madras Veterinary College, did not give encouraging results.

In female animals:

a) Implantation of the intrauterine loop had been tried in some of the Gosalas in Gujarat. Feasibility of this technique is remote in zoo animals.

b) Subcutaneous implantation of progestrom at the shoulder region had been tried successfully at the Bannerghatta sanctuary in large cats (lions, leopards and tigers). This is very expensive and needs reimplantation every three years.

c) Ovariectomy or removal of a portion of the oviduct appears to be surest techniques in the female animals for sterilisation. This technique requires laparotomy which is rather not an easy proposition in zoo animals even though a successful caesarian section had been done at the Vizag Zoo in a tigress.

Under the present set up, the only possible means of preventing prolific breeding in the zoos, is to sterilise excess number of male animals, by performing vasectomy or caudectomy.

Population Control Measures in Zoo Animals

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Two types of problems are encountered for regulation of fertility of zoo animals. For some, it is necessary to promote fertility. Several animals do not breed adequately in captivity. Furthermore, as the stock of males and females is limited, hypofertility of the available animals fails to engender progeny. Being given that the scientific knowledge of reproduction is now fairly adequate, it is possible to induce superovulation by an appropriate regimen of hormones. Hormones can also be used to enhance libido and spermatogenesis in male animals. Techniques of *in vitro* fertilization and embryo transfer can be used to enhance the reproduction of endangered species with low fertility.

Some animals breed in more numbers than desired or containable in a zoo and thus call for regulation of fertility of these animals. Two types of interventions can be adopted. An LHRH vaccine developed by us can be employed to block the fertility of both male and female animals, LHRH being a common 'master' hormone in both sexes. Immunization with this vaccine also reduces libido and aggressiveness, as it inhibits the production of testosterone. The effect of the vaccine is, however, reversible, which is good for some purposes but may not be adequate in cases where long lasting, if not permanent, sterility is desired. For the latter purpose, we have devised an injectible, TALSUR, that can sterilize or castrate a male mammal permanently.

GENETIC MANAGEMENT OF CAPTIVE POPULATIONS: AN OVERVIEW

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Resume

Knowledge of genetics is essential for genetic management of captive populations. Simple knowledge of inheritance of coat colour is helpful for breeding animals like white tigers and black leopards. Studies on protein polymorphism by electrophoresis is widely used for studying the genetic variability in a population. It is generally measured by average heterozygosity. Protein polymorphism may be used for testing genetic purity of captive animals. If inbreeding coefficients of the offspring for all possible pairs are known in advance, an objective breeding plan can be made. Continued inbreeding in small populations leads to the reduction in genetic diversity. Some methods for determining the effective size of an actual population and its effect on heterozygosity have been discussed.

The Central Zoo Authority of India has done a great honour in inviting me to present a paper in the workshop on "Indira Gandhi's Vision on Wildlife Conservation - Zoo as one such Instrument." On this occasion I have decided to present a paper on genetic management of captive populations. I believe, this will be appropriate to the vision of our late Prime Minister, Indira Gandhi on wildlife conservation. The underlying theme of the present workshop may be traced to the view expressed by Dr. Rod C. McKenzie of University of Southern California, USA about 20 years ago. He said that the zoos are world's only hope for wild animal survival, for population pressures through out the world would inevitably lead to the total economic exploitation of wild animal habitats (Newsweek, Aug. 1974, pp. 91-92). Therefore, if we want to conserve wild animals, we should start from zoos.

Most of the zoos in our country are used for exhibition of animals. Until now scientific research has rarely been done for captive breeding. Efficient management for captive populations depends upon maintenance of good records of births, parentage, etc. of the animals. Unfortunately such records are not available in most of the zoos.

I apologize that a number of references cited in my paper are not consulted in original, because they are not available in libraries. Non-availability of relevant books and journals in our libraries is one of the drawbacks of scientific research for captive animals. I sincerely hope that the Central Zoo Authority of India will look into this matter and establish central and/or

regional libraries with all the latest information on animals.

Knowledge in Genetics

Knowledge in genetics is useful for efficient management for captive animals. Those who are in charge of breeding animals in captivity do not have much knowledge of this subject. Let me cite one example. The principle of inheritance of coat colour of white tiger was not known for a long time. If Maharajah of Rewa knew it, he would not have sold the normal coloured offspring of white male, Mohan and normal coloured female, Begum. Similar was the case of one animal dealer in Calcutta who purchased three offspring of Mohan with a hope that they would become white when they would grow old. As the offspring grew older, there was no sign of whiteness in their coat colour. The animal dealer quickly disposed of them and got relief. All these events happened about 40 years ago. Apparently both the Maharajah and the animal dealer were not aware of the fact that the normal coloured offspring they sold out were actually heterozygous tigers carrying a recessive gene for white colour. They have the capability for producing white tigers, if they are interbred or bred with white ones.

Although we now have the knowledge of inheritance of coat colour, still we do not use it judiciously. In many zoos heterozygous tigers were mated with homozygous ones either unknowingly or inadvertently. In consequence, when white tigers appeared suddenly from normal coloured parents in Mysore, Patna and Jaipur Zoos, there were claims that they were new white mutants, as

they were not biologically connected with Rewa or Nandankanan lineage. When ancestry of those white tigers were traced, such claims for new mutants were found false. To breed white tigers, known heterozygous tigers should not be allowed to mate with known pure normal coloured tigers, for their homozygous and heterozygous offspring cannot be distinguished morphologically. If these mixed up offspring are sold, exchanged or loaned to any zoo, there is a possibility of appearing white tigers any time and any where. This is perhaps one of the reasons for those who are not in favour of breeding and exhibiting the white tigers in the zoos.

Similar is the case of inheritance of coat colour in leopard. Very few people know that coat colour of leopards is controlled by a pair of autosomal alleles, the black being recessive to normal (spotted) colour (Roychoudhury and Acharjyo, 1984). If known heterozygous spotted leopards are mated with homozygous ones, it is difficult to identify the genotypes of their offspring. The genealogical chart or studbook for white tigers and black leopards is therefore essential for breeding these animals.

Protein Polymorphism

The extent of genetic variation in a population is generally studied by electrophoretic analysis of proteins. It is measured by proportion of polymorphic loci and average heterozygosity.

(a) Proportion of Polymorphic Loci

A locus is said to be polymorphic, when the frequency of the

most common allele is equal to or less than 0.99, otherwise it is called monomorphic. In a sample of n loci, if m number of loci is found polymorphic, the proportion of polymorphic loci (P) is then

$$P = m/n$$

It is a simple measure of genetic variation in a population, when a large number of loci and a large number of individuals per locus are studied (Nei, 1987).

(b) Heterozygosity

The most widely used measure of genetic variation in a population is the average heterozygosity or gene diversity. Consider a random mating population in which x_{ij} is the population frequency of the ith allele at the jth locus. The heterozygosity for jth locus (h_j) is defined as

$$h_j = 1 - \sum_{i=1}^{k} x'^2_{ij}$$

where k is the number of alleles at jth locus.
Average heterozygosity (H) is the average of this quantity over all loci. If n is the number of loci sampled from a population, then the average heterozygosity is

$$H = 1/n \sum_{j=1}^{n} h_j$$

H = 0, when all the loci are monomorphic (Nei, 1987).

O'Brien et al (1985) studied 52 loci of blood proteins in cheetah of South and East Africa and found all of them are monomorphic. On the other hand Dinerstein and McCrakin (1990) found a relatively high heterozygosity of 0.099 at 29 loci of one-horned rhinoceros.

Protein polymorphism by electrophoresis can be used to ascertain the genetic purity of captive populations. O'Brien et al. (1987) found evidence for infiltration of African lion genes into the captive Asiatic lion (c.f. Hedrick and Miller, 1992). Recently there has been awareness for establishing purity of Asiatic lions as some of them have been mated with African lions in some zoos. Identification of pure Asiatic lions from hybrids is difficult. It is now known that 28 Asiatic lions originating from Gir Forest show monomorphism at 46 enzyme loci, indicating that all the animals are genetically similar at least for these loci (Fouraker, 1994). If any lion showing deviation from genetic sameness, can be suspected as hybrids. In absence of genealogical chart or studbook, genetic testing of blood proteins by electrophoresis provides an alternative for detecting the hybrids. Besides, analysis blood proteins in animals is helpful for studying their phylogenetic relationships and taxonomy. How the knowledge of phylogenetic relationship is helpful in reconstructing an extinct subspecies of Dusky seaside sparrow has been studied by Avise and Nelson (1989). This knowledge is certainly helpful for conservation of biotic diversity.

Inbreeding

Mating between related individuals is called inbreeding. An individual is said to be inbred, when its parents have at least one ancestor in common. Genetic effects are manifested when an inbred individual possesses double dose of a gene which is present in a

single dose in the common ancestor and its parents. A recessive gene hidden in common ancestor is expressed in inbred individuals. Intuitively it is expected that recessive traits occur with increased frequency among the progeny of related parents. That is why most of the white tigers appeared in zoos, when their normal coloured parents were closely related. The degree of inbreeding is measured by inbreeding coefficient. It is the probability that an individual receives at a locus two genes that are identical by descent. The inbreeding coefficients for different types of consanguineous matings like brother-sister, uncle-niece, first cousins and second cousins are 1/4, 1/8, 1/16 and 1/64 respectively.

From a pedigree chart the inbreeding coefficient of an individual (I) can be calculated by using the following formula

$$F_I = \sum (1/2)^n (1 + F_A)$$

where n is the number of individuals (except I) in a closed path leading from one parent to other through their common ancestor. The summation is over all possible paths in the pedigree and F_A is the inbreeding coefficient of the common ancestor at the apex of the path. Note, a path cannot pass through the same individual twice.

Most of the animals in a zoo are founded by a small number of individuals. If they are bred in captivity, after few years they grow a large number of individuals and become related to one another. If they mate each other for long time, inbreeding depression in the form of increased juvenile mortality and

decreased fertility may occur. Analyzing breeding records of 44 species in National Zoological Park, Washington D.C., USA, juvenile mortality of inbred young was found to be higher than that of unrelated young in 41 species (Ralls and Ballou, 1983). To increase the number of white tigers quickly in captivity, matings between close relatives like father - daughter, brother - sister etc. were practiced in Delhi, Calcutta, Bristol and Washington Zoos. In consequence reduced fertility and early mortality in white tigers were observed in these zoos (Roychoudhury and Sankhala, 1979). Modern studbook of an animal provides inbreeding coefficients of offspring for all combination of potential sires and dams (Ballou and Seidensticker, 1982; Smith, 1985; Roychoudhury et al., 1989). The inbreeding coefficient of the offspring can be used as guides in the selection of mates for future breeding of the animal. Apart from age and health consideration, the mates are to be selected in such a manner that the changes in inbreeding coefficient should not go up more than 1% per generation (Franklin, 1980).

When relationship between mating individuals is known, the inbreeding coefficient can be calculated. If it is not known, it can be estimated on the basis of population size. If there are N number of individuals in a population, the inbreeding coefficient (F_t) of individuals in generation t is

$$F_t = 1/2N + (1 - 1/2N)F_{t-1}$$

Sometimes a symbol, P, for the complement of inbreeding coefficient, 1 - F is used. It is called panmictic index.

Substitution of P = 1 - F in the above equation gives

$$P_t = P_{t-1}(1 - 1/2N) = P_{t-2}(1 - 1/2N)^2 = ...$$

$$= P_0(1 - 1/2N)^t$$

where P_0 is the panmictic index of the base population. In the base population, the inbreeding coefficient is zero, and therefore P_0 = 1. Then,

$$P_t = (1 - 1/2N)^t$$

The relative heterozygosity (H) is also defined as panmictic index P (Falconer, 1970). If H_t and H_0 are the frequencies of heterozygotes for a pair of alleles at generation t and in the base population respectively, then the heterozygosity at t-th generation is

$$H_t = H_0(1 - 1/2N)^t \quad \text{(Since, Pt = Ht/H0)}$$

When N = 10 and t = 1, the heterozygosity (genetic variability) is 0.95 or 95% of the initial heterozygosity. After ten generations, the heterozygosity will reduce to 60% of the initial heterozygosity.

Effective Population Size

Effective population size denoted by N_e is a number of individuals who actively participate in the reproductive process. Since all the individuals do not take part in reproduction, the effective population size is generally smaller than actual size of census population (N). Various factors cause the difference. Estimates of N_e for actual populations depend upon (i) unequal number of breeding males and females, (ii) fluctuations in

population size, (iii) non-Poisson (non-binomial) variance in distribution of offspring, (iv) overlapping generations, (v) heritability of fertility, and (vi) geographic structure (Harris and Allendorf, 1989).

Inequalities in number of sexes causes reduction in effective population size. In a population if N_m and N_f are the numbers of males and females respectively, then the effective size of population is given by

$$N_e = 4N_mN_f/(N_m + N_f)$$

The reduction is pronounced in polygamous animals. Suppose a population consists of one male and 20 females, the effective size of population is 3.8 and not 21. If number of males is equal to that of females, then the effective size of population is equal to actual size of population.

If population size varies from generation to generation, the effective population size is the harmonic mean for all generations, i.e.,

$$N_e = n/(1/N_1 + 1/N_2 + \ldots + 1/N_n)$$

where N_i is the population size of the ith generation and n is the total number of generations.

The harmonic mean is smaller or at most equal to the arithmetic mean. If the number of breeding individuals are constant for all generations, then effective population size is equal to actual size of population. If a population goes through a bottleneck, the effective population size is greatly reduced. Suppose a population maintains its size of 1,000 individuals for

four consecutive generations and suddenly it drops to 50 individuals in fifth generation, then N_e becomes 208.

If family size varies, the effective population size will be

$$N_e = 4N/(2 + V_k), \text{ approximately}$$

where Vk is the variance in family size and N is the actual number of population. If all the families contribute equally to the next generation, there will be no variation in family size,

$$N_e = 2N$$

The effective population size is approximately twice the number of actual population. If variance in family size is 2, the effective population size is approximately equal to the actual size. In the literature there are numbe. of formulae of the effective size of populations under different conditions as mentioned above.

The effective size of a population is sometimes used to measure the amount of inbreeding in a finite population. Its effect on heterozygosity can be determined by substituting the effective population number for actual population size (N) in the above mentioned formula, i.e.,

$$H_t = H_0(1 - 1/2N_e)^t$$ (See, Crow and Kimura, 1970)

The rate of loss of heterozygosity (i.e., genetic variation) is a function of the effectve size of population. The smaller the population, the greater the loss of genetic variation. Franklin (1980) suggested that N_e for large mammals should not be less than 50. However, N_e of order 500 can preserve 90% of the original genetic diversity for 100 generations.

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ASSISTED REPRODUCTION IN ENDANGERED SPECIES

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Human development is the primary cause of the ongoing rapid depletion and extinction of wild animals caused by systematically destroying the natural habitats of animals. Hence, attempts were made to overcome this man made difficulty by creating protected habitats for breeding such as zoological parks and wildlife preserves. The success of any such endeavour would be greatly influenced by our knowledge of the reproductive biology, physiology, animal behaviour and genetics of the wild animals. The knowledge thus generated could be used for assisted reproduction in endangered species.

Assisted reproduction techniques have revolutionised treatment of infertility in man and has also lead to selective breeding in cattle. The knowledge acquired thus is now being utilised to perpetuate endangered species and to ultimately relieve them from problems due to inbreeding depression, incompatible mates, captivity stress etc. Assisted reproduction techniques such as intrauterine insemination (IUI), in vitro fertilisation (IVF), uterine embryo transfer (UET), gamete intrafallopian transfer (GIFT), zygote intrafallopian transfer (ZIFT) etc. have now been attempted in cheetah, lion, giant panda, leopard, tiger, puma, deer etc. These studies indicate that assisted reproduction could help conserve wild animals but the complete success would depend on a coordinated activity of population biologists, ecologists, geneticists, veterinarians, reproductive biologists, zoo personnel and finally a continuous funding on a long term basis.

BREEDING BIOLOGY AND ASSISTED REPRODUCTION INCLUDING GENOMME BANKING.

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There is growing interest in conserving the World Animal Genetic Resources which has necessitated understanding of the Breeding and Reproductive Biology of the various species of animals. During the course of evolution of different species of animals particularly the mammalian species, there have been notable anatomic, endocrinologic and physiologic changes. Among the more obvious are; economy in the production of gametes, reduction in the size of eggs, internal fertilization, development of the corpus luteum as a temporary endocrine organ, development of placenta as a nutritive, excretory, endocrine and protective organ and finally, birth at the time appropriate to the species when the young can survive in the environment provided for them. The main effect of these changes was to ensure continuation of the species.

Birds (Aves), fish (Pisces) and amphibians (Amphibia) are "oviparous" and they produce abundant and large eggs surrounded by a large Yolk. In many cases among these animals fertilization of the eggs takes place outside the body of the female whose external genetalia are "Ovoviviparous", their eggs are covered with a protective shells and have an abundant yolk. The larvae hatch inside the body of the female. Mammals, on the otherhand with the exception of Monotremata, are "viviparous". They produce eggs in small number which contain a scant yolk, fertilization is internal, foetal development is completed in the uterus and the external genetalia are well developed. The echidna (Tachyglossus Aculeata) and platypus (Ornithorhynchus anatinus) are the only mammals that lay eggs. The eggs of these mammals are relatively small and do not contain enough nutriment to support development upto an advanced stage, though not to the stage of hatching.

There are several thousand mammalian species, but breeding biology has been extensively studied in less than twenty five, namely Rodentia (Rodentia), Rabbits (Lagomorpha), primates (including man), farm animals and few marsupials. Some of these species again have certain peculiar reproductive phenomena, such as restricted sexual seasons, absence of estrus, presence of menstruation, dissociation of ovulation and estrus, non spontanious obulation, spontanious multiple ovulation with limited implantation, delayed implantation, and ovulation during pregnency.

Among the different orders of animal kingdom Artiodactyla includes a large and diverse group of animals, all characterized by cloven hoofs are distributed World wide from the Aritic to the Equator.

Many species of mammals breed during a relatively restricted period of the year i.e., breed seasonally. In this way they may ensure that births occur at the optimal time for survival of a maximum number of offspring in the population. Seasonality in breeding takes place in different species due to the climatic conditions, availability of high quality food and annual changes in day light. (Hafez, 1980).

Reproduction in the female

Though there are many subtle morphological variations that occur throughout the order Aritiodactylids, the basic descriptions of uterine morphology Still apply broadly to most species. In general the uterine type is bicornuate.

The estrous cycle

The general scheme of the estrous cycle in members of this order involves a short follicular phase, governed by the life of the corpus luteum (CL) which varies considerably between and within species. As more information emerges, differences in the cycle become apparant in different species of animals. The length of estrous cycle varies from 10-12 days in Reindear (Rangifer tarandus) to 35 days in Nile hippo (Hipnopotamus amphibius). Although the estrous cycle is usually viewed as a moans of ensuring that males and females will be together at the optimal time for conception, not all cycles funtion to this end. Silent ovulation is a phenomanon that occurs in a number of species, usually at the onset of breeding season or after pregnancy. The number of ovulation also varies with

species and is not always related to the number of young produced. In the absence of conception the CL fail to mature and begin regressing while a new cycle is initiated.

Pregnancy :

Transformation from a CL of the estrous cycle to one of pregnancy occurs after successful fertilization and implantation. Dependency on the CL for successful maintenance of pregnancy varies widely even between closely related species. The gestation length varies considerably from species to species. It ranges from 120 days in wild bear (Sus sppa) to 420-468 days in Giraffe (Giraffa cameloeardalis). The members of the family camelidae exhibit sexual cycles that are quite different from those of any other ungulate.

Reproduction in the male :

The spamatozoa of the artiodactylids generally resemble those of the domestic bull ; they have a broad flat head and a crescentic apex that tapers somewhat to the posterior.

Breeding :

Dwindling numbers of free-ranging populations of wild life and the ever-increasing difficulty of acquiring new speciemens from the wild have necessitated greater stress than everbefore on the need to ensure that captive populations in zoos and wild life parks reproduce successfully. Armed with a knowledge of breeding biology under natural systems, a breeding programme has to be designed for each group of animals. Evaluation of the animals in respect of genetics, physiology, anatomy and behaviour and breeding soundness of the animals is also a must for the prupose.

Information on the cytogenetics of a species is important to successful captive breeding. Equally important is a knowledge of individual pedigree. The development of the International Species Inventry System (ISIS) programme will provide member zoos with a far ranging ability to inquire into the breeding history of their animals. Assessment of breeding capability and soundness can be made by thorough physical examination of the entire animal including the reproductive system, semen evaluation etc. and by allowing the animals to have access to the members of their opposite sex at the

appropriate time and judging their behaviour and success of reproduction. Evaluation of the normal and abnormal estrous cycle is also important. Predicted breeding dates can also be used to place animal together or to carryout artificial insemination. Once animals have been assessed for their genetic, physiological, anatomical, and behavioural traits, they can be diverted either to the breeding exhibit group or nonbreeding exhibit group. (Fowler, 1986).

Assisted Reproduction :

In an intensive breeding programme there may be several different ways in which animals can be used. These are developed in terms of increasing technological input. For natural breeding, animals of satisfactory quality by all previous criteria are the only acceptable for mating. In assisted reproduction or artificial breeding schemes, not only the sound animals, but the animals that have not measured upto criteria in one of the genetic, anatomical, physiological, or behavioural evaluations can be also included. Artificial insemination (AI) and embryo transfer (ET) are two important tools of artificial breeding.

Natural breeding of the intensive breeding programme includes the mating system, evaluation of estrous cycle, estrus detection and pregnancy diagnosis. Assisted reproduction/artificial insemination includes semen collection, evaluation and preservation for males and estrus evaluation, estrus synchronization, anatomy of tract and pregnancy diagnosis/termination in females.

Conspecific embryo transfer works includes superovulation, choice of method of collection, study of membrane permeability to cryoprotectants, method of preservation and method of transfer. The embryo transfer technique in captive or wild animals could be important in three ways. First, females in nonbreeding areas that are unsuited because of genetic, anatomical, or behavioural factors can be used as recipients. Second, embryo may be implanted in closely related species that are readily available. Third, technological advance may allow the use of micromanipulation in which blastomeres can be integrated with the trophoblast of a nonrelated common species. But many questions still remain to be answered in wild animals like knowledge of appropriate cryoprotective agents, the permeability of different embryos to these agents, and the correct regimens for freezing and thawing for

each type of embryos etc. However, current research on ETT and its application has shown a bright future in breeding and conserving the wild and zoo animals.

Genomme Banking and Wild life Conservation :

Propagation of rare endangered species is one of the major objectives of the modern zoo and conservation effort. Preserves on wild life from human population growth and the resulting habitat destruction have necessitated safegurding some animals in preserves or zoos, lest they vanish in the next decades. With this recent emphesis on breeding, many zoos are trying hard to breed the animals in captivity.

Many experts believe that at present species of organisms are being lost throughout the world at a rate which is at least 1,000 times the background rate. What is witnessed is more severe than any that has occured during the last 65 million years, since the end of the Cretaceous Period , when the dinosaurs disappeared. Such extinction is occuring at a time when genetic engineering has opened up possibilities for moving genes across sexual barriers and thus generate novel genetic combinations to meet new needs and situations.(Swaminathan, 1992).

The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. Thus conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration and enhancement of the natural environment. (UCN+UNEP+WWF and FAO,1980).

For wild animals in-situ conservation-generally called in-situ Preservation- is the maintenance of live populations of animals in their adaptive environment or as close to it as practically possible. Ex-situ conservation involves preservation as animals of a sample in a situation removed from its normal production environment or habitat, and for the collection and cryopreservation of resources in the form of living semen, ova, embryos or tissues, which can be used to regenerate animals, (Hammond,1994). Cryogenic method of preservation of gene or genomme is advantagious when the

frozen embryos are stored. Genomme banking through cryogenic storage is expensive and requires technical expertise besides standardization of the methodology involved for different species of animals. At the present moment both cyrogenic storage and management of live animals are necessary for a complete system.

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ENSURING GENETIC PURITY OF ANIMAL IN ZOO

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The destruction of natural habitats and illegal poaching of wild animals are putting them in danger of extinction both physically and by 'genome pollution' through contact with domestic and other animals. Researchers have recently discovered that supposedly purebred European wolf populations Canis lupus lupus, a subspecies of the gray wolf Canis lupus, are in fact mainly hybrids between wolves and dogs. Most wolves now kept in British Zoos are American hybrids. This has made it essential to identify purebred individuals and then establish stable founder populations. It is, therefore, important to have a method for confirming the identity and purity of the breeds bred in captivity. It is also essential for the health of captive populations and for the preservation or eventual increase of genetic diversity of wild populations that genetic variability is maintained by the reintroduction of captive bred animal. A method, therefore, is also needed for measuring the genetic relationship among individuals.

Recently developed technique of DNA fingerprinting, also known as genetic profiling, offers an attractive method of choice for the above purpose. DNA fingerprinting utilizing multilocus and single locus probes is of proven utility for identification of individuals and for paternity determination. Application of DNA fingerprinting to studies of wild populations has provided the behavioural ecologist with a powerful tool with which to estimate genetic relatedness among socially interacting individuals. Among vertebrates DNA fingerprinting has been widely applied to studies of fishes, birds, and mammals. These include demonstrations of reduced genetic variation in clonal and colonial species. By using Bkm-2(8) probe developed by us, we have been able to obtain individual-specific DNA fingerprints of crocodilians which permitted us to identify individuals, assign parentage, and reconstruct the DNA profile of a missing parent. Band sharing between animals of known pedigrees increased predictably with relatedness and provided a basis for distinguishing relatives from non-relatives. This approach could facilitate genetic studies of wild and captive populations.

Recently using our indigenously developed probe we have shown for the first time that DNA fingerprinting can effectively be used to infer the generic affinities among related group of animals. This was hither to thought not to be feasible largely because the fingerprint profiles are believed to evolve too rapidly to be informative over large time intervals. Based on qualitative differences in the fingrprints and quantitative differences in the copy number of Bkm-related sequences in the genomes, we have been able to infer generic affinities among different species/genera of crocodilians, which are in agreement with the consensus phylogeny reconstructed using various other approaches together. This observation is of great importance as it establishes for the first time the potential utility of this molecular technique in the study of evolutionary relationships of plants and animals.

Techniques for Differentiating Pure Strains and Hybrid Strains, Including DNA-finger printing

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ABSTRACT

Laboratory Animals though evolved from their wild ancestors, are quite different from the latter, as they are selectively bred to meet the specific requirements of biomedical research. They are generally docile and genetically more homozygous. They have to be maintained in 'pure' status to avoid confusion in interpreting experimental results. A genetic monitoring protocol is thus highly essential for the successful maintenance of these strains. Such a programme basically analyses a series of polymorphic traits like coat colour, skeletal features, immunological and pharmacological responses, chromosomal banding patterns and DNA finger print profiles which are characteristic of each strain. Similar programmes can also be extended to wild and zoo animals, to study the evolutionary trends and for the efficient management of breeding in captivity.

Techniques for Differentiating Pure Strains and Hybrid Strains, including DNA-finger printing

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Modern biomedical research requires precision and accuracy of results, so the use of genetically defined animals has became an absolute necessity. The laboratory animals as it exists today, are the products of this prime requisite, and the present day animal houses are not just quarters for captive animals, but are defined laboratories with constant quality monitoring. The research demand is not only for a wide variety of species but also for strains of different species with specific traits. The most commonly used laboratory animals are the mice, rats, guineapigs, rabbits, cats, dogs and monkeys. Of these species, the rodents comprising mice, rats, hamsters and guinea pigs are the choice of animals for majority of the experiments, and these are maintained in several laboratories around the world as inbred, outbred and congenic strains. For example, there are more than 1000 strains of mouse, and 250 strains of rat currently in use, which are well defined genetically, biochemically and physiologically.

Though the laboratory animals were derived from their wild ancestors, they differ from them, profoundly, due to selective breeding in captivity. Thus majority of the laboratory mice and rats, are albinos. Their food requirements, tolerance to outside environment and resistance to infectious agents are totally different. They are generally tame and can be easily handled unlike their wild counterparts. The inbred strains of animals which are widely used in research are deliberately produced genetic lines, which have attained homozygosity at nearly every locus through the use of brother x sister mating for nearly 20 generations. Thus all the members of an inbred line have essentially the same genetic constitution and the allels which are paternally and maternally derived are identical at 98% of all genetic loci. Inbred animals are pure strains and they are ideal tools for research as they are homozygous, and their response to an experimental manipulation is likely to be uniform.

The need for genetic monitoring

The "pure strains" are a selective commodity and their derivation and maintenance can pose quite a few problems. If these are not attended to in time, disastrous experimental results will follow. Factors like mutation, residual heterozygosity and inbreeding depression can lead to alteration of experimental results. Inbreeding depression occurs due to homozygosity of deleterious recessive allels, during the process of inbreeding. This often results in decline in characters associated with fitness, and fertility. Accidental mixing up of the strains can lead to genetic contamination and errors in breeding

procedures can lead to genetic variability. Apart from these, mutations which are sudden heritable changes can lead to strain alteration. Thus it becomes imperative that all the strains maintained in a laboratory should be genetically monitored periodically.

The International Committee of Laboratory Animals (ICLAS), the apex body of laboratory animal science in the world has suggested a set of guidelines for genetic monitoring, as given in the table below:

Techniques used for genetic monitoring @

Sl.No	Techniques	Inbred strains	Outbred strains
1.	Morphological		
a.	Coat colour	++	+
b.	Mandible analysis	++	+
2.	Immunogenetic		
a.	Skin grafting	+++	-
b.	Serological using polyvalent alloantisera and testing by haemagglutination cytotoxicity of florescent antibody tests.	+++	-
3.	Biochemical Screening of protein -Haemoglobin, urinary protein etc.,and selected Isoenzymes-esterases,Alkaline Phosphatase etc using Starch, Cellulose or PAGE	+++	+++
4.	Chromosomal		
a.	Karyotyping	*	-
b.	DNA finger printing	+++	-
5.	Pharmacological Response of animals to chemicals and drugs etc.	*	*

+++ Highly recommendable
++ Recommendable
+ Useful with limitations
* Needs to be tested
- Not useful

@ Melby and Balk (1984)

Essentially it is based on the observation that polymorphism exists in different strains of animals with reference to a series of morphological (skeletal characteristics),

immunological (histo compatible genes), biochemical (proteins and isozymes), and chromosomal (chromosome banding and DNA finger printing) traits.

1. Morphological markers: Morphological markers include coat colour pattern as well as size and shape of some skeletel structures.

a) Coat Colour: In the wild many animals show different and distinct patterns of coat colour, all of which are typical of that species. But by captive breeding many of the laboratory animals became albinos. However, some strains still have unusual or even unique coat colour (like C57 black mouse, black copenhagen rats, NIH. Hartley guinea pigs, golden or syrian hamsters and so on) by which they may be identified. Many albino strains carry "hidden coat colour" allels which can be used to distinguish different strains by means of suitable test crosses to coloured mice. For example mouse strains A, AKR, SJL, BALB/c may be distinguished by mating them with DBA/2 mice. Thus an offspring of strain A will be chocolate brown, those of AKR will be black, and those of BALB/c will be cinnamen and those of SJL will be agouti. A full list of hidden coat colour genes in inbred strains of mice and rats is available (Festing 1979). The disadvantage of using this procedure is the time delay of getting the results and sometimes the desired characters not appearing in F1 generation. There is also the danger to the integrity of the inbred strains because of the presence of hybrids.

b) Skeletel factures: Strain differences can be easily detected for a range of morphological features such as shape and size of internal organs, especially the skeletal features. Lovel et al (1986) showed variation in skeletons in over 400 males and females from 12 genotypes. Maximum variability was shown by mandible, os coxae, femur, tibia, fibia, scapula and humerus. Even skeletal dimension of the entire skull is found to be useful. Festing (1972) developed a method of genetic monitoring based on a series of 11 measurements of the right mandible of mice and rats. The 11 measurements are tangents to the curves of the bone. Measurements 1-6 represent height from the x-axis, while numbers 7-11 represent length from Y-axis. The final data may be analysed using a computer programme appropriate for discriminant function analysis. The skeletal characters are controlled by polygenes, and are highly heritable. They survey a large number of unknown genetic loci.

2. Immunological markers:

a) Skin grafting: Skin grafting is one of the must widely used and sensitive technique to determine the isohistogenecity of inbred strains. Several hundred histocompatibility genes can be monitored by this method. Skin grafts exchanged between individuals of same

inbred strains should be permanently accepted. Many methods of skin grafting have been described; but the one shown by Baily and Usma (1960) was found to be more reliable and technically simple. Here the skin grafts from the tail are exchanged between the animals and the grafts are placed in a reverse position. The acceptance of the graft is judged by the reversed hair growth of the graft on the recepient's tail. A minimum period of 100 days are required to assess, the graft acceptance, as differences in minor histocompatility genes are expressed only after 2-3 months. Though the technique is reliable, it is not suitable for strain authentication, as exchanging grafts within the strain will show whether or not the strain is inbred but not which strain it is.

b) Serological procedures: This can be done either by developing strain specific alloantisera or by polyvalent alloantisera involving a group of strains. Strain specific alloantisera can be developed by injecting cells/tissues or fluids from animals of one strain to animals of another strain using an appropriate immunological test such as haemagglutination, cytotoxicity or flourescent antibody tests. An alternative method is the use of polyvalent antisera which can prepared by injecting lymphocytes from several different strains, to the strain to be monitored. The alloantiserum developed in this way should in the presence of complement, lyse lymphocytes from most animals, but should not lyse lymphocytes from the recipient strain animals. Thus the alloantiserum can be used to test whether the animal is genetically identical with the animals in which the original antiserum is raised. The serological methods require well authenticated pure strains.

3. Biochemical genetic markers: Biochemical markers include enzymes being generated in allelic forms which are termed as allozymes and also a variety of specific proteins that are polymorphic. The polymorphic proteins are haemoglobin(Hba,Hbb), major urinary proteins(MUP),seminal vesicle protein(Svp) and transferrin and the isozymes are several, important ones being alkaline phosphatase, aldehydede hydrogenase and various esterases. For genetic monitoring primary structural genes and only few regulatory genes are considered. Electrophoresis is the method of choice to distinguish allelic products of structural loci and is less suitable for regulatory loci. Although polyacrylamide gel electrophoresis and isoelectric focusing yield higher resolution, starch gel and cellogel are preferred in most laboratories. If buffer, pH,voltage and current are adjusted to the biochemical system to be analyzed a distinct electrophoretic pattern will be obtained. Samples are collected from body fluids or organ homogenates. By this procedure genetic contamination can easily be identified according to the deviation from the established biochemical genetic profile. More than 20 such loci have been found to be of some value

for identifying inbred strains of mice and rats, but in routine screening it may be only be necessary to study 6-12 loci. Some of the common enzymes which show polymorphisom are catalases, peptidase-3, amylase-1, esterases (there are about 17 esterases distributed in different organs), alkaline phosphatase, alcohol dehydrogenase and aconitase. By biochemical monitoring, a genetic map characteristic of each strain can be constructed and used as a standard of purity of that strain.

4. Chromosomal markers: Chromosomal polymorphism in animals can be detected using karyotyping with banding techniques and the more advanced DNA finger printing.

a) Karyotyping and banding: The Karyotypes of hundreds of different species of animals have been investigated and an illustrated catalogue of mammalian karyotypes has been assembled by Hsu and Benirschke (1967). Like the number, the size and appearance of chromosomes and the banding pattern of chromosomes using G,R,C, T and Q techniques are also specific to each species. But strains of laboratory rodents are found to exhibit polymorphism both in centromere location and also the banding patterns. Sasaki (1989) studied 12 strains of inbred rats and detected polymorphism in chromosomes 3,4,5,7,9 and also in x-chromosomes. Though the method is quite reproducible it requires adequate expertise in preparing karyograms and interpreting them.

b) DNA - finger printing: DNA finger printing is an extremely sensitive technique to detect the genetic differences between pure strains. Encoded in the animal DNA there are about 100,000 functional genes. These represent only about 5% of total DNA in the chromosomes. The function of the remaining 95% of the genome is not yet understood. One of the components of this extra DNA consists of sets of box sequences repeated numerous times and are called minisatellites. The origin and significance of these tandem repeats are a mystery, but the minisatellites show a very high level of allelic variation in the number of units and therefore in the length of minisatellites. They thus offer a means of distinguishing one individual from another through DNA typing. Bolstein (1980) suggested, restriction fragment length polymorphism (RFLP) technique of DNA analysis, as an approach to the mapping the human genome. Jeffrys et al (1985) found that myoglobin minisatellite detected other human minisattellites some of which are highly polymorphic. By hybridsing a cloned probe containing one of the four repeat units of 33 base pair long sequences from the first intron of myoglobin gene to restriction enzyme digested genomic DNA, Jeffrys et al (1985) demonstrated a highly polymorphic but individual specific hybridization pattern. Such DNA finger prints detected by the polycore probes are highly individual specific and inherited in a typical Mendelian fashion.

Highly polymorphic probes like the ones described above can be used to determine the degree of homogenity in animal strains. Minisatellite repeat patterns clearly differs between two strains but are identical among the members of one strain. Some of the multilocus probes (MLP) that have been extensively used are 33.6 and 33.15, M_{13} and recently from India, the Bkm and Bkm-derived clone 2(8). The latter has been isolated by Singh et al (1980) as a sex-chromosome associated repetitive DNA from the female Indian banded krait, Bungarus fasciatus. The conserved components of Bkm are long arrays of repeats of the tetranucleotide GATA.

The methods used in DNA profiling are conventional techniques of molecular biology: isolation of DNA from biological samples, restriction digestion of genomic DNA using endonucleases, fractionation of the resultant DNA fragments on the basis of size using agarose gel electrophoresis, transfer of the fractioned DNA fragments on to a blotting membrane, hybridization of the size separated DNA fragments on the membrane with a labelled multilocus probe, removal of nonhybridized probe by washing, and detection of hybridized probe by autoradiography.

DNA - finger printing is thus an useful tool for the detection of various inbred rat and mouse strains. Recently using Bkm 2(8) probe, DNA -finger prints have been made for rat strains in India (unpublished data). Mitochondrial DNA (mt DNA) finger printing is another promising area which can be used in conjection with conventional DNA finger printing. Sequences of mt DNA are also found to be highly polymorphic, and maternal inheritance of mt DNA makes it an unique tool in studies of animal population. This has already been used by Indian and Japanese scientists to study the origin of various mouse population in Asia.

5. Pharmacological markers: Gene differences may alter an individual's response to foreign compounds by affecting their absorption, binding, distribution, excretion, biotransformation or drug-drug interactions. Genetic differences exist in the metabolism of xenobiotics in inbred strains of mice and rats. For examples among 75 inbred strains and sublines of mice tested, about 1/3 exhibit aromatic hydrocarbon responsiveness(Kouri et al., 1977, Nebert et al., 1982a). On the contrary all inbred strains of rats tested were found to be responsive. Among rats "the anaphylactoid reaction" shown to ovalbumin or dextran seems to vary within the strain and between the strains and this reaction can be used as a pharmacological marker to characterise various rat strains. Though pharmacological markers are good indicators to detect strain differences they are yet to be exploited properly. It is of interest to note, that studies in the area of pharmacogenetics had

lead to the development of useful animal models such as diabetic mice and rats (variation in glucose response).

The relevance of genetic monitoring programme in Wild and Zoo animals:

Some of the techniques described above for well defined pure strains of laboratory animals can be applied to wild and zoo animals, for a basic understanding of their origin and the efficient management of breeding in captivity. Such a programme will be useful in the following areas:

1. Study of the origin and evolution of existing laboratory, farm and pet animals from their wild ancestors eg. study the spread of laboratory mice and rats, various breeds of rabbits, cats, dogs etc.
2. Avoidance of contamination of existing genetic pool unless brought about by genetic mutations.
3. Study of phylogeny of various stock of animals existing today, and their relationship to each other. The closeness and fartherness of each class can be established by specific genetic monitoring tools.
4. Study of interspecific and intraspecific variation with in a region or between region. Captive breeding in varying climatic conditions over the years can bring about changes in the genotypes and the accumulation of these traits suitable to specific adaptation can be assessed.
5. Inbreeding depression leading to less fecundity and fertility is a common phenomenon among pure inbred strains. But this cannot be avoided as uniform response in a set of animals is a prerequisite for meaningful scientific interpretations. But in captive zoo animals, such a phenomenon will be disastrous, as the available number of animals contributing to the genetic pool is limited. Perioic genetic monitoring will help to assess the stock getting fully homozygous, and adequate measures can be taken to ascertain heterozygosity, which is essential for continuous vigour in zoo animals.
6. Mutations either beneficial or harmful occurring in a selective breeding group can be ascertained, and depending upon the trait in question such traits can be propagated.
7. Hybrids evolved naturally or intentionally can be studied and the level of inheritance from the maternal and paternal genes can be assessed.
8. The characteristic genotype of each of the species can made, and a genetic library of such magnitude will help to ascertain future trends in evolution.

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ENVIRONMENTAL ENRICHMENT IN ZOOS.

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Historically zoos have sublimated the housing needs of animals to man's perceptions of animals at a particular point of time. The zoo architecture has also been dressed accordingly and used as an expression of civic or national pride, caring little about the needs of the animals. Fortunately there has been greater awakening about animal welfare amongst the visitors to the zoos in western world during recent years. They no longer see the animals just as flesh, blood and bone and have started realising that the animals are composite creatures and they have their own natural desires and feelings.

The efforts towards environmental enrichment of zoos began in the early part of this century, soon after the zoo managers started realising the need of keeping the natural behaviour of animals intact. However, the real urge to do something concrete in this direction is outcome of the difficulties faced by wildlife conservationists in rehabilitating the captive bred animals in the wild. The deficiencies in the behaviour of the animals, living in the zoos for several generations, make them unfit for being introduced in the wilderness areas. It takes lot of planned and sustained effort for making the zoo animals fit for introduction in the wild.

Wild animals in nature experience lot of spatial variations created by soils, rocks, vegetation, water and so on. Temporal variations occur through factors like light, temperature, humidity, food, availability and seasonal changes in vegetation. Other organisms also add to the environmental variation. Wild animals have evolved complex behavioural repertoires which are flexible and extensive enough to cope with the diversity of their natural environment.

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* Central Zoo Authority of India.

Lower animals, which are relatively shortlived respond mainly by utilising preprogrammed unlearned behaviour patterns. In contrast higher animals are relatively long lived and build up a life time experience to cope up with the environmental challenges using learning and intelligence to solve every day problems of survival. Most of the vertebrates are adopted to living in a situation where there is very varied input of information through senses of sight, smell, sound and touch. An active animal carries out a wide repertoire of behaviour which include foraging, exploration, territorial pattroling, marking bounds, avoiding predators and seeking mates. Social behaviour includes parental, agoinistic, sexual cooperative and playing activities. These behaviours involve constant alertness of the visual, olfactory, tactile and audulatary stimuli. Even the inactivity in the wild has its needs; secure resting places such as nests, burrows, hollow logs and branches of a tree. Elaborate behaviour, may be involved in setting up and construction of secure refuge.

The biggest difference between the natural environment and the captive environemnt are the predictability of the zoo environment, lack of environemntal complexity and the time an animal has to spend feeding or searching for the food. In zoos animals are usually fed at the same time each day with very nutritious diet that requires absolutely no effort on animals part and can be eaten in minutes in a cage environment that remains same day after day and month after month. In wild the animal spends large proportion of its time engaged in feeding related behaviour.

The other important factor of zoo environment is the availibility of limited space due to which the animal can no longer maintain a safe flight distance from the visitors, the keepers and other animals particularly its cage mates even if he wants to do. It is also prevented from altering its environment i.e. moving from a hot place to shade or to get

away from the staring eyes of the predator housed next door to the cage. The sterile floor and the ceramic tiled walls of his cell prevent it from burrowing or digging a hole or making a nest. Thus it falls in to a state of helpness and can no longer perform the natural behaviours, which it has inherited from generation to generation and are part of its basic requirement. Lack of stimuli to take up any activity (absence of the factors like hunger and absence of any rewards for its activity) and continued stress due to non-fulfilment of behavioural needs lead to abberent behaviour by the animal. This may be manifested in the form of excessive lethargy, apathy, boredom, over-eating, over-drinking, coprophagy, stereotypy, self directed aggression, over-aggressiveness to other animals, infanticide and at times even the failure to breed. By stereotypy, we mean some sort of repetitive behaviour, which includes pacing, head bobbing, rocking, walking round in circles, overgrooming and perpahs, over plucking of the fur/feathers of its companion or its own self. Such bahaviours look pathetic and appalling.

Since the very beginning the environment enrichmment has gone in two very distinct and different schools of thoughts. The first school of thought have generally been led by behaviour scientists and psychologists which have realised that the best way to remove the deficiencies in the behaviour of zoo animals is to increase the level of its activity and provide it increased stimulus, that may prevent the chronic stress in the animals and safeguard against stereotypic behaviour. They have mainly relied on inventions and installations of apparatus that increase not only the level of activity for the animal but also provides the animals incentives for its efforts as are available to them in the wild. The names which need special mention for the efforts made in this regard are : Yerkes, (1925); Morris (1964); Markowitz, (1982) and David Shepherdson, (1988). Carl Hagenbeck, founder of Hamburg Zoo tried to find out the solutions of the problems of the animals from their behaviour

in the wild and was of the definite view that if a reasonable amount of space and natural materials are provided to animals in the captivity, they can get not only the desired level of activity but can also regain the lost skills of dealing with the challenges in the wild. Hediger, (1969), Michael Hutchins, (1978) and Hancocks, (1980), also support the view that use of natural material to make the zoo enclosures brings numerous benefits to the animals besides improving the aesthetics of the exhibits. They feel that if zoo visitors see an animal in a naturalistic environment, they have a better chance to realise that there is a linkage between the animal and its habitat.

This school of thought insists that best possible enrichment can be achieved by identifying the key behaviour of animals in the wild and providing them the opportunity to display similar behaviours in the captivity. For example, the animals that dig must be provided an environemnt in which they can carry out this activity. Planting of suitable trees and shrubs in the enclosures of the arboreal animals provides them the most suitable environment to climb, to feed, to probe and to play. The 'kutcha' floors can give them an opportunity to feed on insects and other organisms. Provision of natural and live feed brings lot of enthusiasm and activity to the animals. Even in the case of ungulates enclosures, the termite mounds and the trees are used by the animals for rubbing against. The animals are also benefitted by eating the bark which can be striped off from the trees.

Forthman Quick(1984) feels that although the naturalistic approach is attractive but it is not always feasible to provide a naturalistic environment within the constraints of pre-existing enclosures, either because of the lack of space or because the natural materials would be destroyed too quickly by the inhabitats (particularly in case of primates). The mechanical devices can be used to decrease the predictability of captive environment, some thing that a

puristic approach does not always achieve.

Michael Robinson (1993) feels that the zoo curators and the serious critics of the zoos should not confuse the two traditions because they overlap to a considerable extent. He goes on to say:

"There is clearly a continuum from the extreme of training animals to do things outside their natural bevaioural repertoire at one extreme, to providing natural circumstances and stimulation in which they are able to find outlets for all their drives at the other. At one end is Chimpanzee tea party and harmonica-playing elephants and at the other is the food buying Acouchi, in between are all those behaviours that are fascinating part of the animal survival apparatus but redirected at a functionally substituted stimulus. For example an orb-weaving spider responding to a tuning fork is exhibiting natural behaviour at a stimulus that adequately sub stitutes for a prey item in stimulating attack. A cheetah chasing a moving object. is qualitatively in the same category. A tiger swimming in a moat playing with a floating object is still exhibiting natural behaviour. All these cases seem legitimate. Behaviourly engineered response can convey totally wrong messages about animals. The potential for this result increases as the objects involved become less likely to be identified with natural situations, and also as the behaviours become more trivial and less obviously connected with the survival and real life. But with good interpretation important lessons can be taught by most of the behaviour involve stimulus substitution and not training for unnatural acts."

It would be appropriate to mention that, if the resources of space and finances permit the naturalistic diaplays replicating the wild habitats are most suitable displays from the environmental enrichment point of view. But there are many pitfalls in this method. Most of the times in our anxiety to show to the visitors attractive green display, the Zoo Directors provide a "stage of set" which may look aesthetic but does not give anything for the welfare of the animals.

The second problem about the naturalistic displays is of providing live food to animals. The public perspective about the love and affection of the animals are very much distorted. They have no objection if an animal is killed by a human being and fed to zoo animals. But they cannot tolerate the idea of live snakes being fed to King cobra, Rabbit and Guinea-pig being fed to Python, birds being fed to small Cats and some larger mammals being fed live to tigers. If we cannot permit the zoo animals to acquire or retain the natural skills of predation, how would we be able to introduce the zoo bred animals into wild and contribute towards conservation of endangered species. The objective of keeping natural behaviour of wild animals intact in zoos and to keep them fit for return to wild at any subsequent stage, the zoo managers should concentrate on stimulating natural environment of the habitat of the species as closely as possible. Any equipment or apparatus should be used only if it provides functional substitute of the elements of nature and helps directly in increasing the activity level of the animals. Highly sophisticated devices which are likely to be worn off quickly and be functional for only limited periods or the devices which introduce in the animals any artificial traits, not linked with their survival in nature, should not be used.

Environmental enrichment is a developing science and lot of research is needed to achieve the goals of maintaining the natural behaviour of the animals intact. Regular monitoring of the manipulations that are made for achieving this objective should be done and the cost-effective and functionally effective methods should be adopted. There may be no universal solutions. Every zoo will have to work within its own constraints.

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ROLE OF ENVIRONMENTAL ENRICHMENT IN BETTER MANAGEMENT OF ZOOS.

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INTRODUCTION:

Collections of wild animals have been in vogue since antiquity. However great changes have taken place in the World since the establishment of the first public zoos which have evolved from manageries into highly complex professionally managed Zoological Parks.

The importance of environmental enrichment for improving the well-being of Captive animals has been recognised for a long time. In many cases, the desire for easy animal management and hygine resulted in the traditional style of zoo enclosures having hard concrete floors. Whilist these enclosures allowed animals to be kept physically healthy, the physiological needs of the animal were largly ignored. Hediger (1950) emphasizing the need for Environmental Enrichment states that " one of the most urgent problems in the biology of Zoological gardens arises from the lack of occupation to the captive animals". In 1960 Morris, then Curator of Mammals at the London Zoo, described an enrichment device that carried fish around the seal pool before releasing them to the chasing seals and in 1964 he wrote a much cited paper about abnormal behaviours in Zoo animals in which the referred to the great danger of inactivity. Mayer-Holzapfel (1968) also draw the attention to the role of environmental factors in the development of abnormal behaviour in Zoo animals and also wrote of the importance of providing for the specific behavioural needs of captive animals.

The need for environmental enrichment:

Most animals have evolved to live in a complex and varying surroundings where there is a very varied input of information received through the senses of sight smell, sound and touch. Especially mammals are observed to be unique among vertebrates in experiencing a need to carryout

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behaviours which are not necessary for their immediate survival. In the wild, active behaviour includes foraging, exploration, territorial patrolling, boundary marking, avoiding predators, seeking mates etc; Social behaviour includes, determining their rank in the group, parental, agonistic, sexual, co-operative and play. All these activiti-es require constant alertness of visual, olfactory, tactile and auditory stimuli. The psychological well-being of the animal requires the fulfillment of behavioural needs such as need for stability and security, need for companion-ship, need for space and complexity, need for novelty and an element of unpredictability (Poole,1990; Manimozhi and Paulraj,1993).

Some disadvantages associated with life in captivity such as restricted space, isolation, under stimulation and inability to control or manipulate the environment, spreading disease can create serious behavioural problems for a zoo animal. The common ones are Apathy-Boredom-inactivity-over eating or over drinking-coprophagy-stereotype behaviour-self directed aggression-over aggressiveness to others-infanticide-failure to breed (Stevenson,1983).

Environmental enrichment is crucial for captive breeding of an endangered species, Reproduction and successful parent-raising of the young with full potential is all influenced by the quality of the environment that animal has been provided with (Maple,1983; Mitchel,1989; Mellen,1991 Manimozhi and Kalyanasundaram,1992).

In the case of animals for which re-introduction is a future possibility, the quality of captive environment assumes even greater importance in ensuring the development and maintenance of the behaviours necessary for survival in the Wild (Beck et al,1986).

Enrichment plans are now a legal requirement for the keeping of non human primates in all of U.S. Zoos.(USDA, 1991) In India also the central zoo authority stipulates certain minimum standards inrespect of animal houses

enclosure design etc; for the recognition of the zoos. However more than the legal the zoos have an ethical obligation to research into and provide for the needs of the animals.

Environmental Enrichment & Wildlife education:

Education and recreation are in many ways the most important role that zoos can play in helping to conserve the World's biodiversity. Enrichment programmes can be an effective means, not only of improving the welfare of zoo animals, but also educating visitors about the needs of the animals and how they are met within the constraints of captivity. Shettel-neuber (1988) found that visitors prefer naturalistic exhibits. According to shepherdson (1991) the three most common reasons for disliking an exhibit a re inactivity of the animal, dislike of a particular species and poor visibility(frequently a consequence of inactivity)

How to improve the captive environment:

Improving the captive environment can be by naturalistic manipulations where it is aimed to stimulate as closely as possible the wild situation. Owing to limitations of space, availability of social groups and the problem of destruction by the animal, artifical devices are also provided. However most recent enrichment studies published have followed the more naturalistic approach (Carlstead et al,1991) which is perhaps more appropriate and effective for the increasingly naturalistic nature of modern exhibits.

Environmental richment need not be either expensive or time consuming, keeping animals isolated is to be avoided. Compatible social grouping provides a complex and relatively unpredictable set of stimuli with which the individual can interact. Devices which directly increase the animals opportunity to carryout more complex or time consuming behaviour may be included. Anderson(1984) smith et al (1989) demonstracted howeven simple techniques such as scattering food items, providing a variety of objects in the enclosures could enrich primate enclosures.

The Arignar Anna Zoological Park Example:

Some of the environmental enrichment activities/ techniques adopted at the Arignar Anna Zoological Park are described in the following tables:

I CARNIVORES & OMNIVORES

Enrichment Item Technique	Description	Provided to	Comments.
1. Water	Small water Pools and ponds inside the enclosures, and large moat containing water for tiger or Jaguar to swim.	Tiger, Lion, Jaguar, Wid dog, Hyaena, Bears, Wolf, Jackals and bears.	Animal interacts with water helps in play, foraging, temperature regulations etc;
2. Meat with liver & bones.	Whole meat is supplemented with livers and bones.	Tiger, Lion, Jaguar, wild dog, Hyaena wolf and Jackals.	Evidence exists that feeding processed food to carnivores can cause abnormal behaviours and perhaps predisposesanimals to gum disease. Meat 'on the bone' provides animals with an opportunity to display natural foraging and manipulative behaviour and occupies their time longer.
3. Variety Food	Weekly twice chicken is provided.	Tiger, Lion, Jaguar wild dog, Hyaena	Increases the appetite interest in feeding and decreases boredon
4. Dry leaves and logs.	Dry leaves and logs with litter are placed in the exhibits.	Tiger, Lion, Jaguar and Panther.	Provides additional stimulus and novelty, Opportunities for manipulation & Play wooden logs used for claw marking.
5. Honey	Honey soaked in bread is hidden at different places in the enclosure	Bears	Promotes searching behaviour.
6. Substrate	Areas of soil, sand, boulders swampy areas.	Jackal, Wolf, Hyaena Tiger etc;	Allows important behaviours such as digging, scratning. Food hidde in the substrate adds to foragin opportunities. Naturalistic subs trate also help to increase spec and olfactory complexity.

2.		3.	4.
rees & ants.	Planted in the enclosures simulating natural environment.	Tiger, Bears, Wilddog, Panther.	Trunks of trees used for marking the territory, sharpening their claws; trees provides climbing for Panther and bear and taking rest.
rrows (or) nnels & shes	Artificial burrows and tunnels are provided in the enclosures.	Otter, Jackals.	Serves as sheltering place and for keeping young ones.
ive fish	Live fish is allowed in the Pond.	Otter, bears.	Provides opportunities for hunting and stimulate explorative behaviour
igeon sts.	Pigeon holes are provided in the enclosure in the moat wall.	Tiger	Provides complexity. Promotes play ful behaviour and hunting ability.
rey-Predator osure	Tiger, sambar, Lion-Nilgai enclosures are constructed side by side with.	Tiger, Lion	Provides complexity, simulates nature.
ens	Small dark dens provided inside the enclosure.	Bear	For parturition
Termite mound	Natural termite mounds promoted	Bear	Provides complexity, natural food.
ooden climbing flatform.	Wooden climbing flatform is provided in the enclosure.	Bears	Provides complexity, and increase the activity.

II PRIMATES

rge enclos- es	Large enclosure having areas from 1/2 ha. to 1ha. provided.	Nilgiri langur, Lion Tailed Macaque, Baboon, Chimpanzee.	Provide free moving space, avoid increase locomotion activities and facilitate escape from the rivals. large troop can be accommodated.
ees, shrubs grass	Pithacelobium dulce and other edible shrubs are planted.	Nilgiri langur, Lion-tailed macaque. Baboon.	Simulates nature. provide climbing opportunities. shade. resting and foraging areas, manipulative objects, provides food. (Leaves, flowers bark, fruits and insects)

1.	2.	3.	4.
Shelter	A cave model shelter house with both sides opening covered with creepers is provided	Nilgiri langur and Lion tailed macaque	Serves as a resting place, and to avoid heat and rains.
Dead trees and logs.	Large dead trees and logs are provided inside the enclosure.	Lion-tailed macaque chimpanzee	provide climbing structures resting areas and for play.
Flexible ropes	Flexible iron rope tied to two poles at 8' height.	Chimpanzee	Developes interest and in-quisitiv behaviour requires greater skill and balance. The animal develops climbing abilities as seen in the wild.
Swing	A wooden swing with iron ropes.	Chimpanzee	Increases the play activity.
Water with fish and turtles.	All a round in moat	Nilgiri langur, Lion-tailed macaque, chimpanzee	provides complexity, promotes inquisitive and play behaviour.
Scattering the feed	The food items are scattered all over the enclosure.	Nilgiri Languar, Lion tailed Macaque	Increases the foraging activity and avoids in fighting for food.
Hanging fruits.	Whole fruits such as apple, and Oranges are hung from the trees.	Lion-tailed macaque chimpanzee	Promotes co-ordinated, and acrobatic ability to obtain food.
	III HERBIVORES		
Large enclOsure	Large enclosures varying from 1 ha. to 4 hactares area with undulating terraines aree provided.	Barking Deer, Hog Deer, black buck, Chital, brown antlered deer, Nilgai, sambar, Camel, llama, Hippos, Zebra, Elephant, Wild Ass, Kangaroo.	Large enclosure provides free moving space and helps to avoi infight in deers & antelopes.
Simulated environment	All herbivore enclosures are enriched with natural vegetation.	-do-	Gives shade, resting places, cover.

2.	3.	4.
prage & rowse	Grassy areas and shrubs are provided.	Barking deer,Chital, Hog deer,Black buck, sambar,Brow antlered deer,Elephant,Kangaroo wild Ass,Zebra and Llama.	Simulates nature. provides variety of food,leaves,fruits, seeds barks.Increase the natura. foraging activity. Reduce coprophagy pacing and abnormal behaviour.
wamps	A area of high humidity and low temperature is provided.	Brow-antlered deer	To take mud bath and take rest.
athing pond	A bathing pond of 20 mt. dia and 2 mt. depth at centre is provided.	Elephant	Reduces the temperature.
ust baths	A sandy area is provided inside the enclosure.	Elephant, Camel, Llama.	Increases the play behaviour & ward of insects.
allowing pit.	A wallowing pit containing mud is provided	Sambar	To ward of insect bite and oppressive heat.
ovision of od trees.	Different fodder species like, Neem, Bamboo,Thespesia are provided.	All herbivores.	Provides variety and complexity. promotes digestion.

IV REPTILES

ive prey	Live frog either in the pond or in the enclosure is made available.	Krait, Saw scaled Viper water snakes, russels viper cobra and rat snake	Provides opportunities for hunting and stimulate exploration and interest.
	Live rat is dispensed in the enclosure	Rat snake,Russels viper Cobra.	-do-
	Live chicken is dispensed in the enclosure.	Python	-do-

1.	2.	3.	4.
"2 Water	Small water pool inside the enclosure	All snakes, minotor lizards, Iguana, tortoises and crocodiles.	Interact with water for temperature regulation.
3. Natural Painting	According to the species habit & habitat the background wall of the enclosure is painted.	Krait, Rat snake, Saw-scaled viper, and Russels viper enclosure.	Appreciation of the visitor through education and interpretation.
4. Sun light	Each enclosures top is provided with a 2'x2' opening to allow sunlight.	Krait, Cobra, Russels, Viper saw scaled viper, checked keel back, rat snake, python Chaemeleon.	Simulates natural environment and helps in regulation.
5. Substrate	Sand with and other natural material such as sand, log, stones and litters.	All snakes monitor lizard tortoises and crocodiels.	Allows important behaviours such as digging and rooting of plants. Food hidden inthe substrate adds to foraging opportunities, Naturalistic substrate also helps to increa special tactile, and olfacto complexity. For egg laying also.
6. Trees and shrubs.	Trees are planted in the enclosure.	Crocodile, Iguana and monitor lizard.	To provide sahde and shelter.
	V BIRDS		
1. Space	Large areas are provided in the Walk through aviaries (750 M2 approx.)	Terrestial bird walk through aviary, Point calimere, Vedanthangal Birds walk through aviary and Pelicanry, Heronary.	Provides space for free flig perching, nesting, complexity and diversity are ensured.

1.	2.	3.	4.
2. Trees	Trees like Neem, Bamboo,Bauhinia are planted.	Terrestrial and water birds walk through aviaries.	Provides perching and nesting areas promotes, natural foragi Provides natural privacy and attracts insects that also act as food.
3. Natural nesting materials.	Nesting materials like dead leaves sticks, twigs, hay are made available	Terrestial and Water birds walk through aviaries.	Increased breeding behaviour.
4.Water with fish	A large standing pond with fish inside is provided in the middle of the enclosure.	Walk through water birds aviaries.	Increased foraging activity searching swimming activity. Gives opportunity to regulate temperature and humidity.
5. Dead trees and branches	Dead trees with branches are also provided in the enclosure.	Walk through,water birds aviaries.	For perching, foraging insects.
6.Nest boxes/ pits.	Nest boxes made up of wood,Bamboo and pots are provided in different enclosures.	Budgericars, pigeon, doves, parrots, love birds & Cokatiels.	Increase the breeding behaviou gives shelter and security.
7. Substrate	The substrate is provided with dry leaves and litter.	Pheasants	Promotes searching, foraging behaviour.
8.Scattering food.	Grains are scattered in the littered substrate of the enclosure.	Pheasants,Pigeons and doves.	Increases foraging activity and manipulative behaviour.
9.Fruit & Flowering trees.	Gauva,Neem and other trees are planted in the enclosure.	Terrestrial walk through aviary	-do-
10.Water Sprikler	Water sprinkler is provided in the enclosure all round the day.	Terrestrial aviary	Keep the environment cool,stimu rain fall.
11.Variety of food	Destributed specially and temporally.	Terrestrial aviary	Increases the foraging activity

CONCLUSIONS:

Enrichment is an art and science and requires certain level of initiative and imagination and a flexible approach to animal husbandry. Management needs to supply its staff with the information and reward the extra efforts. Information exchange will go a long way in transfer of items from one zoo to the other and thus helps in environment of enclosures and non-repetation of errors.

For many species, especially non primates, there is still not enough information about what kinds of environments to design and future research should be encouraged in this area.

Environmental enrichment is neither a luxury nor just a therapy. It is a basic necessity, as much as food and water and is one of the fudamental rights of an animal in captivity.

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DIET SELECTION OF ZOO ANIMALS.

Dr. George Mahen

The precise nutritional requirements of all domestic animals and birds are established and ready to feed compounded rations of these animals are commercially available. The requirements of the wild animals, especially under our climatic conditions are yet to be worked out. Present day diet calculations of Zoo animals are worked out mostly under presumptions based on the scientific data on the domestic species of their wild counterpart.

The actual feeding strategies in the zoos are naturalistic, traditional and substitution. In naturalistic feeding pattern animals are fed on foods commonly eaten in the wild. In the traditional feeding strategy diets constantly used for a particular species for a number of years and found good are followed. We already have a traditional feeding system in our Zoos which is time tested and proven good. What is needed at present is to examine how best we can modify the existing system further to suit the requirements and habits of the animals.

In the third system namely Substitution we think of substituting natural food items with their equivalents. This strategy actually formulated ready to feed rations that are shaped into dry pellets or cakes or semi-solid feeds. Such diets are supposed to contain all known essential nutrients in the correct proportion. A ready mixed feed in much more easier to handle easier to feed and more nourishing to the animals.

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It might take years for us to achieve so much of progress in evolving such rations for captive wild animals. We feed our animals as far as possible with the diets eaten by these animals at their natural habitats. However, the diets are fortified with vitamins and minerals to avoid possible deficiency.

A sound knowledge of the nutritive requirement of the captive animals and also of nutritive value of feed ingredients is needed to follow this strategy. In the present programme an attempt is made to discuss the nutritive requirements of different Zoo animals and their diets.

Zoo animals may be broadly classified into Carnivores, Herbivores, Omnivores, Aviane, amphibians and fishes.

CARNIVORES

Felidae

Felidae are strictly carnivorous predators. They have only limited capacity to regulate transaminase and urea cycle enzymes and they eliminate higher quantity of N_2 through urine. Therefore, their protein requirements are much higher than Canids. Felids can effectively utilize diets containing 30% or more of calories derived from protein. When the protein source is lowered, providing less than 18% of caloric sources, food intake was found decreased and with consequent weight loss. Felids utilize cooked starch. Dextrin is the most effectively used carbohydrate. When carbohydrates are included in the diets of Felids the dietary requirement of B Complex vitamin is to be increased three fold.

Felids can utilize large quantity of animal and vegetable fat, upto two thirds of the dry weight of the diet.

Felidae are also sensitive to arginine deficiency which produce rapid elevation of ammonia level in blood resulting in ammonia toxicity. Felidae need a dietary source of taurine as its ability to synthesise taurine from 'S' containing amino acids is limited. Taurine deficiency leads to retinal degeneration.

The domestic cat lack hepatic glycolytic enzyme (glucokinase) and they derive much of the glucose from amino acids by gluconeogenesis.

In all animals tryptophan is converted to niacin but in felids tryptophan is a dietary requirement. This is of little consequence in the wild because the 'Whole prey' is rich in niacin.

Essential fatty acid requirement of Felids cannot be met by linoleic and linolenic acids alone. They need arechidonic acid also which is available from animal sources. Felids cannot use carotene as a source of Vitamin-A.

Terrestrial vertebrates are the predominent prey of many of the mamalian carnivores. The composition of specific tissues of the animals may differ substantially from that of the whole body. Zoo animals are often fed on muscle meat which differ in composition from the whole prey. Therefore, it has become customary in most of the Zoos to supplement muscle meat with concentrates of vitamins and minerals.

The ideal diet for Felidae is whole prey of the size to commensurate with normal prey. Small rodents, rabbits and poultry can be fed to small felids. Muscle meat is deficient in Calcium, Vitamin-A, E, also Sodium, Potassium, Iron, Selenium and some of the B Vitamins especially niacin B_6 and B_{12}. Therefore, prolonged feeding of muscle meat without supplement leads to deficiencies characterised by alopecia, anorexia, follicular hyperdermatosis and general unthriftness. Liver is a good source of Vitamin-A.

In the Zoos of USA, a complete carnivorous ration similar in composition of the whole carcass is used. Such a ration is prepared out of horse meat or beef, cereals, vitamins and minerals. Introduction of such balanced diets have excluded incidence of nutritional and metabolic bone diseases.

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Canids

Canids range in body weight from 1 kg. (fennec fox) to 75 kg.(wolf). Commercial dog food is excellent for Canids. Small species should be offered semi-moist feed or puppy formulations and larger species do well on complete dry or Canned dog food. Large bones may be offered as play objects but not as a supplement of calcium and phosphorus.

Requirements

Canids need 80-90 calories per kg. body weight, during gestation the level is enhanced to 85-100 calorie and during first week of lactation 105 calories and next 8 weeks 275 calories/kg./day. Protein in the feed should supply roughly 25% of energy needed which works out to 4-5g/kg. body weight. Commercial dog foods contain 10% fat and fat is well digested by Canids. Cooked carbohydrates can form 65% of dry matter of the diet of Canids, excess levels may cause diarrhoea.

Raw meat is well digested by Canids and cooking even though softens collagen does not improve digestibility in the dogs. Over cooking destroys protein structure and also some vitamins. In Zoos Canids are mostly fed on lean muscle meat. Such meat has a composition of water 70-75% Protein 20-22% Fat 2-9%. The composition of offal such as Kidney, Liver, Spleen and heart does not vary much between species. All meats, muscle and offal are deficient in calcium and have a very wide Calcium and Phosphorus ration 1:15 to 1:26. Therefore, if meat alone is fed without supplementing with Calcium may lead to undermineralisation of bone. Meat and meat offals are also deficient in Vitamin A and D, except liver and Kidney which are good sources of these vitamins.

Whole fish when cooked and properly processed make a better diet for dogs. The protein of fish is similar to meat and is of high quantity.

Complete dog foods formulated for different stages of growth are commercially available and when fed on such feeds Canids need be provided only drinking water. Since too soft a diet may not provide sufficient dental exercise to prevent Caries and tartar development large bones may be provided twice a week.

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In the Zoos, Jackals are fed on 1 kg. beef which is more than sufficient to satisfy their protein needs. However, 1 kg. meat alone cannot meet its energy, mineral and vitamin requirement. A supplement similar to that is given to Lion and Tiger alongwith some cooked rice has to be provided to the animals as a source of energy.

Bears, Pandas and Raccoons

Raccoons and Pandas belong to the family Procyonidae but Bears belong to the family Ursidae. Both the family belong to the order Carnivores by ancestory but undergone adaptations to suit the environment and has become Carnivorous.

Bears range in size from 30 kg., (Sunbear of rain forest) to 800 kg. (polar bear). Raccoons are all much of the same size but vary considerably in food habits.

Pandas are the most extreme herbivores within the Carnivora. They have opted for low energy low activity life style eating a diet consisting of shoots of leaves and stemps of bamboos.

Most bear species depend on energy rich diet of plant matter. The black bear in the wild state hibernates during winter awakening for brief periods if warm weather occurs. During spring they emerge from their dens and feed on available plant material, invertibrates including termites, ants, fruits and nuts. In Tibet, these bears are reported to kill domestic sheep and goat. In captivity black bear thrives on a commercial dog diet supplemented with bread and small amounts of vegetables. One kg. canned food for every 30 kg. is the usual quota, but individual adjustments are necessary (female weight 42-70kg. and male 50-120kg.) Alongwith canned dog food (80%) dog buiscuits, fruits and vegetables depending on local availability can also be fed.

Sloth bear (weight 90-120kg.)

They are mainly dependent on ants, termites etc. In captivity they can be fed on commercial dog diet or an omnivorous diet supplemented with fruits and vegetables.

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Bears are fond of honey and usually it is offered 2 to 3 times a week.

Polar bears thrive on seal and by scavenging dead animals. They also feed on berries sea weeds and hunt birds.

Raccoons

They are generally omnivores but in aquatic habitats they relish hunting for crey fish frogs, fishes birds and eggs. Upland Raccoons may feed on insects small rodents, worms and fruits, corn earheads. Raccoons would wash their food, if water is available and this habit is more frequent in captive animals. Being a nocturnal in habit they are active during dawn and dusk. They enter into a torpor during winter with metabolic rate half of normal animal.

Pandas

The giant pandas weighs 75-160 kg. and are of distinct bear like form, feeding on bamboo shoots, stems and leaves. The red pandas have a more diverse food but they too largely depend on bamboos. As a result of their diet they have low metabolic rate, slow growth, late maturity, low survival of the young and low lactation. The lesser pandas are omnivorous and most of the time search for small insects and plants.

Ruminants

Ruminant animals of zoo include giraffe, antilops, deers, wild goats and sheep, bison and buffalo. In the wild these animals spent eight hours or more on foraging for a living. They are most actively engaged in grazing or browsing in the ~~n~~eaning morn and late afternoon. During periods of extreme deprivation they might graze during night hours also. Therefore in the zoo also feed is offered during morning and late afternoon hours. The ruminants are fed on good quality grass hay, legume hay, green grass and fresh legume for maintenance. However, pregnant growing or lactating animals should get a concentrate mixture that is given to dairy cows. The grass hay used should contain atleast 10% Cr. protein ~~and a concentrate feed mixture used for~~ during ~~cows~~. Concentrate mixture is fed at the rate of 5-10 g per kilogramme body weight. As a general rule non producing ruminants need 2 kg feed in dry matter for every 100 kg body weight.

During lactation the feed intake in terms of dry matter may go upto 3% or even 4% in certain species. To avoid fight between animals sufficient space should be provided in the feeders. If a ~~s~~ingle hay rack is used, only dominant animals in the group feed. It is therefore essential to have atleast two feed sources for each four animals in the pen. A hay rack 1.3 metre long with access from both sides would provide space for four hornless individuals.

Ideally each ruminant in collection should have its own stall to receive concentrate feed so that feed intake can be monitored. Free ranging ruminants tend to spread out during feeding activity periods and establish regular pattern of spacing known as individual distance. For this feed bunks or hay racks should be widely dispersed in the pen. In large enclosures accommodating ruminants, it is essential to provide creep feeding station that will allow access to smaller species/smaller sized members but deny access to larger species and mature males. In spite of all precautions dominant males would chase away weak males from feed troughs.

Wild ruminant may drink water infrequently apparently due to the inaccessibility to water source. But in captivity they should have access to fresh cool water 24 hours a day.

Camelidae

Animals of this group should be fed a high quality grass hay and alfalfa (legume) hay adlibitum placed at a height of either eye level or maximum 0.5 mt lower. A concentrate mixture containing 12-14% protein should be fed at the rate of 5-10 g per kilogram body weight (4 to 8 kg/animal). A trace element salt block also should be made available at all times. The protein content of concentrate mixture recommended is only 12-14% when the animals are fed on grass hay having 10% of protein or

when fed on grass legume mixture of hay or green stuff. In most zoos such high quality roughage is not available and therefore a concentrate mixture testing 20 of Cr. protein or a standard dairy cattle feed is given.

An active adult would eat 2% feed in terms of dry matter but a lactating female or a growing juvenile eat upto 4% of its body weight.

Llamas are known to be affected by white muscle disease due to deficiency of Vit.E. Periodic injection of Vit.E, selenium combination is needed in captivity.

Wild deer

Wild deer browse on buds, twigs and bark. Grazing on extended periods is only during spring. They are fed in the zoos on good quality grass, hay or grass legume hay supplemented with a concentrate feed. A standard dairy cattle ration can be used as concentrate feed. The quantity of roughage fed ranges from 2-3% of its body weight on dry matter basis, the hay racks being fixed at eye level and concentrate bunks at ground level. The quantity of concentrate is usually 5-10 g/kg body weight. A mineral salt brick and adlibitum fresh cool water should be made available in the pen.

Giraffe

They are high browsens and hay racks should be kept at eye level. The concentrate and water also should be offered 0.5 metre

below eye level to ensure consumption. The quantity of roughage and concentrate to be given fall within the general formulae for ruminants.

In the wild habitat giraffe feed on forage very high in protein. In a number of zoos peracute mortality has been reported, the precise cause being unknown. Low protein intakes is often a contributing factor for such deaths.

Sheep and goats

Wild sheep and goats are browsens but are adaptable to consume herbs and grass. In captivity they thrive a good quality grass/alfa hay and grass. They are susceptible to white muscle disease and their diet must be monitored for any deficiency.

Zebras, tapirs, rhnoceroses, hippopotamuses and elephants

The basic nutritional requirements of these animals are those of domestic horse. They are basically herbivores but on occasions ~~are~~ Omnivorous. In the wild they browse and graze on grasses and other vegetations. These animals drink more water than others and a constant source of water is needed.

Hay or good pasture when fed adlibitum is ~~x~~ difficient to maintain adult animals. However it is customery to give same horse feed also to these animals.

Zebra - Grass/hay free choice

Tapirs - Grass hay free choice
10-25% legume hay
1-2 kg horse pellets
1-2 kg dairy cow ration
Vegetables and fruits 0,5-1 kg

Rhinoceros - Grass or grass hay free choice
10-25% legume hay
Equine feed 2-3 kg
Dairy ration 2.0 kg

Hippopotamus - Grass or grass hay free choice
10-25% legume hay
1.5-2.5 kg horse feed
1.5-2.5 kg dairy ration
Fruits 2-3 kg

Elephant - Grass or grass hay mixed with
10-25% legume hay free choice
Yellow vegetables 3-5 kg
Equine feed 3-5 kg
Special Dairy ration 3-5 kg

Primates

The order primates comprises of 11 families. Primates consume a variety of food stuffs. Tree shrews are entirely insectivoreous. Lemurs in the wild state feed on insects small invertebrates and eggs. The slender loris also live a lizards frogs, birds and egg. Macques feed on a variety of plant and animal feeds. Baboons chimpanzees feed on leaves, roots fruits nuts etc. Chimpanzee feed a medium sized vertebrates and insects also.

Most of these species would readily adjust to basic monkey pellet diet supplemented with small amounts of canned dog food, or fruits nuts flower seeds and vegetables.

In the zoo caloric deficiency is the major problem encountered in monkeys especially newly acquired primates. Monkeys fed on a standard mixture of fruits and vegetables even though they seem to take sufficient bulk, are found to reduce in body weights. Caloric deficiency can be diagnosed by studying dietary history. The animal will be having low blood glucose, ketonuria, emaciated body condition and depressed attitude.

The primates need 3-5% of fat in the diet. Excessive levels of fat in the diet may lead to diarrhoea and if extended for a prolonged time may end up in defective absorption

of vitamins and minerals especially calcium selenium, iron and Vit.E.

Old world primates need 15% of protein and new world primates 25% protein in their diets. The protein should be of high biological value.

The zoos the diet given consists of fruits, nut, vegetables, egg, bread and milk. In cases where caloric intake is found insufficient glucose biscuits may also be given in addition to bread.

Avians

Natural feeding habits of different species vary very widely. Many birds are omnivorous eating practically any food item.

It is easier to feed omnivorous birds in captivity on formulated rations containing a number of food items ground and prepared into a mash or pellet. Such diets contain all nutrients in a proper balance.

Carnivorous birds are fed on fish, mice, poultry chicks, meat from poultry, horse or cattle. Muscle meat when fed, in place of mice and other whole prey, has to be supplemented with calcium, phosphorus, trace elements and vitamins.

Energy requirement of smaller birds and for birds in flight are much higher than heavier birds, per unit size. The absence of teeth in birds is compensated by the presence of a muscular gizzard. This is particularly noticeable in omnivorous and seed eating birds. Grouse has exceptionally long caeca for digestion of fibre. Carbohydrates from grains and seeds are well utilised by the birds. The feed should contain 5% of fat to provide sufficient linoleic acid. The body fat content of birds ranges from 6% in lean birds to 40% over fat ones. Fat is needed for maintenance of the health of the skin, plumage and also for absorption of fat soluble vitamins.

Except vitamin C, para and amino benzoic acid, inositol and all other vitamins are required by birds. Since the requirement of B-complex vitamins are more in the avian compared to other species deficiency is very common in birds raised under captivity.

Unlike felidae birds utilise carotene as a source of Vit.A. If the birds in captivity get a chance to expose themselves to sun their vitamin D, requirements are taken care of. In other birds vitamin D is supplemented in the diet in the form of Vit.D_3.

Pelicon

Brown pelican weighs about 3.6 kg and feed on large variety of marine fishes. American White pelican weighing 7.7 kg (average) feed on large fresh water fishes. In most of the zoos these birds are fed on fish alone. In the wild habitat they are used to catch and eat live fish and in captivity some initial problems in feeding fresh dead fish is likely. Better to feed on a variety of fishes than feeding on one variety of fish alone with supplements of vitamins and minerals.

Common cormorant

Weighs 3.63 kg (average) and feeds on shell fishes, shrimp, spider crab, prawns, herring cod etc. Marine birds usually need supplements of salt in their diet. Supplements of Vit.A and E along with feeding whole fish is also recommended.

Cranes

Cranes are omnivorous feeding on amphibians, field mice, mollusk , insects and various kinds of vegetation including grains. The nutritive requirements of cranes is not clearly understood and therefore it is customary to feed them on a variety of foods to avoid deficiency. A mixed pellet diet containing grains, fish meal, oil cakes testing 23% of protein and 2689 Kcal energy/kg is needed for young ones. As they became adult the level of protein is reduced to 15%.

In the absence of a ready mixed feed cranes may be fed on fish 200-250 g and grain 200-250 g and some locally available vegetables.

Strokes and Flemings

The order Ciconicformes include herons, egrets, bitterns strokes,ibises and spoon bills. Most of these birds live in aquatic habitats world wide. Strokes, ibises and spoon bills are colourful and therefore popular zoo exhibits. Flemings are also popular because of their brilliant plumage and unique feeding patterns.

The above birds are aquatic carnivores eating fish amphibians, mollusks and small mammels. In zoos it is easier to maintain them on commercial trout feeds combined with fish minced meat or earth worms. They eat about 10% of their body weight.

Green pea plant, cabbage, palak, loan grass etc. are usually fed in addition to grains.

Swan

Most common is mute swan having a pure white plumage and greyish to orange bill. Size varies from 12-15 kg. They feed on vegetables cabbage, palak, amaranthus etc. approximately 200 g. Crushed grain and a good pelleted duck feed (about 200 g ~~each~~) also is needed.

Grouse, Pheasant, Guinea fowl and Turkey

Pheasants are the most popular among this order. In the natural habitat they eat a variety of seeds, insects and plants. In captivity they can be fed an a feed high in protein 25-30% during early stages and protein content can be gradually reduced as the birds became adults.

In zoos they are fed on crushed mixed grain, leaves, onion and fruits like papaya, watermelon, banana etc. Instead of feeding a crushed mixed grain alone addition some oil cakes, fish powder, mineral mixture and vitamin supplement would make a better balanced diet. The birds consume 100-200 g of the above mixture and vegetables.

Pigeons and Doves

Pigeons grow most rapidly during the first 20 days of life. The young one receive the first feed from pigeon milk

A compounded flemings diet should contain 20% protein 3% fat 4-5 of Cr. fibre, 4% calcium and 1.2% phosphorus, 0.5% sod. chloride and 2500 Kcal energy/kg. A commercial broiler finisher diet diluted with 25% wheat bran might make a more or less balanced diet. However, such a diet has to be supplemented with vitamins so that one kilogramme of mixed feed would contain 15-20,000 IU Vit. A, 2000 IU Vit. D_3, 75 mg Vit.E, 75 mg Vit C. and B complex vitamins.

Commercial trout or salmon fish feeds, or commercial fresh water prawn or fish feed also can be tried. To make good any vitamin deficiency that may occur in those diets it is always preferable to supplement the diet with carrots, lettuce, sprouted grain, alfa alfa and Cod liver oil.

Commercial feed can be available in pellet form can be fed as such in water, and feed in mash form can be soaked in water to form a gruel and fed ~~water-fowls~~.

Goose

A wild medium sized goose (2-5 kg) eating only grass would eat approximately 750 g-day in winter. In captivity it needs smaller amounts especially when supplementary grain feeding is also given. Before egg laying adult water fowl needs supply of calcium grit such as crushed oyster shell.

Commercial diets for ducks are unsuitable for goose as it is meant for medium growth andegg production. Fast growth in goose causes fatty infilteration of liver.

regurgitated from the parent pigeons crop. When 20-40 days old young pigeons can be fed on a pigeon feed. Unlike other birds, pigeons do not eat mash, so the feed should be either cracked grains or commercially prepared pellets which is complete in all known nutrients. In the absence of such a pellet a variety of cracked grains corn, wheat, sorghum and peas may be offered in an open pail having different compartments for each grain. Grains to be offered twice a day. A free choice mineral mixture containing 50% medium sized ground oyster shells, 25% grit of appropriate size, 20% Bone meal or dicalcium phosphate and 5% salt may also be offered in a separate feeder.

Ostrich

Ostrich is the largest bird in the world. At maturity it stands 3 mtrs tall and weights 150 kg. They become full size within 6 months but attains sexual maturity only by 3-4 yrs of age. Unlike other birds ostriches eliminate urine and faeces separately.

During young stage they need a diet containing 28% protein. The same diet used for turkey can be used for ostriches also. In India in the absence of turkey ration broiler ration supplemented with 1/8 part by weight of soybean meal can be tried as a trial along with vegetables.

A thorough evaluation of the diet pattern followed in different areas in relation to local availability of feed ingredients, environmental and seasonal factors is needed before any suggestion is made for the best feeding programme of existing poultry.

CURRENT TRENDS IN GENERATING DNA-BASED POLYMORPHIC MARKERS FOR DIFFERENTIATING PURE STRAINS/BREEDS AND THEIR HYBRIDS WITH SPECIAL REFERENCE TO LIVESTOCK SPECIES

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Resume

Current trends in generating DNA-based polymorphic markers viz., Restriction Fragment Length polymorphism (RFLP), Minisatellite based DNA fingerprinting and PCR based Random amplification of polymorphic DNA assy systems have been discussed. The pros and cons of these techniques in differentiating pure strains/breeds and their hybrids as well as their usefulness in conservation of endangered species and economically important farm animals have been presented.

Introduction:

The determination of the degree of genetic relatedness among invididuals is important. Much of population genetics research in past had relied on protein-based multilocus enzyme electrophoresis method. The realization that DNA sequence polymorphism between individuals can be used for genetic mapping has dramatically changed the scenario. Natural variation in DNA sequence can be detected in several ways. One way of course is to directly sequence the DNA and make detailed comparison. Unfortunately this method is still very cumbersome and time

consuming. Recently several new marker systems that promised to meet the requirements for differentiating pure strains and hybrid strains have become available. This article describes three of the major techniques viz., 1) Restriction fragment length polymorphism (RFLP), 2) minisatellite based DNA fingerprinting and 3) Random amplification of polymorphic DNA assay system. Merits and demerits of these techniques alongwith examples taken from published reports and work carried out in our laboratory are presented. Application of these techniques in conservation of endangered breeds/species is also discussed.

1) **Restriction Fragment Length Polymorphisms (RFLPs).**

RFLPs are DNA fragments of different length generated by cleaving with specific endonuclease, they can be used for genetic mapping particularly in interspecific crosses. The idea of using RFLPs for genetic mapping was introduced in 1980 (Botstein et al., 1980). Since that time there has been rapid progress in the development of genetic maps in a variety of organisms, including humans, mice, and many crops and livestock species. RFLPs occur as a result of DNA base changes, deletions, insertions or rearrangements that either create, eliminate or translocate restriction enzyme cleavage sites, Such variants are inherited in a Mandelian fashion and since gene expression is not required for RFLP analysis, variation in the flanking regions or introns of genes may also be detected. Since one can use RFLP markers to simultaneously follow the segregation of all chromosome segment during a cross, the basic idea is to look for correlations between the quantitative trait of interest and

specific chromosome segments marked by RFLPs. If correlation exists then the chromosome segment must be involved in the quantitative trait. The difficult part in the proocedure is establishing the correlation between the trait and specific chromosome segment. RFLPs monitors only that part of the genome that represents restriction sites under scrutiny or affect the relative placement of these sites. Thus in some applications, particularly those involving processes between improved strains deriving from a narrow genetic base, even RFLPs may not provide sufficient differentiating markers for some breeding or analytical purposes. In this case a more abundant class of polymorphism will be necessary. The amount of DNA required for RFLP analyses is relatively large (5-10 ug), but a single southern blot may be reprobed many times over a period of years, making this technology more efficient. Multiple southern blots corresponding to hundreds of individuals can be probed simultaneously and many highly saturated RFLP maps have been produced in this way. An alternative to one of the disadvantages of RFLP markers, the need of radioactive probes, has come with the availability of sensitive non-radioactive system. However, Automation of RFLP mapping is difficult.

2) **Minisatellite & microsatellite based DNA fingerprinting:**

Scattered throughout the genomes of many species are clusters called minisatellites of tndemly repeated sequences, the core sequence of which is rather small and common to them all. If an individual's genome is now chopped up with restriction enzyme, run on a gel to separate the fragments according to size and then

treated with radioactive core sequence, a ladder like pattern of bands is detectable.

If all of the tndem repeats in one individuals were identical with those in other individuals then the band pattern would be common to all. In fact, for various reasons of oellular genetics, the size of each tandem repeat can vary considerably among individuals; many of those loci have 20 or more variants. It is this variability that can generate a near-unique pattern - the DNA fingerprint - for each individuals. The application of DNA fingerprinting in forensics (Gill et al., 1985), immigration law (Jeffreys et al., 1985) paternity testing, transplant screening, ecological genetics (Pemberton et al., 1992) segregation analysis with disease (Jeffreys et al., 1988) or production traits (Georges et al., 1990) and gene mapping (Wells et al., 1989) are for reaching and well documented.

3) **Random amplification of Polymorphic DNA (RAPD):**

RAPD is one of the most promising methods which uses single oligonucleotides of arbitrarily chosen sequence to prime DNA synthesis at low stringency from pairs of sites to which the oligonucleotide is matched or almost matched. This generates strain-specific arrays of amplified DNA fragments. The formation of these arrays does not depend on prior knowledge of the nucleotide sequence, nor it is affected by DNA modifications that complicate typing by restriction endonuclease digestion of genomic DNA. Because the RAPD method is PCR-based, only nanogram quantities of DNA re required and the DNA not be double-stranded, highly purified, or of high molecular weight.

Polymorphisms in genomic fingerprints generated by Arbitrary Primer PCR (AP-PCR) can distinguish between slightly divergent strain of any organism. Single oligo primers have been used to generate such fingerprints, with the same primer being present at the 5′ end of both strands for every PCR product. Welsh and McClelland (1991) used three Arbitrary Primers (AP), individually and in pairs, to generate six different genomic fingerprints of the same mouse genomic DNAs. Fewer than half of the products in the genomic fingerprints generated using the oligos in pairs were the same as those produced by AP-PCR fingerprint with the potential to identify new polymorphism.

Divergence of even a fraction of a percent between two genomes often results in different fingerprint pattern because a somewhat different set of sites in the genome have the best matches with the primer. PCR products that are shared between only some individuals act as polymorphic markers, equivalent to other polymorphic characters used in phylogenetic and genetic mapping methods. Each primer gives a different pattern of AP-PCR products, each with the potential of detecting polymorphisms between strains. Thus the data produced allows the differentiation of even closely related strains of the same species. These polymorphisms can be mapped genetically. We have applied the method to strain identification and genetically mapping in economically important farm animsls (Ghosh and Gupta, 1994) RAPD fingerprinting is, in many respects, dramatically easier and faster than established methods for genetic mapping. We can begin a mapping program without having to dirst identify

RFLP probes. No clones need to be made and no plasmids purified. Polymorphism can be generated by almost any primer we choose. Most of the steps in RAPD are automatable. The method can use ethidium detection. Fluorescent detection or only tiny amounts of labelled based relative to southern hybridization. Furthermore, RAPD generated DNA polymorphisms can be isolated directly from gels and reamplified to use as probes in genome walking or restriction mapping strategies (McClelland et al., 1994).

We have applied RAPD technique assay for authentication and differentiation of seven different breeds of Indian goat viz., Burberry, 2) Beetle, 3) Jamnapari, 4) Jakhrana, 5) Kuchhi, 6) Marwari, 7) Sirohi. We have demonstrated by using short random primers of arbitary nucleotide sequence that it is possible to identify reproducible DNA markers, characterization of individual animals, population or breeds of goat. Results of this work have shown that bandsharing is greater within breeds than between breeds (Ghosh & Gupta, 1994).

Garole sheep are found in the Sunderbans of West Bengal. They are highly prolific, average litter size is 2.3 lamb/lambing and may be resistant to foot rot disease. Their population in W. Bengal is estimated to be around 50,000 (Ghalsasi and Nimbkar, 1993). Genomic DNAs isolated from peripheral blood of 28 individuals selected from various locality around Sunderbans have been randomly amplified using 10-mers in RAPD-PCR and an interesting association between the litter size and specific amplicon has been established (Gupta and Ghosh, unpublished observation). Detailed study using various combinations of oligonucleotides to determine the segregation pattern of the

marker DNA fragment associated with the fecundity gene (?) is underway. Similar attempts by Crawford et al., (1993) using DNA fingerprinting analysis of Booroola pedigrees of merino sheep in Australia has not been successful.

5) **Application in Conservation of endangered species:**

Hundreds of the world's hardiest breeds of farm animals are on the verge of extinction because of the spread of western techniques and live stock in the developing world. Ironically aid programs that aim to boost food production in developing countries by crossing native breeds with western live stock are partly to blame. Some breeds, such as the Sahiwal cattle of the Indian subcontinent had already attracted the attention of conservationists. The Sahiwal is in danger as farmers try to adapt the Holstein, the world's most popular dairy cow, to condition in tropical countries.

In efforts towards conservation of cattle breeds that posses valuable traits, such as disease resistance, approaches employing several markers systems should increase accuracy of genetic characterization of such breeds.

The usefulness of these modern techniques may be exploited for differentiation of yet uncharacterized species and strains which are getting critically depleted from their niche. A concerted effort from various agencies will certainly be the call of the day. In India these DNA based polymorphism amongst different vertebrate species is being studied only at 3-4 major Research Institutions.

Protecting the country's genetic wealth has become crucial particularly after the General Agreement on Tariffs and Trade (GAAT) which allows patenting of genes and microorganisms. In order that our country does not miss out in the World trade it is important that all the best known breeds and traits are studied using the latest technologies indigenously.

Recently individualization and estimation of relatedness in Crocodilians has been studied by DNA fingerprinting with a Bkm-derived probe (Lang et al., 1993). Ali et al., (1988) had shown genome specific loci in B. taurus and B. bubalis using oligodeoxynucleotide probe). Prithwiraj (1993) used RAPD analysis for differentiating amongst various livestock species. DNA fingerprints which are not shared amongst different species are therefore, powerful tools for discriminating these species.

7. Concluding Remarks:

Oligonucleotide as well as amplification fingerprinting both have potential to complement classical and molecular marker techniques in various fields of animal biotechnology and conservation. These techniques are versatile, fast, relatively easy to perform and recognize diversity at a sensitive level. Provided that the conditions for PCR are kept constant from experiment to experiment the amplification fingerprint techniques presently appears superior to oligonucleotide fingerprinting, since it neither requires the isolation of pure high molecular weight DNA nor the performance of hybridization steps. However, since both techniques visualize different region of the genome, they are more likely to complement than to compete with each

other.

RAPD markers allow multilocus fingerprinting in contrast to protein polymorphisms which normally examine a single locus. However, comparison of the RAPD-PCR to other DNA-based methods, such as mitochondrial sequencing and microsatellites, will require a reliable designation of the RAPD allelic patterns in order to allow exchange of such markers between laboratories).

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29th October, 1994
Saturday

SCIENTIFIC SESSION

Developing public perception on Wildlife conservation

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Developing public perception on
Wildlife conservation

EDUCATION AND INTERPRETATION IN THE INDIAN ZOO CONTEXT

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The conservation objective of zoo includes education. The potential of zoos to educate is vast : hundreds of millions of people visit zoos every year.[1] In India the 350 "plus" zoos which have requested recognition attract lakhs of visitors even in a single day.[2] The range of daily visitor numbers is wide, varying from few dozens or hundreds to some of the small zoos and deer parks to as much as one lakh of visitors on special days to one or two of the large zoos.[3] A very wide range of people from a different age groups, social and economic classes, educational levels, and interests visit zoos[4]

Although the audience of media consumers is normally not included when considering the educational impact of zoos, it is common knowledge that articles and features in the press, periodicals and television news concerning zoos and their wild animals reach hundreds of crores of readers and viewers. The influence of the media on public and zoo visitor attitudes has not been studied systematically in India, but every zoo director has an idea of its impact by the number of visitors who visit or phone with questions and comments – both negative and positive – about items they have read in the press or items view on television.

The Central Zoo Authority has collected information about the size and status of animal collection of most of India's zoos.[5] It is evident from this information that many small zoos and deer parks may not be in a position to contribute directly to *in situ* conservation by participating in delicate research, breeding or rehabilitation programmes. They can, however, contribute to conservation in other ways, possibly the most significant being zoo education, no matter what their size or status.

Over a twelve year period of casual visits, consultancy requests and inspections of Indian zoos by this writer over the last decade, it has been noted that quality and quantity educational activities in Indian zoos varies widely. Some zoos have made no attempt to educate at all and lack even identification boards for enclosures. Some of them justify this by stating that the animals themselves are sufficiently educational. At the other extreme are zoos which have proper education and information officers, zoo guides, attractive signage and educational literature, interesting programmes and events during the year, and innovative outreach activities. Probably no zoo in India has all of these educational features yet, but a few zoos have a combination of several of these features. Moreover, the effectiveness of the educational activities of zoos in India has not been evaluated systematically so far.

It would be a pleasure to devote this paper to praising the multiplicity of creative and innovative efforts of individual Indian zoo personnel and their institutions, but the time and space allotted will not permit this. Instead, this paper will examine some of the basic elements necessary to improve zoo education for all zoos, both great and small, in the Indian context and to suggest a more systematic approach to education, e.g. the What, Who, Why, What, Where, When of zoo education.

What? -- find a theme

Perhaps the first step towards a more systematic approach to zoo education might be looking at what should a zoo teach? Zoos are unique and wonderful in that a variety of biological themes can be explained through the medium of zoo education, the conservation message itself particularly important among them[6] Other themes include endangered species, habitats, ecology, adaptations, evolutionary biology . . . just to name a few. Some zoos are designed from the beginning around a specific educational theme. The Himalayan Zoological Park in Darjeeling with its emphasis on high altitude species is one example. The upcoming Nilgiri Biosphere Conservation Park, an interpretation centre for a biosphere reserve, is another. Any zoo, however, can find

multiple themes within its collection. The point is to select one or two themes or a few subjects and focus educational efforts in a systematic or coordinated fashion around them. While no studies exist which evaluate what visitors actually learn on a zoo visit in India, it is not difficult to imagine the confusion of ideas which might result from haphazard and occasional signage and lack of interpretation. Interpretation, which involves explaining how the zoo fits into the "big picture" of conservation and a crucial aspect of quality zoo education -- is far easier and more effective if it can be constructed around a specific theme. Further, themes and educational devices can (and should) be changed from time to time to provide variety in the zoo encourage local people to visit again and again.

Who? -- There are two "whos !"

"Who" number one: Who visits the zoo? We know a variety of people from all walks of life visit zoos, but every zoo has its own special mix. "Know your audience" is one of the most important principles in planning any aspect of zoo education.[7] The first step in planning an effective Education Programme should be to conduct a systematic and comprehensive visitor's survey for several months. Subjective impressions of zoo visitation are prone to error. A survey should reveal what percentage of visitors are literate/illiterate; kids/teens/adults/aged; of what linguistic preference; are locals or tourists; are first time or frequent visitors; have special interests; what they liked best; etc.

The value of knowing your audience is inestimable. Obviously an education programme which relies primarily on printed text to convey its message is doomed to failure if the majority of visitors are unable to read, or are not proficient in the language used on the signs. If most of the visitors are tourists, having boards in the most commonly used language is important. If zoo visitors are mostly children, special exhibits and graphics may be in order. Knowing your audience includes knowing what approach is appropriate for different age groups.

The value of knowing your audience is not limited to knowing how to plan educational activities but also in planning future exhibits and programmes. If, for example, the audience is overwhelmingly adult a zoo might want to create an outreach programme to attract more school groups. More elderly visitors may indicate the need for special "short" routes through the zoo or other features.* (Mysore Zoo paper, Shivanna).

"Who" number two. Who is an educator ? Who will be an effective educator also depends on who is your audience. Zookeepers themselves make excellent educators because they know the animals "personally". With some training they can combine scientific facts with day to day anecdotes about the animals behaviour which would be particularly interesting to uneducated visitors as well as children. In fact, in Mysore Zoo when teacher training workshops were conducted some years ago, the most popular lecturers with the teachers were the zookeepers.

Everyone at the zoo is or should be a potential educator / interpretor of the zoo[8] Older students and special interest groups might be fascinated by a lecturer on veterinary care from the zoo veterinarian. What the animals eat and how food is acquired and distributed makes an interesting story by the Storekeeper. The long and tedious process of how animals are acquired from abroad can be related by an Office administrator. How animal behaviour is studied and applied to keeping the animals better can be explained by the zoo biologist, etc. Having zoo personnel from different departments occasionally do "education duty" for special groups also can have the effect of making them realise the importance of their job, breaking their routine and creating an "teamwork" atmosphere.

Volunteers can be trained to give lectures and tours and also to participate in outreach programmes to schools, special interest groups, etc. It is an excellent way to utilise volunteers as almost any number of them can be accomodated in this hungry field. Volunteers as educators can do double duty on Zoo Patrol. A study conducted in three zoos in Tamil Nadu for an M.Sc. thels indicated that an overwhelming majority of visitors who are caught teasing animals in

zoos will apologise and move on if polightly asked to stop. This study also indicated that most visitors who teased animals did so without thinking of the consequences; when they were told about how animals could suffer from stress they were fascinated and sympathetic.[9] It has been observed in several zoos that volunteers quickly become bored if required to do only Zoo Patrol, [10] but combining Patrol duty with Educational lectures can make both more interesting and effective.

The effectiveness of WHOever educates depends on coordination. Every zoo should have some one person specifically designated as responsible for Education. Ideally there should be a Zoo Education Officer to plan activities, induct zoo personnel and volunteers, organise training in interpretation for them, and monitor the process. The success of Volunteer programmes depends very much on the presence of a Volunteer Coordinator, a person employed by the zoo who is responsible for volunteers and has authority to direct and regulate their behaviour. It has been the experience of many zoos that another volunteer will not make an effective Volunteer Coordinator.

Where ? While there are great advantages to outreach programmes or field visits which will be noted below, the power of the living collection in the zoo is its primary advantage. The unique character of a living collection was first noted in an Indian institution nearly 150 years ago. The Superintendent of the Madras Government Central Museum, Edward Balfour, experimented with his visitors by adding a young tiger and a cheeta to the museum exhibits. Balfour kept a careful record of visitation and recorded that visitation increased significantly on the addition of these animals, decreased when he removed the animals and again increased when he put them back. This experiment, and the first systematic "zoo" visitor's study, inspired Balfour to start the Madras Zoo in a small corner of the Museum grounds.[11]

Conducting educational activities in the zoo itself has enormous advantages: the animals, a convenient venue, zoo personnel to assist, security, etc. When planning a long-range Education Programme; outreach activities and even field trips to natural areas should be considered.

Outreach programmes, in which zoo personnel or volunteers, take presentations to schools and special interest groups can be extremely effective in encouraging people to visit the zoo, preparing them so that they understand the importance of the institution, and even in influencing their behaviour.[12] Details about habitats, conservation in general, species taxonomy and biology, and other related subjects which might not be possible during a zoo visit can be conveyed in special outreach programmes. "Touch tables" in which a display animal artifacts such as tusks, teeth, horns, antlers, bones, skins, etc. of different animals can be passed around or demonstrated in a class room are very effective educational tools. Such displays are sometimes done in the zoo itself but if crowd control is a problem, conducting them in a controlled classroom setting may be more suitable.

Field visits to nearby natural areas, reserve forests, sanctuaries, project tiger areas and national parks are uniquely possible in India where so many cities are located within a few hours of a natural area of some kind. Organised zoo visits can focus on selected species viewed up close in the zoo and reinforced by field trips conducted collaboratively with schools and conservation - n.g.o.'s can be particularly effective.

When ?

Zoo education is a daily affair. While special events such as Wildlife Week and World Environment Day, etc. can provide an excellent opportunity for good press coverage and public programmes, the effectiveness of the zoo as an educational institution will be diminished if sporadic bursts of activity sandwiched in between long stretches of lethargy. Education in the zoo should be dynamic. Every day there should be a veritable frenzy of activity if we are to make the best use of the zoo as a conservation tool. The Education Department should be as busy as any other department, taking more than adequate care of visitor learning potential just as zookeepers take special care of animal health and well being.

How ? -- **Programmes, Master and Mini**

1. Programme v/s activity (or Master programme vs mini-programme). A Zoo Education Programme v.s. zoo educational activities (or mini-programmes). Zoo education can be most effectively carried out when it is systematically planned over an extensive period.[13] Just as zoos develop Masterplans and Management plans which include zoo education (or should do), there should also be an Education Masterplan. Most zoos perform their education function in a haphazard and occasional fashion with a variety of isolated activities or mini-programmes (spelled with a lower-case "a". For maximum effectiveness, an Education Programme (spelled with a capital "P") needs to be planned out over a long period which includes several *integrated* mini-programmes (See Appendix 1). A long-range Programme can be made as a three to five year plan for purposes of requesting funds, taking into consideration the zoo audience, theme, resources and requirements of the zoo, etc. A more detailed Programme can be planned from year to year in which special programmes events such Wildlife Week, World Forestry Day, Animal Welfare Fortnightly, etc. can be celebrated with other themes and events (e.g. outreach programmes, school visits, training programmes, animal births, new enclosures, special conservation programmes with other zoos, workshops and seminars, etc.) filling in the spaces.

An Education Programme doesn't condemn the zoo education team to following a tedious and monotonous plan. Flexibility should be built into the programme with room to take advantage of unexpected events -- a new animal, a special visitor from out of town, a donation of literature, etc.

2. One small how: the ABC of effective education: Always Be Creative.

Zoo education should not be boring. Sometimes senior officers and administrators forget what caught their interest when they were children. Or perhaps they think that everything produced on their watch should be "dignified". Children -- and sometimes even adults -- are not necessarily attracted to dignity. People are attracted by something catchy, creative, innovative. Different approachs will be appropriate for different age, educational level, and economic groups. Being creative is not difficult -- there are even some simple Guidelines which can be used for any type of group: A few of them are listed in Appendix 2.

3. Another big "how" is How did it work? -- Evaluation

Evaluation of individual education programmes, publications, projects and devices is very important. Subjective impressions of what other people learn from a particular programme or publication are likely to be biased and wrong. When one creates an educational item, he is so familiar with it that it is crystal clear to him what it means. It may not be so clear to a visitor reading it in passing and for the first time. Evaluation is essential. Appendix 3 (below) is a summary of the process structure which can be used for creating any size programme.

Appendix 3: PROGRAMME PROCESS

The same three point process will work when planning almost any kind of programme, master or mini.

1. INVESTIGATE -- Who is your audience? What are they learning? What do they want ? What will make the come back.

2. IMPLEMENT -- do it. Try it. Experiment. Innovate. Make mock up signs and brochures before going for expensive projects.

3. EVALUATE -- How did it work? Be honest and unafraid. You lose far more by not finding out what is effective. You lose the opportunity to educate about conservation.

4. A neglected "how" : MEDIA as Educator instead of Annhilator

Crores of people read newspapers and periodicals and watch television every day. People who can't read can watch t.v. Moreover, they do so every day of the year, sometimes for several hours. Compared to this, a zoo visit is small potatoes.

Such being the case, it is hard to understand why zoos don't give more attention to interacting with the media. The potential for both good and bad from media is vast – why not harness it for promoting zoo conservation and education.

A casual survey of a few years worth of press clippings from a national service indicated that bad stories about the zoo outnumbered good ones by far. A bad story, rather several months or years of reading bad stories about zoos can convince a person that there really is nothing good about this institution. Potential visitors can be put off. Potential supporters can be turned into detractors. Even government officers heading Finance and Planning Departments can be put off by bad press.

Many zoo directors fear and dislike the media and many press persons distrust and dislike zoo personnel. The fault lies on both sides. Press persons need current news and they need it fast; consequently they are sometimes too quick to print without completely checking the facts. Zoo personnal are also to blame, however. They are quick to report a "great event" such as a birth or new aquisition but cagey when it comes to giving information about sickness or death in the zoo. Sickness and death are a just a part of Life. In the best zoos, the very best vets and keepers fail to save the lives of some animals, just as happens in hospitals with people.

However, zoos trying to hide the facts conveys the impression that wrong things are going on. Press persons report "rhino is dying and zoo is doing nothing" when actually the Director and Vet have not slept for three days, run up a phone bill trying to contact other doctors who have treated rhinos, and keepers have sat up all night with the animals. Zoos might be more forthcoming about death and illness and give the press sufficient information for a story that will gain public sympathy and interest and achieve education objectives rather that lose friends for the zoo.

Zoos can exploit the press for education -- for a good cause, rather than the other way around ! Regular stories about the animals and their place in the conservation story can be prepared and build up tremendous public support for the zoo. Many directors in India have done this with excellent results for both.

WHAT GOVERNMENT CAN DO . . . SOME SUGGESTIONS

State Governments and CZA can recognise the need for and value of systematic and comprehensive zoo education and provide for

1. A post of Education Officer or Information Officer for zoos
2. Funds sufficient for signage, special exhibits and programmes, published literature and contingencies
3. A mechanism for fundraising for education in zoos
4. Produce or contract the production of generic signage and educational literature in major Indian languages in sufficient quantities for all the small zoos which have no education budget
5. Invest in improving zoo education facilities instead of necessarily starting additional educational centres
6. C.Z.A. can recognise the "Zoo Week" suggested at the 1988 meeting of the Indian Zoo Directors' Association

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Appendix 1 : DEVELOPING PROGRAMMES AROUND SPECIES OR EVENT

SPECIES

1. Endangered species, *particular*
   a. An endangered species in your zoo
   b. An endangered species not in your zoo but in your country
   c. An endangered species not in your zoo or your country but as a symbol or flagship

2. Endangered species, *general*
   a. A group of endangered animals that can illustrate or focus on de struction of a pa ticular habitat or biome, e.g. animals of Manas
   b. The concept of endangered species, -- "Vanishing species" as in American Zoo Association literature
   c. A "representative" group of endangered animals, mammal, bird, reptile, etc.

3. Engaging/attractive species -- or the opposite
   a. An attractive animal whose size, beauty or cuteness or ability is a focal point : e.g. "charismatic mega-vertebrates", size - rhino, ele phant; speed - cheeta; cuteness - panda.
   b. An animal that has a birthday, naming ceremony (Raju the ele -phant is a year old today)
   c. A traditionally "unpopular" animal with a negative image (such as vultures).

4. Official/commerical animal or species
   a. Your state or national animal (or the symbol of your zoo)
   b. A species that is the logo of a company that will fund a project for that species

EVENTS

EVENTS CAN BE LOCAL, STATE, NATIONAL, INTERNATIONAL

1. International

Designated world events. World Environment Day, World Forestry Day, World Animal Day

2. National or State

Events or holidays. Wildlife Week, Animal Welfare Fortnightly, Zoo Week, Indian Environment month. Does not necessarily have to be connected with wildlife (i.e. Republic day, Mother's Day, etc.)

3. Local

Any local civic event..."Clean up Week".. Can even make up your own event ... Zoo Day, Kindness Week Collaborate with service organisations -- invite Lions Club or Rotary Club to celebrate their events in your zoo. Collaborate with schools

Appendix 2: HOW TO BE CREATIVE – SOME GUIDELINES

USE SIMILARITIES AND OPPOSITES

SMALL	LARGE
SLOW	FAST
GOOD	BAD
HOT	COLD
SHORT	TALL

SMALL populations of wild animals have BIG problems

The SLOOooooooOW tortoise . . . disappearing FASTI

The TALL giraffe is "short" on BRAINS

REPETITION with slight change

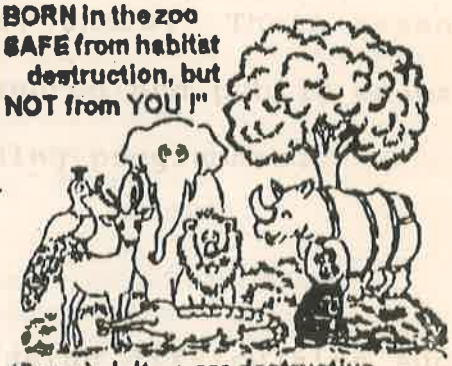
ZOOS give wild animals with
NO CHANCE
A LAST CHANCE

USE DRAMATIC TECHNIQUES

EXAGGERATION & ALLITERATION
State Bank of India
State Bank of Animals

RHYMES
"Born in the zoo
SAFE from habitat destruction, but
NOT from YOU !"
(Some) visitors are destructive to wild animals

BORN in the zoo
SAFE from habitat destruction, but
NOT from YOU !"



(Some) visitors are destructive to wild animals

HUMOUR
O Vulture !
What would we doooooooo
Without
Yooooooooooooooooooooooo

IRONY
The Vulture :
Imagine Life – or Death – without him !

The "dearest" deer

PUNS
"The Dearest Deer"

PLAY ON EMOTIONS
PERSONALISE ISSUES

I.E. Golden rule: Do unto others as you would have them do unto you, e.g. Put yourself in their place.

ZERO IN ON ONE ASPECT
DEVELOP OUTWARD

USE TIME-TESTED CONCEPTS
IN A NEW WAY

THE ROLE OF "FRIENDS OF ZOOS" PROGRAMME IN CREATING PUBLIC AWARENESS ABOUT WILDLIFE CONSERVATION

RESUME

1) THE ROLE OF ZOOS TODAY

There is an increasing controversy about the purpose of zoos; are they really necessary? Zoos today are an indispensable component of wildlife conservation due to the destruction of forest cover every where. Their essential role is to promote scientific research and public education as well as conservation and breeding programmes.

2) ZOOS: "AN ENDANGERED SPECIES"?

Zoos today are faced increasing difficulties such as rising costs, inefficient administration and acts of cruelty. Government support is not enough; concerned citizens must take the initiative and become involved with their local zoo.

3) FRIENDS OF ZOOS AND THEIR ROLE IN INDIAN SOCIETY

ZOOWATCH is one example of a group of concerned citizens. Our members and volunteers monitor the condition of the animals and also concentrate on improving public awareness about the importance of conservation.

4) CREATING PUBLIC AWARENESS ON CONSERVATION: A MULTIFACETED APPROACH

The systematic guidelines devloped by ZOOWATCH may prove useful for similar groups in the future:

a) SELECTION OF VOLUNTEERS

Only those volunteers may be chosen who have studied the entire Zoo thoroughly and have great tact and patience.

b) ISOLATION OF PROBLEM ZONES

The chosen zoo workers then identify the areas of greatest harassment. For increased effectiveness the work only in pairs.

c) PREVENTION OF TEASING AND FEEDING: A SYSTEMATIC PROCEDURE

The Friends of Zoos persuade the members of the public not to tease or feed the animals. They also strive to instil the awareness of the importance of all wildlife among these people, concentrating especially on the younger generation. The Zoo authorities must also whole-heartedly support the zoo workers.

5) ROLE OF MASS MEDIA

One component of the ZOOWATCH strategy in raising public awareness is the close link with the media. Through

frequent articles or interviews we can influence the maximum number of people.

6) **STRATEGIES OF INTERACTION: COOPERATION OF THE ZOOS WITH VOLUNTARY GROUPS**

All zoo groups should maintain an amicable relationship with the zoo authorities. Criticism offered must be constructive. The zoo authorities should also realize the immense value of such zoo friends and tap their maximum potential for the benefit of their wildlife.

7) **CONCLUSION**

The Indian Government should encourage the efforts of these "Friends of Zoos". Such groups play a mediating role between the zoos and the public and can thus create a greater public awareness about conservation.

THE ROLE OF "FRIENDS OF ZOOS" PROGRAMME IN CREATING PUBLIC AWARENESS ABOUT WILDLIFE CONSERVATION

PAPER FOR THE CENTRAL ZOO AUTHORITY
WORKSHOP ON "INDIRA GANDHI'S VISION
ON WILDLIFE CONSERVATION - ZOO AS
ONE SUCH INSTRUMENT"

29-31 OCTOBER 1994
VIGYAN BHAVAN
NEW DELHI

1) THE ROLE OF ZOOS TODAY

Any conference on the role of zoos in wildlife conservation should actually begin with three very controversial questions: 1) Are Zoos really necessary?

2) Why can we not leave wild animals to roam freely in the forests?

3) Why must we imprison them for the amusement of the common man?

The answer to all three questions is: Yes, zoos are today absolutely essential institutions as important as any university in their role as centres of scientific research and public education of the tremendous urgency of preserving our environment and wildlife heritage. They also function as nuclei of breeding and propogation. In India, as in other developing countries, over population, ignorance and poverty have led us to deplete our forest resources to such a dismal level that it has become almost impossible to sustain any

kind of wildlife population at a viable level. Today where so many nature reserves have been denotified, there are hardly any area free of human intrusion, where animals can thrive without fear of poaching and the danger of possible extinction.

Therefore, the role of zoos is paramount today, in ideal conditions, they are the "safe-deposits" where our precious wildlife can flourish until such time as it is possible to return them to a safe eco-system.

2) ZOOS: "AN ENDANGERED SPECIES"?

A recent article in Time Magazine (June 24, 1991) emphasised the acute crisis that faces zoos everywhere. Increasingly, zoos find themselves caught between wildly spiralling costs of upkeep and increasingly vociferous attacks by animal rights activists who describe all zoos as "prisons designed for the amusement of mindless gawkers".

Another article in India Today (30 April, 1993), titled appropriately "Cages of Misery" listed the severe problems of Indian zoos. The author has isolated 6 basic danger zones:

1) The huge shortage of dedicated and trained personnel eg. lack of full-time vets.

2) Out-dated cages, bad food and negligence.

3) Red tapism and lack of systematic medical care
4) Paucity of funds
5) Political high handedness
6) Constant cruelty inflicted by the public.

One step in the right direction was made by the Honourable Minister of State for Environment, Shri. Kamal Nath, who set up the Central Zoo Authority in February 1991 to bring some order into this confusion and to ensure a better deal for the animals in captivity.

However, as in any healthy democracy, the government ministries can only play a supporting and counselling role. It is for us, the citizens of India, to also become involved with our local zoos, for the simple reason that, in the final analysis, it is the civic duty of every human being to protect these precious storehouses of our natural heritage.

3) FRIENDS OF ZOOS AND THEIR ROLE IN INDIAN SOCIETY

The Indian Constitution, in Articles 48 A and 51 A (g) points out that it is the basic duty of every citizen to protect our environment and to have compassion for every living creature. Today, the increasing awareness of the rapidl destruction of our environment in the last thirty years has had one very important result: the concerned citizen who, in the past would have remained a passive spectator, has now realised that he or she can make a

difference, however slight it may be. Through sincere and committed action, through genuine respect for the rights of all animals to lead a life with dignity, these citizens are now helping to change our society.

From an all-encompassing compassion for animals comes the specific desire to help those animals in captivity. Several such organisations exist today with different areas of activity.

One such group is based in Trivandrum and is called ZOOWATCH. The experiences of this association in pursuing its aim of creating a better Zoo in Trivandrum may prove useful to similar groups in future.

ZOOWATCH was founded in September 1993 as an association of concerned citizens. Our area of activity has two major components.

1) ZOOWATCH functions as a "watch-dog" for the daily routine of the Zoo. Volunteers visit the zoo regularly, especially at feeding times, to check on the health of the animals and the condition of the cages. Any cases of illness, negligence, cruelty or maintenance problems are reported immediately to the concerned authorities.

2) The second focus of activity is aimed at improving public awareness about wildlife conservation. The importance of this

work cannot be overstated as it intends nothing less than the reeducation of the common man for the benefit of future Indian generations - opening his eyes as it were, to the inestimable value and beauty of these wild animals and their special place in Nature.

4) CREATING PUBLIC AWARENESS ON CONSERVATION: A MULTIFACETED APPROACH:

The creation of a specific consciousness in the general public with reference to the role of zoos in conservation is a Herculean task and cannot be approached on a sentimental or disorganized basis. In this context, the experience of ZOOWATCH volunteers and members may provide some valuable guidelines to other organisations, as this task requires a bread based strategy .

a) SELECTION OF VOLUNTEERS

An essential factor, and one which is very often overlooked, is the selection of the workers involved here. A constructive interaction with members of the public can only succeed if the workers themselves:

a) have thoroughly familiarized themselves with the rules and routines of the zoo.

b) can answer moser questions on the life and habits of the individual animals.

In addition, each volunteer must be selected very carefully on the basis of his/her personality. Due to the frequent illtempered reactions among the visitors to any attempt to prevent them from acts of cruelty, the zoo worker must possess immense maturity, patience, tact and firmness in the face of this constant provocation. Losing one's temper implies a gross failure since the person involved will merely repeat the offence elsewhere, no doubt with extra vigour.

A sentimental attachemnt to animals is not enough; only from the basis of an intelligent respect for their rights can the zoo volunteer exercise an educational influence on the members of the public. These efforts must also be directed at the zoo keepers. For many keepers, interaction with a ZOOWATCH volunteer is their first contact with the belief that the animals they care for are living beings, valuable in their own right and deserving of all compassion and protection. From an initial reluctance to get into conflicts with the public, it will soon be noted that the keepers will begin to come to the defence of any animal being harassed, since their protective instincts have been awakened.

b) <u>ISOLATION OF PROBLEM ZONES</u>

Any group of zoo activists will soon come to recognise that, in every zoo, there are specific areas of harassment eg.

the big cat enclosure, or the cages of primates, since these animals, when provoked, will provide the maximum feedback for the entertainment of the public. It is essential therefore, due to limitations of personnel, funds and time, to concentrate on these areas for effective interaction with the public. For increased effectiveness, the volunteers normally work in pairs.

c) PREVENTION OF TEASING AND FEEDING: A SYSTEMATIC PROCEDURE

The zoo volunteers will also come to realise that they are faced with two different modes of behaviour:

1) teasing 2) feeding

The fact that this is a problem not exclusive to Indian zoos is made clear by the founder of Jersey Zoo, General Durrell, when he says:

"Today, in all the more advanced zoos, feeding by the public is forbidden, and quite rightly too. But it is one thing to forbid and quite another to prevent. The average member of the public seems to think that he has an unassailable right in any zoo to do three things without let or hindrance: to scatter litter around him like dandruff, to prod animals with umbrellas and sticks or to throw stones at them in order to stir them up if they are so ill-manned as to be asleep or stationary, and to feed anything in sight that will accept what he has to offer, be it peanut or sugar-lump, lipstick or razor-blade".

The approach to individual members of the public who are teasing the animals must be adjusted according to their age and psychological make-up. In order to prevent teasing, the zoo voluteer must understand it; it is often a symptom of ignorance and high spirits, and not necessarily cruelty as such. For these people, animals behind bars are not really recognised as living creatures with a right to privacy, happiness or dignity; they are merely subjects of entertainment. The average citizen, when prevented from testing, will be more astonished than angry at the attempt to deprive him of what he sees as harmless fun. The frequently heard statement is: "I am only playing with the animal".

In the name of this "entertainment", ZOOWATCH volunteers have, in the last one year, prevented people from prodding the animals with sticks, throwing stones, offering lighted cigarettes, dry cells, umbrellas, trash bags coins or drinking straws, and in extreme cases, from pulling a lion's tail.

Feeding, on the other hand, is an activity indulged in by the majority of all visitors and is often done out of reasons of pity, since most people are firmly convinced that all zoos starve their animals.

The procedure in cases of teasing or feeding has been evolved for the maximum effect and is as follows:-

The ZOOWATCH worker must approach the offender with an air of authority. This is absolutely necessary, as he

otherwise risks immediate rejection, if the offender assumes he is merely another visitor. For this reason, it is advisable for the Zoo authorities to issue very distinctive badges empowering the worker to function under the direct authority of the Zoo Director.

The volunteer must make it clear that such behaviour is unacceptable. Immediately afterwards, the volunteer should explain (i) that each animal has his feelings and must be treated with respect.

(ii) that the value of each animal is immeasurable and that it is an intrinsic part of India's heritage

(iii) that feeding would actually lead to disease and even death for the animal involved.

Each volunteer should, if possible, seek out students or children for conversations since our strategy is oriented towards the future of India. A young person who learns to respect the wildlife heritage of India will become a citizen committed to improving his environment.

For this reason, the Zoo volunteers should speak at least two, if not more languages, with the view of reaching the maximum number of people. Where groups are concerned, it is more practical to approach the teacher in charge and request him to for ten minutes in the zoo and explain these vital facts to his students.

Certain offenders who are not willing to listen must be restrained by threats of repurcussions and the presence of keepers in uniform. In this circumstance, it is absolutely essential that the Zoo authorities should:-

i) clearly recognise the very real danger that this behaviour represents to their charges.

ii) that they are prepared to place security guards/keepers in uniform at key locations in order to back up the volunteers wherever necessary.

iii) that they also train their staff to actively educate the public on the offences of teasing and feeding and on the reverence which we owe to these "citizens without a vote"

iv) that they provide large, multilingual signs clearly listing forbidden practices

5) THE ROLE OF THE MASS MEDIA

Another very important approach to the problem of raising public awareness in the close interaction with the media. Systematic appeals to the public as well as interviews or articles in the mass media (especially before on public holidays) will influence the maximum number of people. For this reason, it is advisable to maintain contacts with selected journalists, TV reporters etc., who will help to raise public enthusiasm for the local zoo.

6) STRATEGIES OF INTERACTION: CO-OPERATION OF THE ZOOS WITH VOLUNTARY GROUPS

To achieve the greatest possible success in these endeavours, it is required that the Friends of Zoos interact as closely as possible with the concerned authorities, from the keepers up to the Director and the Minister. We all have one basic aim in common: to ensure the welfare of the animals in captivity, and to constantly improve their living conditions. For this reason, it is essential that the concerned "Friends of Zoos" work in close co-operation with the authorities and consciously avoid any open conflict. Advice or criticism offered must be constructive, and the zoo volunteers must also comprehend the difficulties of every Zoo director and learn patience.

Similarly, the Zoo authorities should tap maximum potential utility of these active groups for the greatest benefit to the zoo. Istead of seeing them as possible threat, the he should demand constant feedback on matters such as daily routines, maintenance, financing and ideas for improvement. Friends of Zoos represent a valuable resource for any Zoo director, since they frequently have contacts on a personal level in the administration and can use their influence for the benefit of captive wildlife.

7) CONCLUSION

The greatest advantage to the Indian Zoos is represented by the "Friends of Zoos" who seek no other benefit from their voluntary service than a better deal for captive wildlife. At the same time, the greatest threat to these volunteer groups is the slow disintegration of group morale which is basically due to apathy on the part of the authorities and a feeling of helplessness or financial constraints. For maximum effectiveness in raising public awareness on the urgent necessity for conservation, zoo groups need

a) the active, not passive co-operation of the Zoo staff

b) sufficient funding for proposed projects.

A vast percentage of the activities of such groups must be directed towards fund raising. Unlike the developed countries, the involvement and patronage of major companies in India is limited and begrudging. Part of the strategy for Indian Zoo groups must be to arouse the civic interest of such companies in sponsoring projects for their local zoos. However, given the level of bureaucratic involvement in wildlife parks and zoos, the greater part of such funding must necessarily come from Central or State Government.

If the Zoo director wishes to improve his aviary or clean out a most, he must turn to the State Government for PWD aid and money and both are not always readily forthcoming. The

result is that the Director must postpone urgent maintenance work which could be done in weeks for far less money by such "Friends of Zoos". The Director should be able to turn to his local zoo group for assistance in all such matters. For these reasons, the government should ensure the possibilities of financial support for maintenance/development projects which ar worked out by Zoo volunteer groups.

One may ask: Why should the Indian Government encourage such associations?

The answer is thus: Zoos are Nature's banks. From them we draw our deepest reserves for the future of India's environment and from their inmates we learn reverence for Nature in her most beautiful and unusual forms. In short, we can learn from Zoos that wildlife conservation benefits all citizens.

As Indira Gandhi said in her speech at the World Conservation Strategy Conference in Delhi on March 6, 1980, "In his arrogance with his own increasing knowledge and capacity, man has ignored his dependence on the earth and has lost ... communion with it. He no longer puts his ear to the ground so that the earth can whisper its secrets to him. He has cut his links from the elements and has weakened resources which are the heritage of millions of years of evolution - all those living or inanimate things which sustained him and gave

him inner energy: earth, water, air, the flora and the fauna. This loosening of his intuitive response to nature has created a feeling of alienation in his and is destructive of his patrimony. So, while we have to think of conservation, we have also to think whether man himself is growing into a being worth saving".

In the India of today, we must, in order to preserve our heritage, help make man a being worth saving. Between the public and the Zoos stand the Friends of Zoos with exactly this aim - to help awake a new awareness in the Indian citizen about the need for wildlife conservation and by doing so, at some distant date in the future, create a world where zoos are not needed.

...

ROLE OF FRIENDS OF ZOO'S IN PUBLIC AWARENESS FOR WILDLIFE CONSERVATION

In the recent past the idea of public awareness creation was felt widely since the Govt. machinary alone couldn't succeed in protection of wildlives. The forest Deptt. earned a bad name in the public though not as worse as police. People looked down the forest deptt. as their enemy who only denies everything and agrees for nothing. Under such adverse circumstances of ever increasing population and continuous pressure on forests the efforts of the department is laudable since it is able to protect the entire land and real forest still up to at least 12%. Forest deptt.'s attitude of staying away from the public has largely been responsible for not being able to convince the people of the indirect benefits that they get from the forests. The hacking of the forest and the wanton killings of the wild animals resulted in a large chunk of forest being converted in to scrubby, barren mass of lands.

The demand for hydroelectric energy, thermal energy and various minerals for our industry has been in continuous conflict with the goal of wildlife (plants animals) conservation. Even the people of the higher echelons of the society has till now not been able to understand this reality and continuous paper fight goes on amongst various departments. It is not wise to blame the poor, downtrodden and illiterate mass of our society for destruction of the wildlives since their entire means of livelihood is dependent on the forest.

Contd...P/2

Lately it has been felt that the people of all strata of the society have to be made aware of the grim future so that the Govt. sponsored programmes do not get step sisterly look from the people. We the people are aware of our rights but conveniently we forget our duties and beyond our right we exploit our own nation least realising our children will be buried in the same graves. We may see the graveyard after we die but our children may be buried alive for the undoing of ours.

To end the hostile attitude of the public towards conservation efforts creation of public awareness has become the need of the hour. The resources we lose in maintaining the Zoos and the torture to the animals harped upon will be successful if the positive reaction can be initiated amongst the public so that our vildlives in their natural habitat would flourish.

Who is to be made aware of :

The term public awareness is very broad to think of or act upon. There are all total six groups of people those who are largely responsible for the damage done to the wildlives.

a) Some influential persons or their relatives.

b) Some local political leaders.

c) Local rich zamindars.

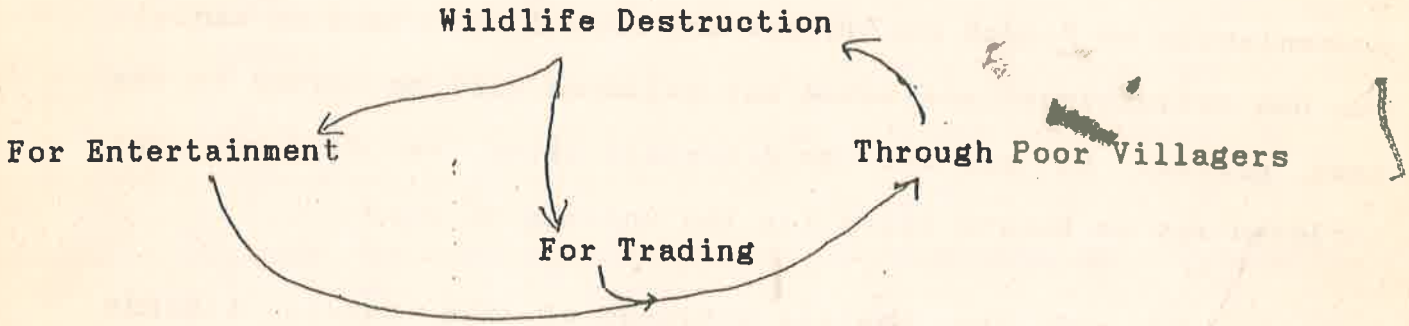
d) Wild life traders.

e) Villagers ... or near the forest.

f) Corrupt officials.

Contd...P/3

This is done mainly due to two reasons : Enternainment and Trade. The rich people mostly come under these two categories.



But on their own they can not enter into the forest and cause damage to the wildlives without active support of either the corrupt officials or the local people who reside in or around the forest. Even the corrupt officials ultimately exploit the poor residents of the forest for this dastardly act. They are allured into this job by paying them very meagre amount of money. Least understanding the calamity behind the stage, for paltry sums the poor is bent upon damaging the nature's palace. So, largely our target persons are rich people and poor people. Very rarely middle income groups indulge themselves in such activities.

Why residents of forest form the core group for destruction :

Largely four causes are visualized for the involvement of residents of forest in such nefarious activities.

i) For small incomes

ii) To reduce damage to their crops by the wild animals

iii) To perform age old rituals (true for most tribals)

iv) Illiteracy.

Contd...P/4

As it is, the sources of income for the people living inside the forest is very limited. ?Effect of industrialisation or developed agriculture has not reached them. Their landed property is very less and that too the land in mountains suffers from low fertility. The only recourse for them is to cut tree or kill wild animals for whatever money they could earn.

Their crops are also the first targets for the elephants, deers, bears etc. That also breeds hatred against the animals. Inspite of the advanced techniques developed to check this, even 10% of the affected crops have not yet been protected.

Indian society still continues to have many age old customs which have become irrelevant now-a-days. This is more in tribal areas. The age old practice of mass hunting in particular days of the year & Jhoom cultivation are still practised. The local leaders also try to encash it politically since the Govt. has put a ban on hunting.

The fourth but major reason for all the above three is the highest level of illiteracy in the forest villages. So they are always carried away by the emotions and sentiments induced to them by vested interests.

Target persons for motivation :

By now it has become clear that which type of persons are responsible for the destruction of the wildlives. To be more

Contd...P/5

explicit in our approach for a better formulation of strategies the target groups for our purpose are as below :

a) Lower ranking Govt. officials of all departments working in the forest areas plays a major role in it. Since the field level officers come in close contact with various types of people they can play a major role in it. The officers or employees of their department do not feel any responsibility regarding saving the wild lives. At times they instigate the low level leaders or villagers to be indulged in this lucrative profession. So proper motivation is needed urgently.

b) Local leaders, village school masters, village school children, village women and lastly village men folk can be our subjects of interests. Creating public awareness in this needs constant and regular effort. Here come the friends of Zoos who can contribute a lot in these areas.

Why Friends of Zoos ?

Why should we invite a third party for this job of ours. The basic assumption we have taken in that we, as governmental bodies have failed in it.

a) People have a general aversion towards such activities done by Govt. officials since mostly they see the

Contd...P/6

officials from the negative angle. It is difficult to break this biasness now. People also take it casually if govt. officials go in motivating since they feel that it is part of their duty only, no moral obligation is involved in it.

b) There is inadequate motivation in Govt. officials themselves. Generally Govt. employees do the minimum possible of their assigned duties. There is also a tendency to stick to the old pattern of only punishing the guilty. That also is not done properly due to various types of pulls and pressures. In a situation where self motivation in the department is lacking it is infructuous to expect them to be motivating agents for others.

c) Conservation of nature has also become a fashion for the upper class society, since their day to day needs are not based on this. So generally their speeches go unheard of by the lower level people. The rich also do not have the innate wish to go to the local people or solve their other problems. That is why only round the table conferences have not yielded much result in this area. So it is a fact that Friends of Zoos can contribute largely to this area provided minimum back up is given to them.

Contd...P/7

Who can be the Friends of Zoos ?

Anybody who has the right love for animals and plants having the wish to spare some time & energy in their conservation can be the friends of Zoos for our purpose. It is the Zoo Director who can play a lead role in creating the friends of Zoos.

Role of Friends of Zoos

They can help motivate our target groups in following ways :

i) By talking directly to the target persons. By making their children friends of Zoos. They can interact with school children in forest areas and involve them in conservation efforts.

ii) By taking the School children to forest areas regularly as part of their education trips, School children of the small townships adjucent to forest areas should be involved in these programmes. Nature camping motivates them more.

iii) By conducting appropriate contests for school and college students such as nature paintings, nature photography, etc. by the friends of Zoos. More of these contests relevant to the economic conditions of the children should be carried out in forest areas.

Contd...P/8

iv) Cleaning of Zoos at regular intervals by the friends of Zoos will have great impact on the visitors psychology. They also develop attachment to the nature subconsciously.

v) Friends of Zoos at regular intervals can come to the Zoo and move around the cages to request visitors not to tease the animals. This can be done during holidays.

vi) Wildlife paintings and photographs should be displayed by the friends of Zoos in the form of exhibitions or in any other manbner in important places like schools, colleges, lounges of hotels, Railway platforms, Airport lounges etc.

vii) Friends of Zoos can work in nurseries for plants themselves so that they can make other children know about this.

viii) Children of railway authorities, airport authorities, cargoship authorities, custum authorities should be involved in all these programmes as far as possible so that their parents get the positive feed back which is very effective in motivating the adults.

ix) Friends of Zoos can influence people in disuading them in hunting by organising rallies in the effected areas. In Danapur cantonment areas this has shown good result in protecting openbilled storks from being killed.

Contd...P/9

x) Nukkad dramas (street side drama) organised by the friends of Zoos have greater impact on the village people rather than telling them directly not to destroy wildlives.

xi) Rare plants & medicinal plants exhibition conducted by them also serve the purpose to some extent by generating interests in plants.

Experience in Patna

There are 3 organisations in patna we can call friends of Zoos. Those are Ecotask Force, Taru Mitra and Save International. Their efforts in this regard is praise worthy. The different programmes conducted by them in practice are outlined above. It is never a theory only. These are already practised here in small scale. The total No. of students (schools & colleges) involved in these programmes is approximately 2000.

What the Govt. should do in this regard ?

1. General knowledge test regarding wildlife conservation should be a compulsory part in all types of tests for recruitment in to all kinds of employments in Govt. and Private sectors.

2. Plant and animal conservation effort should appear in the ACRs, evaluation reports or service books for all grades of employees & officers in all services.

Contd...P/10

3. Officers in management grades of defence and police department should have short term training courses on wildlives conservation.

4. For all sorts of relevant seizures part money should be given as incentives to who soever has done it or helped in doing it including local villagers.

5. Education programme should be made a compulsory part in Zoo management. All these would ultimately help in motivating the public for wildlife conservation.

What should the Zoo Directors do or learn to do to motivate the friends of Zoos ?

For all these programmes done by the friends of Zoos the Zoo Directors have to play a vital role in it. Because motivation of the friends of Zoos entirely depends on the Directors. The education programme should be based on proper learning and communication methods.

Study on learning has shown that out of 100% learning the following functions can achieve as follows :

Taste	-	1%
Touch	-	1.5%
Smell	-	3.5%
Hearing	-	11%
Sight	-	83%

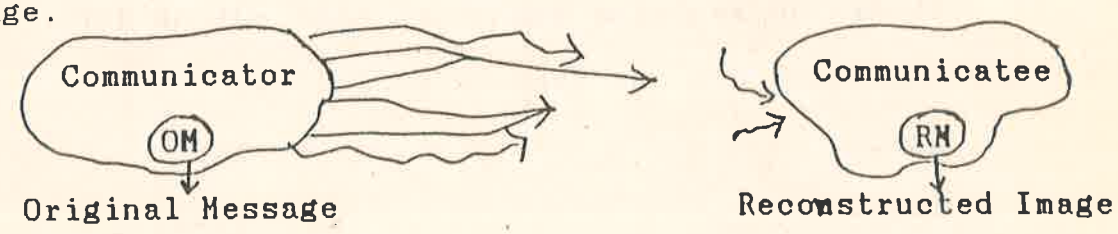
Contd...P/11

So Zoo Directors should show the friends of Zoos the real day to day work that we do in the Zoos for animals and plants. Once learning process ends then to know how much is retained in their memory test practice has to be conducted. Study shows the retention percentage for the following processes.

Reading	-	10%
Hearing	-	20%
Seeing	-	30%
Hearing & Seeing	-	50%
Saying	-	70%
Saying & Doing	-	90%

From this it is quite evident that after showing them the details we should let them do the job to some extent as far as possible e.g. let them clean the enclosure and say why certain procedures are followed.

Director or the Officer-incharge of the education should be a good communicator to ensure proper communication of the message.



There may be wide gap between the original message and the reconstructed image depending on the mode of communication and various other factors.

Contd...P/12

a) As it is words communicate very little. The signage, the live examples and proper mode of expression conveys the message better.

b) The Director should be a skilled communicator who should be not necessarily very fluent in certain language but onw who can put up the right mix of verbal and nonverbal symbols appropriate for each group.

c) Lack of interest in the communicator may create negative motivation in communicatee.

d) Stereotype thought regarding others (e.g. the communicatee) communicate very poorly.

e) Distractors play great role in poor or miscommunication.

f) The Directors also should take into account the cultural differences amongst various groups. The children of cities, of villages and forest villages have different thinking in their minds due to variations in culture and situations. So for different groups different modes of communications should be applied.

Once we are able to create real friends of Zoos then the rest of their duties are automatically taken care of.

PRAKASH CHANDRA MISHRA
DIRECTOR,
SANJAY GANDHI BIOLOGICAL PARK,
PATNA.

Abstract

FRIENDS OF ZOOS AND WILDLIFE CONSERVATION

I recall the words of Chief Seattle (1854) "If all the beasts were gone, we would die from a great loneliness of spirit ..... All things are connected whatever befalls the earth befalls the children of the earth. Hence there is an urgent need to educate the public about our heritage and the ways to conserve it for the generations to come.

If every living being loves freedom and wants to live in its natural habitat why keep snimals in captivity - in 'Zoos?' and what is Zoos' role in wildlife conservation and how do we tell the public their purpose. Most of the people visit a Zoo for a picnic and during their spare time take pleasure in teasing the animals, feed them with odd things and often cruelty towards these animals is seen rather than appreciation and love.

The Eco Task Force, (ETF) a Student Body of Patna Women's College works for environment protection through its various avtivities. In everything that the members do, they keep in mind the objectives such as

Awareness,
Knowledge,
Attitude,
Skill,
Evaluation ability, and
Participation.

For the past two years the members have taken active part in building in themselves love for animals in our Zoo (Sanjay Gandhi Biological Park, Patna). Often field trips to Zoo were arranged. Animal feeding and care was demonstrated and behaviour was explained. Their presence in the Zoo made the public ask "What's on today?" The curiosity itself was enough to create awareness that animals in the Zoo are for appreciation.

The E^{TF} members, are now rightly can be called the 'friends of Zoos'. Keeping their objectives in mind they conducted a public awareness programme about wildlife conservation, through "Spot Zoo Photography Contest" which was unique to Bihar, and may be even to the Nation, on 20th March 1994, at Anj Sanjay Gandhi Biological Park, Patna.

It is through the medium of photography, ETF sought to inculcate in the public, an attitude of appreciation towards beauty in wildlife. All the Amateur photographers after observing the animals for almost 6 hours were completely changed

in their attitude and behaviour. Similar response was received at the exhibition of these photographs.

All our activities at the Zoo have been joyful and useful for us and for the public because of the magnamimous nature of Mr. P.C. Mishra, Director, Sanjay Gandhi Biological Park, Patna. He has remained open to educational programmes at the Zoo and has actively participated in innovative experimental methods.

As 'Friends of Zoos' we plan to do many more activities to create public awareness in wildlife conservation. Our next move will be 'Philately and Wildlife'. We want to capitalize people's interests and Hobbies as means to create love for wildlife and to prevent cruelty to animals by the public specially at the Zoos.

- Dr. (Sister) Doris D'Souza, A.C.
President
Eco Task Force
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BIHAR.

Paper for Presentation.

FRIENDS OF ZOOS AND WILDLIFE CONSERVATION

Being an Ecologist, one day in my wildest dream, I was lost in fantasy, and I saw in a thinnest jungle, wild animals were discussing their future. One asked the other - Do you think we will have a home to live in the future? Pat came the reply, - 'May be in the Zoos'. And I recall here the words of Chief Seattle (1854) "If all the beasts were gone, we would die from a great loneliness of spirit ... All things are connected whatever befalls the earth befalls the children of the earth. Hence there is an urgent need to educate the public about our heritage and the ways to conserve it for the generations to come.

If every living being loves freedom and wants to live in its natural habitat why keep animals in captivity - in 'Zoos'? and what is Zoos' role in wildlife conservation and how do we tell the public their purpose. Most of the people visit a Zoo for a picnic and during their spare time take pleasure in teasing the animals, feed them with odd things and often cruelty towards these animals is seen rather than appreciation and love.

The Eco Task Force, (ETF) a Student Body of Patna Women's College, works for environment protection through its various activities. In everything that the members do, they keep in mind the following objectives:

1. Awareness: To acquire an awareness of and sensitivity to the total environment and its allied problems.
2. Knowledge: To gain a variety of experiences and acquire a basic understanding of the problem.
3. Attitude : To acquire a set of values and feelings of concern for the environment and the motivation for active participation in environmental improvement and protection.
4. Skill : To acquire skills for identifying the problems and to seek solutions.
5. Evaluation ability: Evaluate environmental measures and education programmes in terms of ecological, economic, social, aesthetic and educational factors.
6. Participation: To provide an opportunity to be actively involved in the related problems.

For the past two years the members have taken active part in building in themselves love for animals in our Zoo, (Sanjay Gandhi Biological Park, Patna). Often field trips to Zoo were arranged. Animal feeding and care was demonstrated and behaviour was explained. Their presence in the Zoo made the public ask "What's on today?" The curiosity itself was enough to create awareness that animals in the Zoo are for appreciation.

The ETF members, are now rightly can be called the 'friends of Zoos'. Keeping their objectives in mind they conducted a public awareness programme about wildlife conservation, through "Spot Zoo Photography Contest" which was unique to Bihar, and may be ever to the Nation, on 20th March 1994, at Sanjay Gandhi Biological park, Patna. Many of the participants of Spot Zoo Photography Contest 1994 have rightly questioned "In what way Zoo education connected with photography and how does photography help in "Wildlife Conservation". The awareness was already created even before the contest started. People started thinking and questioning about the problems - Isn't that an awareness already achieved?

It would have been very easy to arrange for a lecture on "the importance of Zoo in Wildlife Conservation". But the Eco Task Force is looking for newer avenues to tap the latent talents in youths of Bihar, to awaken the sense of responsibility towards the Earth and all its inhabitants, veneration for the Creator, through harmony with creation. It was found apt therefore to give a call to the amateur photographers, to exhibit their skill and creativity in capturing animals at the zoo on film. Though these animals are kept in captivity for the urban man, they still exhibit their emotions, feelings and are sensitive to human interference-love or harassment. This has been the experience of all the participants while they patiently waited for a best pose. It is through the medium of photography, ETF sought to inculcate in the public, an attitude of appreciation towards beauty in wildlife.

To quote just three evaluations out of ninety two participants "The programme was highly beneficial to me. I came to know various behaviour and moods of animals and birds. I began to love animals more than before. I came to know that they also act and react like men. They also have emotions and can feel both joy and sorrow, so one should not try to hurt them but should be friendly with them". "I got the opportunity to visit this place many times earlier but I had seen the animals without any interest. I came here just for the sake of fun and pleasure. But today I experienced a pleasure from the core of my heart. The photography contest 'Shoot to Save' held by the ETF of Patna Women's College gave me a real chance to appreciate the beautiful Creation of God. While writing my experience the saying of great saint Arubindo comes to my mind. "A man becomes great if he learns to appreciate the creation of the Almighty but even greater he becomes when he, his mind and his heart, is filled with love for them." I am just unable to find exact words for expressing my feelings towards the animals now." "It is for the first time in our Capital, the Eco Task Force is organising this eventful photography contest. It is very useful for the youth of this Capital because it motivates us to do something for our environment as

wildlife. In our country there is great need for this type of work (Environment protection) because every day our environment becomes more polluted. In the field of photography there is a wide area and certainly we can do something special when Government provides us this type of opportunity and facility".

There were 92 entries by 19th March and no entries were accepted thereafter. If all the entries had been accepted the number would have exceeded 150. Along with the participants there were relatives, friends and the onlookers who had come to visit the Zoo. All the Amateur photographers after observing the animals for almost 6 hours were completely changed in their attitude and behaviour. Their words of appreciation and beauty in the wildlife were consoling to know that we have achieved our purpose. This awareness campaign didn't end here. An exhibition of all these photographs was organised. People ~~were~~ expressed their astonishment while going through the exhibition that one (now) has to believe that our Zoo is really beautiful. People thronged to see the exhibition, which remained open for public for a week. The Director of the Srikrishna Science Centre extended his full co-operation.

All our activities at the Zoo have been joyful and useful for us and for the public because of the magnanimous nature of Mr.P.C. Mishra, Director, Sanjay Gandhi Biological Park, Patna. He has remained open to educational programmes at the Zoo and has actively participated in innovative experimental methods.

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- Dr. (Sister) Doris D'Souza A.C.,
President,
ECO TASK FORCE,
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Bihar.

Providing Guide Service for Zoo Visitors

-S.K.Patnaik,
Director,
Nandankanan Zoo.

RESUME

Gradually conservation education has assumed very high order of priority for Zoological Parks of the country in place of recreation and amusement. In order to fulfill this objective, oral communication is much more effective than any written communication in the form of signages as visitors often tend to ignore them due to want of time and due to high degree of illeteracy and language barrier. Engaging registered guides with fixed charges with a short training on zoo animals has been found to be quite effective in educating the visitors for last seven years in Nandankanan Zoological Park. This has also reduced zoo vandalism by the conducted tourist groups as the guides remain responsible for the conduct of individuals in his or her group. Even the tour operators guides, who have been registered and trained and are only allowed to enter the zoo as a guide. This has also reduced littering the zoo premises by tourists and they prevent use of radios, tape recorders etc.

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COORODINATION OF BREEDING PROGRAMME FOR ENDANGERED SPECIES.

S.C. Sharma

It has been a common practice in zoos to breed the animals that are least aggressive and easiest to handle. For the sake of convenience the young ones of the same litter are kept together and allowed to breed. This brother sister breeding obviously reduces the genetic variation and essentially leads to unintended domestication.

The importance of genetic variation, had been clear for much of this century. It is important at two levels- the population and the individual. Within population, genetic variation is the basis for change. When environment changes, a population must change equally as fast, or become extinct. How rapidly a population adapts to the changing environment depends on how much genetic variation it contains. If there is none, it cannot adapt at all. There is a second way in which genetic diversity may be important to populations. Genetic differences between individuals may allow them to utilise slightly different resources. Thus reducing competition, they would allow a larger size of population and probably improve stability of numbers. The magnitude of this is still not known.

On an individual level, genetic variation-or heterozygosity-is related but not identical to the genetic variation in populations. Both decline with inbreeding. In small, close populations - such as many existing zoo populations - some inbreeding is inevitable; in most respects it has been found to be individually harmful. The decrease in genetic variation generally leads to loss of 'vigour' and reduced vaibility, growth rate, fertility, fecundity, lactation and competitive ability. Damage is detectable at various levels of inbreeding and published reports show deleterious effects at inbreeding coefficients of 0.25 to 0.75 (0.25 is the amount of inbreeding from a brother-sister mating).

Laboratory tests have shown that most of the small populations which are excessively inbred can become extinct rapidly. Attempt to produce lines of laboratory animals by brother-sister matings results in about 95% of cases in extinction. The slower rate of inbreeding causes much less damage as selection has an opportunity to counteract the deleterious effects of inbreeding.

How do we conserve genepool?

Basic prerequsites for any conservation programme should be the founder population. A founder is defined as an animal from a source population (wild) that establishes a derivative population (in captivity). To be effective, a founder must reproduce and be represented by descendants in the existing population. Technically to constitute a full founder, an animal should also be unrelated to any of other representative of the source population.

Basically the more founders, the better it is. More the number of founders, smaller the minimum viable population required for maintaining genetic diversity. There is also a demographic founder effect. Larger the number of founders, less likely would be extinction due to demographic stochasticity. However it is easily possible to establish a viable population of a specie, if the programme starts with 20-30 effective founders.

Scientific population management would consists of mating the least related animals with each other for each succeeding generation. Any breeding programme that starts with 20-30 founders under the ideal breeding scheme of this kind would preserve atleast 90% of the genetic diversity for 200 years,(provided we can build up a genetically and demographically viable population). This fact is illustrated by the studies done by various geneticists (Fig.1).

Equal number of offsprings from each founder pair has additional advantage. Equal number of offsprings or equal family size, means that no animals breed in preference to another - in other words that all animals make an equivalent contribution to the next generation. In a population which is expanding, each individual might, for example, be permitted four offsprings in a stable situation, management strategy would ensure that it had one young that reached the reproductive age. Not only does this approach help minimise inbreeding but also slows unintentional domestication. By equalising offsprings numbers, the trend towards domestication is significantly modified, and the capacity of the species to adapt to wild habitat is preserved.

The second aspect of population management involves maintaining an effective population size, designated as Ne. Ne is not the same as the census size, N. Ne is the effective number of animals that are reproducing and transmitting genes to the next generation. Ne is usually much less than N. This means that founders should constitute an equal family size and to keep the value of Ne at optimum level, each founder should contribute to future generation equally. Ideally each family should have an equal number of males and females. A population with an even (1:1) sex ratio would preserve nearly twice as much genetic material as a population of similar size with a sex ratio of 1:5. For numerous management and behavioural reasons, however, the sex ratio of breeding animals often deviates widely from theoretical ideal.

To avert the consequences of rapid inbreeding and intensified artificial selection resulting from a highly unequal distribution of offsprings between the founders, would require conscious practice of management techniques, such as the rotation of males which will redress the balance.

The third aspect of population managenment would be to maintain longer generation time. As generation time is the average age at which animals reproduce, with a longer generation time the species would have fewer oppurtunities to lose genetic diversity. As a consequence the minimum viable population (MVP) can be smaller for species having longer generation time.

Thus if reintroduction is to become a reality, a vigorous, geneticaly diverse population that is minimally adapted, both genetically and behaviorally, to captive conditions will be required. The optimum plan for achieving a population of this calibre might be constructed along the following lines:

1. Begin with as large a founder group as permissible; its sex ratio should be approximately even.

2. Expand the founder group to maximum captive carrying capacity as quickly as possible, ensuring equal family sizes and breeding all available animals.

3. Select pairs for mating wherever possible in accordance with the maximum avoidance of inbreeding scheme.

4. Rotate males as necessary to meet social criteria for reproduction while at the same time equalising male breeding potential.

For achieving the objectives mentioned above the first requirement is stud book data in respect of all endangered species. On the basis of stud book data suitable founder animals can be identified. Depending upon the founder animals the target population or the minimum viable population can be worked out.

Before starting the actual breeding programme knowing of the carrying capacity of different zoos for the species will have to be determined, and such institutions which have capability for carrying out the programme in planned manner will have to be identified.. Any institute where there are chances of genetic pollution should be kept out of this programme.

The species coordinator will have to monitor the births, deaths of animals regularly and ensure that the population is growing at the desired rate. If there are any problems arising, help of experts in assisted reproduction should be taken. Any animal that is in excess of the required sex ratio should either be transfered to a participating institution or taken out of the programme and sterilized.

EDUCATION AND INTERPRETATION IN ZOOS

Human attitudes towards nature and wildlife have evolved through the ages. Zoological parks are undergoing major redevelopment and change. The mission of Zoo is rapidly shifting from popular entertainment to conservation of management of rare & endangered species education & interpretation & research. In the past collections of animals have kept for several reasons as symbol of wealth, power, recreation, zoological interest, for public enlightenment such as 'Center of intelligence' created in China before 1,000 B.C. Although we know a little about it the name suggests that the educational potential of captive animals was recognised in that period too. Even Greeks & Romans collected animals in Zoos for study and students were taken to these zoos as part of their education. In 15th Centuries zoos sprang up in India.

Though Zoos are the most convenient place to gather knowledge about animals modern zoos are relatively underused as a resource for education & interpretation, but increasingly aware of the resources and information they keep within their gate. Infact conservation & education are closely intertwined.

To conservee wildlife in the long term we need the help of an informed and caring public, so education is the key. Public education is a relatively new activity in Indian Zoos. Lakhs of people visit zoos every year, attracted by the opportunity to see animals at close quarters not only diversity of exotic species but also rarely seen native species. We have the opportunity to influence public attitudes to enhance their understanding and appreciation of wildlife to interprete the factors

Contd....2

that threatens the survival of animals & their habital & to convey zoo's role in conservation & research. Zoos should provide 'recreational education' where animals become the entertainment hooks used to put-across the important message and there is a need for casual visitors to be able to relax between experiences.

The role of Zoo education should be -

- To provide an educational experiences for all visitors
- create respect, empathy & positive feelings for all visitors for wildlife.
- To teach conservation ethic.
- work as centres of ~~interests~~ network to mobilise human resource for support & conservation.
- focus attention or threatened species and environmental awareness first locally which leads to global concern.
- provide education at different levels of visitors e.g. community, schools, university, adults teachers, youth groups, literate illiterate etc.
- to carry out curricular & cross curricular educational resources in the life science, conservation biology and arts, geography, history, english etc.
- to organise programmes according to target groups (pre primary, primary level, secondary, senior secondary, adult, literate, illiterate, disabled & mentally retarded persons etc.)
- to establish friends of zoos' club.
- to collaborate in the training of keepers.
- to conduct outreach programmes to target distant populations.
- to participate in the selection of animal species on the planning and designing of animal enclosures.
- to establish in service teachers workshops and strong relationship.
- with local educational Institution.
- to make good interpretive signages to create positive attitudes, to publish zoo guides, brochures postents etc.

Contd....3

- to organise interactive sessions with NGOS, seminar workshops, on zoos inviting field and resource persons.
- to develop practical teaching method, and strategies.

Zoo educators has a major role to "turn through strangers into visitors, visitors into participants and participants into believers."

To organise press days and conferences to see 'what goes on behind the seenes' followed up by radio and TV broadcast, newspaper articles and so on on success and projects of the zoo.

Approaches -

Zoo education is a life long process & can be achieved in different ways but the concept that influences is- learning by doing, learning by discovery and learning by participation. Zoo is a didactiloogy more or less formal and informal education to visitors. A cross-section of multilingual visitors urban, rural, young, adult, literate, illiterate, small & large groups, VIPs, journalists etc. disciplined & vandals visit Indian zoos keeping in mind about quantity & quality of visitors the educative & interpretive programmes has to be designed carefully to attract the interest & attention of general visitors unless "education fails to motivate". The target groups should be categorised as organised/unorganised visitors. The key target groups and(1) decision makers, (2) technicians, practitioners & professionals and the(3) visiting public

Organised groups are Pre school, elementary, secondary teritory, scouts, teachers, researchs, vets interness, trainees fron forst school & colleges groups with special needs such as blind, handicapped etc. The rest comes under unorganised groups.

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We should lay more emphasis on the last groups & basically children because attitudes about wildlife are formed at a very age. Designing pregranes for young people are crucial to influence their attitudes. Childrens are choosen to interactive devices.

As in western zoos the Indian zoos should focus on school groups, they are diverse from casual visitors. Though it is not feasible in the zoo to study the whole science curriculam in the zoo, the teachers can make use of the zoo resources which can provide information, facts about environment, animals, their adaptations and zoo educators can provide support to teachers to link zoo education with Schools curricular. Zoos provide opportunity for cross-curricular work such as- Science, language, maths, geography art etc. A veristy of learning ' tricks' can be used such as games, drama, resource parks, hands on experience, ecological role play, etc.

Non visiter oriented education is another purpose for zoos. The zoos should give encouragement to student to use zoo for their thesis topics which will be interesting for P.G. students & helpful for zoo management. The research & project may be on diverse subjects like, behaviour behavienr, reproduction diet enclosure , visitors attitudes education programme, interpretive signale, etc. Biology students come for field study in the zoo should be taken around for detailed lectures & briefing should be done with slide shours. Veterinary colleges should introduce intervaling course (atleastfor a month) to make work with zoo animals, their disease & treatment. Though wildlife causes courses are introduced in some veterinary colleges still we have a long way to go.

Contd....5

Training for zoo p keepers in animal management. Most zoo keepers are uneducated and even unmotivated. To motivate the training should be oh local language and hand arts on personal hygiene, sanitation, animal restraint, safely and how should they behave with public should be distributed.

Slide shows, animal fitness & lectures workshop, meetings should take place in interpretation centre/lecture halls. The zoo library exhibits, reference books, journal, publish zoo research thesis etc. In this centres we can use volunteers to provide information. A special telephone line for public enquiries about animals should operate in the centre or library. The "touch tables" of confiscated items of wild life are displayed for visitors to "touch & feel" and get the message of conservation. Different slogans and labels can be used for touch tables.

Interpretation is not same as information. Interpretation is revelation based on information which create a mental impact or link between interest & information. These interpretation should be informal, concute & appealing & needs focus on only visitors should care about vanishing WL Mo. It should be based on what people see in the enclosures & maintain the connection between the actual experience and the message. Guided tours, animal handling signage, cabels, educational packets, worksheets, theatic zoo publications are some medium of interpretation.

Zoo signs & labels are one of the important aspect of zoo education, should be integrated & responsive & sound concentrate on what the visitors can actually experience. There are some categories such as

1. Exhibition of habitat signage.
2. Specimen label.
3. Directional signage
4. External identification of the Zoo.
5. Changeable signage
6. Statutory signage etc.

Contd.....6

There are written communication devices that replaces human interpreter. Graphics for illiterate should design so that they glean some information from it within sketch talk. In education we should lay to involve illiterate people from rural area which will prove in zoo education.

Animal enrichment can be used for interpretation dispenses of fruits, honey, termite, playing tools, rope, dry tree branches are all good focus points for interpretation.

Zoo publications like guide book, guide maps, zoo magagine, worksheets, posters, stickers, brochures etc. are essential medium of zoo education. In the information centre these publications should make available for public. The centre can provide information about zoo & activities also.

In India visitors misbehaviour and vandalism are common phenamenon in zoos. As it is not possible to orient & educate everyone before the visitors teasing emotional megsages on zoo boards (moral approaches) why they should not feed or tease animals & litter zoo premises may be effective for misguided visitors. To confront the problem again we need planning for other kind of programme. Theatrical & costuming performances is another foot to illustrate and inform conservation message. It is entertaining understandable & fun. The mask can be created in the education centre by students and design a skit utilising the works. Through skits messages about conse will be delivered. Animal handling programme is another tool where small live tame animal can be used to affect attitude in visitors specially school children. It encourages observation skills as well as language skills. Living interpretation is another method to introduce cultural & natural heritage of the area. Such interpretations

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on forest based items, handicraft may be done by imperative labels applying good display technique (zoo museum). Zoos can develop programmes around events like zoo day, environment day, Republic day, Wild life week etc. can collaborate with other organisations as nature clubs, schools etc. In India most zoos observe wildlife week & organise painting competions amongst the students and public meeting.

Working with media :-

Zoo in developing countries like India rarely have public relation officers establishing a good relationships with the press is extremely important which helps to convey good news and defuse troublesome situation like tragic events in the zoo. Changing public opinion and establishing zoo's image can be done using national, state & local press alone. Education department in zoo have a role to play.

The scenario of Indian zoos.

It has been observed that in recent time many leading Indian zoos have come up with education programmes. Anna Arignan Zoo, Nandan Kana Zoo, National Zoo are few to mention. As our zoo policy mentioned to have conservation oriented educational programmes where apart from forest officials participatione of NGOs and individuals are encouraged. In above mentioned zoos they organise training for animal keepers, projects for student of wildlife Biology. Animal welfare fortnight, world environment day etc. In Assam State Zoo non visitors oriented programmes are there. The college of veterinary science has introduced one month course on wildlife for the internees, they work with zoo animal, their diseases & treatment Trainees from Rangers College, Forest School from different parts of the country come to the zoo every year to learn about wildlife manage[illegible] Biology students come for their

fieldtrips where they get bringing about wildlife. Many ~~reasea~~ research & project works have been done by P.G.Students from veterinary college & university in last four years.Every year on spot painting competition is organised during wildlife weeks.This year scouts have come for educational activities and co-operate with zoos regular cleaning activities.After that a lecture is given on certain topics.Though zoo education is a challenging subject the potentiality is enormous. Economical educational project is a must and every zoo should take a pilot project & ~~educakexka~~ evaluate to determine the effectiveness of the project. To be success~~fu~~, education department should have equal status to all other wings withing the zoo and should be adequately funded & equipped in terms of staff,materials & accommodation.

Finally, where conservation is the end goal, then education is crucial.Whatever a zoo's main aim education can aid the achievement.Education is a major zoo mission because conservation will have to be "for the people by the people".The Indian zoos are marching ahead with its mission for the cause of wildlife.

Rajashree Sharma.

Corrections.

The role of Zoo education — Point-no-7(Curriculum)

Point No.-13-Relationship with local institution should include in the point -No-13 insted of point no.14.

Page-3	Para-4(Approaches) 4th line Zoo is a didactic tool and offersmm more or less.		
Page-3	last para	first line	non visitor.
		7th line	signages
		10th line	shows
		11th line	Internship
Page-5	4th para	3rd line	concrete
page-6	1st para	4th line	big sketch talk.
	2nd para	2nd line	dispensers
Page-7	2nd para	7th line	put"here" before education.
Page-7	last para	10th line	put"basically"before non visitor.
Page-7	Continuing para from last page(2nd line)		Informative instead of imperative.
Page-8			

Please include the following sentences in the 9th line af after"Certain topics"

The interpretation centre is there to facilitate Public,students, conservation communities with great deal.The centre has a strong audiovisual backup to organise educational activites,Seminers, workshops etc.

Thankyou.

R.Sharma.

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