2015

Status of Zoos in Bangladesh and their Potentialities for the Conservation of Biodiversity

Uddin, Mohammad Farhad

University of Rajshahi

Status of Zoos in Bangladesh and their Potentialities for the Conservation of Biodiversity

A Thesis Submitted to the
Institute of Environmental Science
University of Rajshahi for the Degree of

Doctor of Philosophy

By

Mohammad Farhad Uddin
B.Sc. (Honours) in Veterinary Science
M.S. in Pharmacology

Institute of Environmental Science
University of Rajshahi
Rajshahi-6205, Bangladesh

June, 2015

Dedicated

To my
beloved parents, brother and sisters

DECLARATION

I do hereby declare that the thesis entitled "**Status of Zoos in Bangladesh and their Potentialities for the Conservation of Biodiversity"** submitted to the Institute of Environmental Science, University of Rajshahi for the award of Doctor of Philosophy in Environmental Science is the results of my own experimental research work under the supervision of Professor Dr. M. Nazrul Islam, Department of Zoology, Univesity of Rajshahi.

I further declare that this thesis or any part of it has not been submitted to any other University for any degree or diploma. To the best of my knowledge and belief the contents or part thereof the thesis was not published previously by anyone except due reference is made in the text whenever needed.

Mohammad Farhad Uddin
Ph.D. Research Fellow
Session 2009-2010
ID No. 09105
Institute of Environmental Science
University of Rajshahi
Rajshahi, Bangladesh

Department of Zoology **University of Rajshahi**
Rajshahi-6205
Bangaldesh

CERTIFICATE

This is to certify that the thesis entitled "**Status of Zoos in Bangladesh and their Potentialities for the Conservation of Biodiversity"** submitted for the degree of Doctor of Philosophy is an original research work by Mohammad Farhad Uddin, carried out at the Institute of Environmental Science, University of Rajshahi, under my supervision. The thesis or any part of this has not been previously presented for any diploma or degree to any other University.

It is also noted that the researcher has made some distinct contribution through this original study in the field of Zoological Garden and conservation of biodiversity. I gladly recommend him to submit the thesis to the University of Rajshahi for the award of Ph.D. degree.

Supervisor

(Professor Dr. M. Nazrul Islam)
Department of Zoology
University of Rajshahi
Rajshahi-6205
Bangladesh

Acknowledgement

The author expresses his immense ever appreciation and indebtedness to his reverend supervisor Professor Dr. M. Nazrul Islam, Department of Zoology, University of Rajshahi, Bangladesh for his guidance, inspiration, supervision and critically going through the manuscript. The author also expresses extreme sorrowness in memory of his co-supervisor Professor Dr. Md. Abdul Mannan, Department of Zoology, University of Rajshahi, Rajshahi, who untimely leaved us.

The author would like to express his special gratitude and great thanks to Professor Dr. Md. Azizul Islam, Director, Institute of Envrionmental Science, University of Rajshahi, for providing laboratory facilities and moral support during the progress of the work. The author also acknowledges with gratitude to all the respectable teachers of the Institute of Envrionmental Science, University of Rajshahi for their kind cooperation and affection during this work. Thanks are due to the Officials of Institute of Envrionmental Science, University of Rajshahi, Rajshahi.

The author thanks to all the officials of the study area who patiently provided all the required necessary data about zoo animals and kind help in various ways during the study period. Without their cooperation and help, it was too difficult to complete such type of work.

The author is ever grateful to a number of libraries like Rajshahi University Central Library, Library of the Institute of Envrionmental Science, seminar Library, Department of Zoology and divisional and district level livestock office of the study area, which enriched the research.

The author also expresses his regard to his beloved parents, brother and sisters for their cordial help and encouragement to complete the work. The author offers his heartiest gratitude to his spouse Firoza Akter and sons Mahi and Mahadi for the sacrifices and constant encouragement during the study period in so many ways.

The author thanks to Md. Mokhlechhur Rahman and Faizul Islam Faruk, Senior Computer Operator, Active Computer Center, Rajshahi, who helped him in collecting online literature and in completion of the thesis.

The Author

Contents

List of Table

List of Figures

List of Plates

List of Abbreviations, Acronyms and Glossary

ABAs	Access and Benefit Sharing Agreements
AD	Anno Domini
ASLA	American Society of Landscape Architects
AZA	Association of Zoos and Aquariums
BAP	Biodiversity Action Plan
BC	Before Christ
BIAZA	British and Irish Association of Zoos and Aquariums
BPA	Biodiversity Programme of Action
CARER	Conservation, Animal welfare, Recreation, Education and Research
CBC	Complete Blood Count
CBD	Convention on Biological Diversity
CBSG	Captive Breeding Specialist Group
CDC	Centers for Disease Control
CNRS	Centre for Natural Resource Studies
CITES	Convention on International Trade in Endangered Species
CMS	Content Management System
CT	Computerized Tomography
DAISY	Digital Automated Identification System
DNA	Designated National Aurhority
EBBL	Environmental Biology and Biodiversity Laboratory
ECAs	Ecologically Critical Areas
ECG	Electrocardiography
FAO	Food and Agriculture Organization
GFRC	Glass Fiber Reinforced Concrete
HR	Human Resources
HRM	Human Resources Management
ICBP	International Centre for Birds of Prey
ICTS	Information Communication Technologies

ICZA	Indian Central Zoo Authority
IM	Intramuscular
ISIS	International Species Information System
ITV	Internal Target Volume
IUCN	International Union for Conservation of Nature and natural resources
IV	Intravenous
km^2	Square kilometer
MNHNP	Museum National d'Histoire Naturelle, Paris
MRI	Magnetic Resonance Imaging
NBSAP	National Biodiversity Strategy and Action Plans
NGOs	Non-government organizations
NRC	National Research Council
PVOs	Private Voluntary Organizations
RAMSAR	The Ramsar Convention (formally, the Convention on Wetlands of International Importance, especially as Waterfowl Habitat. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
SC	Subcutaneous
SSC	Species Survival Commission
SSPs	Species Survival Plans
UK	United Kingdom
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
USA	United States of America
USAID	U.S. Agency for International Development
USDA	United States Department of Agriculture
UV	Ultraviolet
WAZA	World Association of Zoos and Aquariums
WCMC	World Conservation Monitoring Center
WHC	World Heritage Centre
WWF	World Wildlife Fund
WZACS	The World Zoo and Aquarium Conservation Strategy
WZCS	World Zoo Conservation Strategy
ZIMS	Zoological Information Management System

Abstract

Bangladesh is one of the biodiversity rich countries in the world. However, the biodiversity is declining day by day due to many reasons like human population growth, habitat destruction, pollutions, agriculture, global warming, forest fragmentation etc. For this reasons wild life comes out to the locality often and caught and killed by the local people. Bangladesh homes to roughly 116 species of mammals, 380 species of birds, 139 species of reptiles, 53 species of amphibians, 19 species of marine reptiles and 5 species of marine mammals. In addition to the large bird count, a further 310 species of migratory birds swell bird numbers each year. IUCN-Bangladesh 2006, have been identified some species as threatened. Of the known vertebrates, 13 have already become extinct from the Bangladesh territory. Of the inland fish species 54 are threatened. The number of threatened amphibians, inland reptiles, resident birds and inland mammals are 8, 58, 41, and 40 respectively. In this situation Zoos and Safari park can play a vital role for the conservation of biodiversity. Captive breeding and ex-situ conservation are the best methods of maximizing chance of survival of a species by relocating part of the population to a less threatened location. As a sound and safe place, a number of animals can be nurtured in zoos and can be reintroduced into the wilderness. With that, by displaying animals in stimulated natural environment and through public education, visitors have a better appreciation for wildlife and conservation issues. With the overcome of some obstacles and by providing animal friendly environment Dhaka zoo, Rajshahi zoo, Rangpur zoo and Dulahazra safari park has the potentiality to conserve biodiversity. Additionally, zoos and safari park afford an opportunity for researchers to make further researches, particularly about the conditions in which diverse species will flourish.

Chapter One
General Introduction and Review of Literature

Zoo or Zoological Garden is a place where many kinds of wild animals are kept for the public to see and where they are studied, bred and protected (Hornsby, 2007). The objectives of a modern zoo are Conservation, Animal welfare, Research, Education and Recreation. Modern zoos have an important role to play in conservation of biodiversity. By displaying animals in stimulated natural environment and through public education, visitors have a better appreciation for wildlife and conservation issues.

American Heritage Dictionary of the English Language the word “Zoo” is defined as — A park or an institution in which living animals are kept and usually exhibited to the public.

1.1 Fundamental of Zoos

A zoo (short for zoological park or zoological garden) is a facility in which animals are confined within enclosures, displayed to the public, and in which they may also be bred.

The word zoo has been used in 1826 by the Zoological society of London. The term “Zoo” has been popularized in 1847 by a theme song “O.K, thing to do, walking in the Zoo” when the London Zoo was opened to the people.

London Zoo, which opened in 1828, first called itself a Menagerie or "Zoological Garden," which is short for "Gardens and Menagerie of the Zoological Society of London" (Blunt 1976; Reichenbach 2002). The abbreviation "zoo" first appeared in print in the UK around 1847, when it was used for the Clifton Zoo, but it was not until some 20 years later that the shortened form became popular in the song "Walking in the Zoo on Sunday" by Alfred Vance. The term "Zoological Park" was used for more expansive facilities in Washington, D.C., and the Bronx in New York, which opened in 1891 and 1899 respectively (Hyson, 2000; Hyson, 2003).

Relatively new terms for zoos coined in the late 20th century are "Conservation Park" or "Biopark". Adopting a new name is a strategy used by some zoo professionals to distance their institutions from the stereotypical and nowadays criticized zoo concept of the 19th

century (Maple 1995). The term "biopark" was first coined and developed by the National Zoo in Washington D.C. in the late 1980s (Robinson 1987). In 1993, the *New York Zoological Society* changed its name to the Wildlife Conservation Society and rebranded the zoos under its jurisdiction as "wildlife conservation parks" (Conway, 1995).

The predecessor of the zoological garden is the menagerie, which has a long history from the ancient world to modern times. The oldest known zoological collection was revealed during excavations at Hierakonpolis, Egypt in 2009, of a ca. 3500 B.C. The exotic animals included hippos, hartebeest, elephants, baboons and wildcats.(World's First Zoo) King Ashur-bel-kala of the Middle Assyrian Empire created Zoological and Botanical Gardens in the 11th Century BC. In the 2nd century BCE, the Chinese Empires Tanki had a "house of deer" built, and King Wen of Zhou kept a 1,500-acre (6.1 km^2) zoo called *Ling-Yu*, or the Garden of Intelligence. Other well-known collectors of animals included King Solomon of the Kingdom of Israel and Judah, queen Semiramis and king Ashurbanipal of Assyria, and King Nebuchadnezzar of Babylonia. By the 4th century BCE, zoos existed in most of the Greek city states; Alexander the Great is known to have sent animals that he found on his military expeditions back to Greece. The Roman emperors kept private collections of animals for study or for use in the arena, the latter faring notoriously poorly. The 19th-century historian W.E.H. Lecky wrote of the Roman games, first held in 366 BCE.

At one time, a bear and a bull, chained together, rolled in fierce combat across the sand. Four hundred bears were killed in a single day under Caligula. Under Nero, four hundred tigers fought with bulls and elephants. In a single day, at the dedication of the Colosseum by Titus, five thousand animals perished. Under Trajan lions, tigers, elephants, rhinoceroses, hippopotami, giraffes, bulls, stags, even crocodiles and serpents were employed to give novelty to the spectacle (Lecky, 1869).

Henry I of England kept a collection of animals at his palace in Woodstock, which reportedly included lions, leopards, and camels (Blunt, 1976). The most prominent collection in medieval England was in the Tower of London, created as early as 1204 by King John I. Henry III received a wedding gift in 1235 of three leopards from Frederick II, Holy Roman Emperor, and in 1264, the animals were moved to the Bulwark, renamed the Lion Tower, near the main western entrance of the Tower. It was opened to the public

during the reign of Elizabeth I in the 16th century (BBC News, 2005). During the 18th century, the price of admission was three half-pence, or the supply of a cat or dog for feeding to the lions. The animals were moved to the London Zoo when it opened.

The oldest zoo in the world still in existence is the *Tiergarten Schonbrunn* in Vienna, Austria. It was constructed by Adrian van Stekhoven in 1752 at the order of the Holy Roman Emperor Francis I, husband of Maria Theresa of Austria, to serve as an imperial menagerie as part of Schönbrunn Palace. The menagerie was initially reserved for the viewing pleasure of the imperial family and the court, but was made accessible to the public in 1765.

In 1775, a zoo was founded in Madrid, and in 1795, the zoo inside the *Jardin des Plantes* in Paris was founded by Jacques-Henri Bernardin, with animals from the royal menagerie at Versailles, primarily for scientific research and education. The Kazan Zoo, the first zoo in Russia was founded in 1806 by the Professor of Kazan State University Karl Fuchs. The Zoological Society of London, founded in 1826 by Stamford Raffles, adopted the idea of the Paris zoo when they established the London Zoo in Regent's Park in 1828, which opened to paying visitors in 1847. Dublin Zoo was opened in 1831 by members of the medical profession interested in studying animals while they were alive and more particularly getting hold of them when they were dead (Costello, 2011). Germany's first zoo opened in 1844 - the Berlin Zoological Garden. The first zoological garden in Australia was Melbourne Zoo in 1860. In the same year, Central Park Zoo, the first public zoo in the United States, opened in New York, although in 1859, the Philadelphia Zoological Society had made an effort to establish a zoo, but delayed opening it until 1874 because of the American Civil War.

The zoo in Thiruvananthapuram, Kerala, India is one of the oldest in the country, and was established as an adjunct to the Museum in 1857 by the Erstwhile Maharaja of Travancore in order to attract more visitors. Lahore Zoo in Lahore, Pakistan was established in 1872 by a local philanthropist Lal Mahundra Ram and Lahore Municipal Corporation.

In 1907, the German entrepreneur Carl Hagenbeck founded the Tierpark Hagenbeck in Stellingen, now a quarter of Hamburg. It is known for being the first zoo to use open enclosures surrounded by moats, rather than barred cages, to better approximate animals' natural environments (Rene, 2001).

When ecology emerged as a matter of public interest in the 1970s, a few zoos began to consider making conservation their central role, with Gerald Durrell of the Jersey Zoo, George Rabb of Brookfield Zoo, and William Conway of the Bronx Zoo (Wildlife Conservation Society) leading the discussion. From then on, zoo professionals became increasingly aware of the need to engage themselves in conservation programs, and the American Zoo Association soon said that conservation was its highest priority (Kisling, 2001). Because they wanted to stress conservation issues, many large zoos stopped the practice of having animals perform tricks for visitors. The Detroit Zoo, for example, stopped its elephant show in 1969, and its chimpanzee show in 1983, acknowledging that the trainers had probably abused the animals to get them to perform (Donahue, *et. al,* 2007).

Human beings were sometimes displayed in cages along with non-human animals, supposedly to illustrate the differences between people of European and non-European origin. In September 1906, William Hornaday, director of the Bronx Zoo in New York with the agreement of Madison Grant, head of the New York Zoological Society had Ota Benga, a Congolese pygmy, displayed in a cage with the chimpanzees, then with an orangutan named Dohong, and a parrot. The exhibit was intended as an example of the "missing link" between the orangutan and white man. It triggered protests from the city's clergymen, but the public reportedly flocked to see it (Bradford, *et al.,* 1992; Man and Monkey Show Disapproved by Clergy, 1906). Human beings were also displayed in cages during the 1931 Paris Colonial Exposition, and as late as 1958 in a "Congolese village" display at Expo '58 in Brussels.

Zoo animals usually live in enclosures that attempt to replicate their natural habitats, for the benefit of the animals and the visitors. They may have special buildings for nocturnal animals, with dim white or red lighting used during the day, so the animals will be active when visitors are there, and brighter lights at night to help them sleep. Special climate conditions are created for animals living in radical environments, such as penguins. Special enclosures for birds, mammals, insects, reptiles, fish, and other aquatic life forms have also been developed. Some zoos have walk-through exhibits where visitors enter enclosures of non-aggressive species, such as lemurs, marmosets, birds, lizards and turtles. Visitors are asked to keep to paths and avoid showing or eating foods that the animals might snatch.

Some zoos keep fewer animals in larger, outdoor enclosures, confining them with moats and fences, rather than in cages. Safari parks, also known as zoo parks and lion farms, allow visitors to drive through them and come in close contact with the animals. The first of this kind of zoo was Whipsnade Park in Bedfordshire, England, opened by the Zoological Society of London in 1931, and covering 600 acres (2.4 km²). Since the early 1970s, a 1,800 acre (7 km²) park in the San Pasqual Valley near San Diego has featured the San Diego Zoo Safari Park, run by the Zoological Society of San Diego. One of two state-supported zoo parks in North Carolina is the 2,000-acre (8.1 km^2) North Carolina Zoo in Asheboro (Ferral, 2010). The 500-acre (2.0 km^2) Werribee Open Range Zoo in Melbourne, Australia, displays animals living in a savannah.

The first public aquarium was opened in London Zoo in 1853. This was followed by the opening of public aquaria in continental Europe (for example, Paris 1859, Hamburg 1864, Berlin 1869, Brighton 1872) and the United States (Boston 1859, Washington 1873, San Francisco Woodward's Garden 1873, New York Battery Park 1896). In 2005 the non-profit Georgia Aquarium with more than 8 million US gallons (30,000 m³; 30,000,000 litres) of marine and fresh water, and more than 100,000 animals of 500 different species opened in Atlanta, Georgia. The aquarium's specimens include whale sharks and beluga whales.

Roadside zoos are found throughout North America, particularly in remote locations. They are small, unregulated, for-profit zoos, often intended to attract visitors to some other facility, such as a gas station. The animals may be trained to perform tricks, and visitors are able to get closer to them than in larger zoos (Guzoo Animal Farm, 2009). Since they are sometimes less regulated, roadside zoos are often subject to accusations of neglect (Roadside zoo animals starvin, 1997) and cruelty (Dixon, 1992).

A petting zoo, also called children's farms or children's zoos, features a combination of domestic animals and wild species that are docile enough to touch and feed. To ensure the animals' health, the food is supplied by the zoo, either from vending machines or a kiosk nearby.

An animal theme park is a combination of an amusement park and a zoo, mainly for entertaining and commercial purposes. Marine mammal parks such as Sea World and Marineland are more elaborate dolphinariums keeping whales, and containing additional

entertainment attractions. Another kind of animal theme park contains more entertainment and amusement elements than the classical zoo, such as a stage shows, roller coasters, and mythical creatures. Some examples are Busch Gardens Tampa Bay in Tampa, Florida, Disney's Animal Kingdom in Orlando, Florida, Flamingo Land in North Yorkshire, England and Six Flags Discovery Kingdom in Vallejo, California .

When they arrive at the zoo, the animals are placed in quarantine, and slowly acclimatized to enclosures which seek to mimic their natural environment. For example, some species of penguins may require refrigerated enclosures. Guidelines on necessary care for such animals is published in the *International Zoo Yearbook* (Encyclopaedia Britannica, 2008).

Conservation and Research

The position of most modern zoos in Australasia, Europe and North America, particularly those with scientific societies, is that they display wild animals primarily for the conservation of endangered species, as well as for research purposes and education, and secondarily for the entertainment of visitors (Tudge, 1991 and Manifesto for Zoos, 2004), an argument disputed by critics. The Zoological Society of London states in its charter that its aim is "the advancement of Zoology and Animal Physiology and the introduction of new and curious subjects of the Animal Kingdom." It maintains two research institutes, the Nuffield Institute of Comparative Medicine and the Wellcome Institute of Comparative Physiology. In the U.S., the Penrose Research Laboratory of the Philadelphia Zoo focuses on the study of comparative pathology. The World Association of Zoos and Aquariums produced its first conservation strategy in 1993, and in November 2004, it adopted a new strategy that sets out the aims and mission of zoological gardens of the 21st century.

The breeding of endangered species is coordinated by cooperative breeding programmes containing international studbooks and coordinators, who evaluate the roles of individual animals and institutions from a global or regional perspective, and there are regional programmes all over the world for the conservation of endangered species.

To reduce the need for animals from the wild, the breeding of animals within zoos is encouraged. Eric Baratay and Elisabeth Hardouin-Fugier of the Université Jean-Moulin, Lyon, say that the overall "stock turnover" of animals is one-fifth to one-fourth over the

course of a year—with three-quarters of wild caught apes dying in captivity within the first twenty months. They say that before successful breeding programs, the high mortality rate is the reason for the "massive scale of importations" (Jensen 2002).

The downside to breeding the animals in captivity is that over time, without additional genetic material from the wild, all the animals in captivity can become related. The *San Jose Mercury News* conducted a two-year study that suggested of the 19,361 certain species of mammals that left accredited zoos in the U.S. between 1992 and 1998, 7,420 (38 percent) went to dealers, auctions, hunting ranches, unaccredited zoos and individuals, and game farms (Goldston, 1999).

The condition of the animals varies widely, especially in zoos in countries with little or no regulations. The majority of zoos continue to work to improve their animal enclosures, although constraints like size and expense make it difficult to create ideal captive environments for some species, such as dolphins and whales (Norton, 1995 and Malmud, 1998). The bear cages, one square meter in size, in Dalian zoo, Port Arthur, Liaoning Province, China, in 1997.

Some critics argue that animals that live in zoos are treated as voyeuristic objects rather than living creatures, and are often driven to insanity in the transition from being free and wild to incarcerated and dependent on humans for survival. A four-decade Oxford University study found that polar bears, lions, tigers, and cheetahs show the most evidence of stress in captivity (Derr, 2003).

Feeding by visitors is often discouraged. However, in the Badaltearing Safari Park in China, zoo visitors can throw live goats into the lions' enclosure and watch them being eaten, or can purchase live chickens tied to bamboo rods for the equivalent of 2 dollars/euros to dangle into lion pens. Visitors can drive through the lion's compound on buses with specially designed chutes leading into the enclosure into which they can push live chickens. In the Xiongsen Bear and Tiger Mountain Village near Guilin in south-east China, live cows and pigs are thrown to tigers to amuse visitors (Penman, 2008 and Ferocity Training, 1999). In the Qingdao zoo, visitors engage in "tortoise baiting", where tortoises are kept inside small rooms with elastic bands round their necks, so that they are unable to retract their heads. Visitors then throw coins at them. The marketing claim is that if you hit one of them on the head and make a wish, it will be fulfilled.

In the United States, any public animal exhibit must be licensed and inspected by the United States Department of Agriculture, United States Environmental Protection Agency, Drug Enforcement Administration, Occupational Safety and Health Administration, and others. Depending on the animals they exhibit, the activities of zoos are regulated by laws including the Endangered Species Act, the Animal Welfare Act, the Migratory Bird Treaty Act of 1918 and others (Grech, 2004). Additionally, zoos in North America may choose to pursue accreditation by the Association of Zoos and Aquariums (AZA). To achieve accreditation, a zoo must pass an application and inspection process and meet or exceed the AZA's standards for animal health and welfare, fund raising, zoo staffing, and involvement in global conservation efforts. Inspection is performed by three experts (typically one veterinarian, one expert in animal care, and one expert in zoo management and operations) and then reviewed by a panel of twelve experts before accreditation is awarded. This accreditation process is repeated once every five years. The AZA estimates that there are approximately 2,400 animal exhibits operating under USDA license as of February 2007; fewer than 10% are accredited (www.aza.org).

In April 1999, the European Union introduced a directive to strengthen the conservation role of zoos, making it a statutory requirement that they participate in conservation and education, and requiring all member states to set up systems for their licensing and inspection. Zoos are regulated in the UK by the Zoo Licensing Act of 1981, which came into force in 1984. A zoo is defined as any "establishment where wild animals are kept for exhibition to which members of the public have access, with or without charge for admission, seven or more days in any period of twelve consecutive months," excluding circuses and pet shops. The Act requires that all zoos be inspected and licensed, and that animals kept in enclosures are provided with a suitable environment in which they can express most normal behavior (www.defra.gov.gov.uk).

According to new world encyclopedia free encyclopedia: zoological garden, zoological park, or zoo is a facility in which living animals are confined within enclosures and usually displayed to the public. Beyond recreation, other functions of zoos include research, education, and conservation (such as breeding endangered animals and sometimes reintroducing them into the wild). While some domesticated animals may be kept for display, the main focus is on wild animals.

Human beings, which receive joy from observing nature and have a role as stewards of creation, have, in the ideal sense, a natural internal desire to look at, better understand, and protect nature. Zoos provide these basic functions (recreation, research, education, and conservation), and indeed, often allow humans access to animals that would be difficult to see in the wild. Unfortunately, historically there also have been unethical zoo operators, more concerned with exploiting this human nature for profit than in providing satisfactory conditions for the animals exhibited.

Zoo possess and manage collections that primarily consist of wild [non-domesticated] animals of one or more species, that are housed so that they are easier to see to study than in nature (According to the World Zoo Conservation Strategy), That means the modern zoo is a CARER-supports 5 pillars are Conservation, Animal welfare, Recreation, Education and Research. In this aspect zoo design and management is an important issues. Zoo design means keeping animals in their appropriate condition, good presenting of them to the visitors and good construction for the visitors for showing the animal. Zoo management means providing and maintaining all facilities both for the animals and for the visitors.

Thus zoo design and management posses a great role in favor of CARER for preservation of endangered population, for giving joy and pleasure to the people, for research and for creating public and political awareness on natural resource sustainability but if the zoo cannot plan a good design or maintain better management system then all of these objectives will become meaningless.

Zoological Garden (chidyakhana) public or private park where living animals are kept for exhibition, recreation and study. The menageries and aviaries of China, Egypt, and Rome were famous in ancient times. From the late medieval period many rulers had private menageries, some of which later formed the nucleus of public exhibits. Nearly all-large cities now have zoological reserves. Modern trends include breeding threatened animals in captivity, exhibiting animals in enclosures simulating their natural habitat rather than in cages (open-range zones or safari parks), and educating the public about principles of ecology.

In Bengal in the early 19th century, starting from 1801 there were four well-documented institutions in Calcutta, which could be called menageries or even zoos and a host of hearsay private collections.

The rich forests of Northeast India, Burma (now Myanmar) and other border countries, and the state of Bengal itself has its own rich forests to supply a very great diversity of animal life. Calcutta also was a gateway or seaport to the rest of southern Asia (even South India and Sri Lanka) and South East Asia which guaranteed a steady flow of animal life into Calcutta. These factors alone are sufficient to account for the phenomenon that four early and most interesting zoos or menageries originated in Calcutta. They were: 1. Barrackpore Menagerie, founded c 1801 and closed c 1879; 2. Wazir Ali Shah's menagerie founded c 1830's and wound up c 1880; 3. Marble Palace Zoo, founded 1854 and continuing but in decline; and 4. Alipore Zoo, founded in 1875, continuing and renovating both for the exhibited animals and visitors.

The Marble Palace Zoo (1854 to present) Rajah Rajendro Mullick Bahadur founded the Marble Palace Zoo in Chorebagan, Calcutta in 1854, and it still stands today in the centre of Kolkata city. The Rajah consciously and intentionally founded it as a public service for education and entertainment of the public. Rajah Rajendro Mullick was a student of natural history and the menagerie in his house contained birds and mammals collected from different parts of the world as well as India. The zoo had important (animal) collections, even before opening to the public. Mullick gave numerous animals to other institutions such as London Zoo. He also gave the Calcutta Zoo valuable animals and was honored by having the first animal house named after him. Persons who admired and cared deeply about the dramatic and beautiful interesting creatures from around the globe nurtured Marble Palace Zoo. Much thought went into the keeping and display. The first cage ever to be constructed in the Marble Palace Zoo still stands, today holding rabbits and guinea pigs. Even the traveling cages of early days are still there.

Alipore Zoological Garden (1875 to the present): Although Barrackpore Menagerie continued, there were people even as early as 1841, who felt that Calcutta should have a proper zoo. The July 1841 issue of the Calcutta Journal of Natural History relates a proposal by Mr. Raleigh for the establishment of a Zoological Garden. In February 1873, Mr. L Schwendier, a member of the Council of the Asiatic Society of Bengal, detailed the scheme for the establishment of the Zoological Garden. The Society and the Agri-Horticultural Society approved his suggestions. The principal features of the original scheme were: (i) to provide recreation, instruction and amusement for all classes of the community; (ii) to facilitate scientific observations of the habits of animals, more

especially those peculiar to tropical countries; (iii) to encourage the acclimatization, domestication, and breeding of animals and to improve the indigenous breed of cattle and farm stock; and (iv) to promote the science of Zoology by the interchange, import and export of animals.

An area of about 14 ha of land was allotted at Alipore by the Government of Bengal and development work started at the instance of Sir Richard Temple, the then Lt. Governor of Bengal. Mr. Schwendler readily donated his fine collection of specimens, and by December 1875 a sizeable menagerie was established with the spontaneous contributions from a number of donors. Raja Surjakanta Acharya Chaudhury of Mymensingh, and the Nawab Abdul Gani and Khajah Ahsanullah Khan Bahadur of Dacca were among the donors. King Emperor Edward VII, the then Prince of Wales, drove through the Garden on his way to Belvedere on the afternoon of 27 December, 1875 in the presence of the elite of Calcutta and inaugurated the zoo formally on the 1st of January, 1875. However, the zoo was made open to the public on the 1st of May 1876. Two young elephants and a leopard were sent to the Garden as a token of interest evinced by His Royal Highness who consented to be the patron of the garden. Ever since the starting of the zoo, the management of the Garden has been vested in an honorary committee appointed by the Government. At present the garden is run under the Alipore Zoological Garden (Management) Rules 1957 framed under the Bengal Public Parks Act, 1904 and the Managing Committee consists of 22 members (of which 10 are ex-officio members), nominated by the State Government.

Twenty thousand visitors a day is not unusual, and on special days the count reaches 100,000. The first attempt of modernization of the zoo was made in 1957 when the authorities of the zoo constructed an open-air enclosure for tigers. The construction and opening of a freshwater aquarium in l977 added a new dimension to the Alipore Zoo. It was the first significant addition to the zoo after its centenary. It is one of the largest freshwater aquarium in the Eastern India having 17 large and 48 small tanks. It has now about 1500 freshwater fishes belonging to different species both exotic and indigenous.

A spacious (1064 sq m) new reptile house was established in 1979 for better housing and display of different reptiles. It has 48 exhibition cages arranged in circular fashion for display of different species of reptiles and a big central pool with a canopy of dome

shaped wire netted roof for exhibition of crocodiles and gavialis. The construction of new small carnivore house in 1981 with twelve large cages has provided a good opportunity for better exhibition and breeding of jaguar and other carnivores. An open air enclosure for bears having six dens have been constructed in 1985. An open-air enclosure for elephants was constructed in 1999. The most significant and striking achievement of Alipore Zoological Garden is the breeding of giraffe in 1988. The zoo is still holding a Giant Tortoise in its collection since 1875.

Principally the gate receipts, supplemented by annual grants received from the State Government maintain the garden. The garden, as it stands today stretches over 16 hectares of land with its charming layout of lawns, flower beds, lakes, bridges, avenues, animal houses, aviaries, waterways, plants, and shrubbery (en.banglapedia.org).

Rahman, 2009, Zoo can be an excellent place of captive breeding of those wild animals who are decreasing in the number day by day and to increase scientific knowledge about helping of wild animal conservation there are lot of facilities present in the zoo.

IUCN-Bangladesh 2006, some species have been identified as threatened. Of the known vertebrates, 13 have already become extinct from Bangladesh territory. Of the inland fish species 54 are threatened. The number of threatened amphibians, inland reptiles, resident birds and inland mammals are 8, 58, 41, and 40 respectively.

Smith, T. (2004), Zoo Research Guidelines: Monitoring Stress in Zoo Animals. BIAZA, A protected animal is any living vertebrate, other than man. This includes mammals, bird and reptiles from halfway through gestation or incubation periods and fish and amphibians from the time at which they become capable of independent feeding. Trivedi P.R. and Raj Gurdeep, 1997, Some species have become extinct due to natural causes, but the greatest danger to wildlife results from human activities. Thus, we ourselves have created this need for wildlife conservation. Coe. Jon C.1987, Zoo education is essential to joining the mixed goals of recreation, education, research and conservation. Educators deserve a voice equal to this role. In 1969, British wildlife expert Guy Mountford of World Wildlife Fund (WWF) came to Bangladesh to prepare a list of local wildlife and also visited the Sundarbans as part of his mission. But he was skeptical about the number of tigers more than 300—reported by forest officials who relied solely on guesswork.

Zoos of different types and status in Bangladesh, are playing their own role in conservation of wildlife as one of their main mandates to the nation. Prevailing conservation practices ultimately contribute a lot to the national biodiversity conservation efforts, but in a limited mode. Introduction of conservation education and research programmes could further expedite the scope of conservation of the rich heritage of biological diversity in Bangladesh. The enormous number of species and populations along with that of 10 million visitors per year has generated rethinking the scope and limitations of our capacity. The formulation of national guidelines for animal release using the IUCN Reintroduction Specialist Group Guidelines may lead to very concerted effort of all concerned and proactive wildlife organizations and institutions in Bangladesh to adopt more systematic practices. Zoos playing different roles aiding the higher goal of nature conservation depends upon refining our present conservation concept by reviewing our mission and vision. This may generate the potential to make Bangladesh zoos a knowledge generation center for conserving biodiversity. Zoos get a huge influx of visitors which need to be educated about the problems and potential of wildlife and biodiversity (Ahasan, 2007).

Status of Zoological Gardens in Bangladesh

Almost all visitors visit zoos for recreational purpose, not for being updated on natural history through observation and learning, except for a very few. Roughly 10 million zoo visitors to Bangladesh zoos around the year want to see attractive animals and visit them for entertainment. While more and more zoos and aquariums see themselves primarily as conservation institutions, the perception of the public at large is still very different. For the vast majority of the more than 600 million people visiting WAZA network institutions every year, the main or only purpose of zoos and aquariums still is leisure and entertainment (Dollinger, 2006). As their attitude is not anti-nature, it may not be too difficult to mold them as a nature observer as well as a tourist and teach them to consider playing a role in conserving biodiversity. There is not enough incorporation of the word conservation in our mandates and if it exists, it is hardly understood. Occasional practices of conservation are undertaken on ad hoc basis, rather than learning the skills required to maintain studbook along scientific lines. Only when scientific methodology is applied, it is possible to maintain genetic diversity and be qualified to carry out genuine conservation breeding programs in keeping with the IUCN Policy Statement on

Translocation of Living Organisms. Only then, can zoos in Bangladesh consider reintroduction programs a possibility for conservation. National biodiversity conservation initiatives may be supplemented by the activities of zoological gardens effectively only if scientific and welfare conditions are met. Without improvement and integration of these sectors, our national biodiversity conservation efforts will remain crippled. "The World Zoo and Aquarium Conservation Strategy (WZACS) calls on institutions to pursue a strategy of integrated conservation' (WAZA 2005) i.e., to integrate all aspects of their work with conservation activities. "No single organization, be it zoo, aquarium, conservation charity or development organization should act alone. Conservation activities should be collaborative, with all the stakeholders working towards the same need, and avoiding competition or exploitation". Unlike many conservation organization, which are not highly visible to the general public, zoos and aquariums, because they are popular visitor attractions, have unique opportunities to introduce their visitors to a wider world and to explain the issues of international conservation" (WAZA, 2005).

"The continued existence of zoos and aquariums depends upon recognition that they are based on respect for the dignity of the animals in their care, and that they serve the higher goal of nature conservation" (WAZA, 2003). Zoological gardens can contribute to the conservation of biodiversity by hosting training for their staff as well as educating the public in the conservation and animal welfare sciences such as small population biology, reproductive biology, conservation medicine, modern wild animal husbandry, environmental enrichment, animal behaviour, and research. These topics can be aimed at identifying and improving zoo and aquarium operations, such as visitor attitudes, visitor behaviour, fund raising, animal welfare, etc. Integrated conservation as defined by WAZA is a broad attempt to link up every action with best practice of conservation principles. This is not only to include the systematic maintenance of studbooks and practice of scientific breeding, etc., but also to cover operating their institutions in an environmentally friendly manner. Every act of this nature (fixing leaky faucets, refraining from inappropriate captures or releases of wildlife, utilising zoo space wisely for conservation, adopting effective waste management practices, etc. aids in small parts to global conservation of natural resources. Zoos and aquariums will make further contributions to conservation in the wild by providing knowledge, skills and resources through initiations in zoo breeding, translocations and reintroduction, wildlife health,

research, training, education and by funding field activities. "In appropriate circumstance, zoos can provide the necessary animals, skills and knowledge for breeding: identifying breeding stocks (through genetic analysis when necessary); establishing appropriate social units for successful breeding and rearing attending to behavioral needs; determining diet and welfare standards" (WAZA, 2005).

Human Resource Development

In order to progress towards world class wild animal facilities, zoological gardens in Bangladesh will have to refresh their human resource management practices. Managing wild animals in captivity is very difficult and knowledge dependent. To be effective and successful, all levels of staff should possess a wide range of skills to undertake tasks promoting wildlife health and welfare. Managing an institution with visitors also requires expert knowledge. The activities of animal, visitor and infrastructure management must include science as well as arts and technology. Despite all, it is the individual and his intent, combined with technology, that can achieve high standards and success. "It is a matter to understand the depth and importance of skilled manpower, which can help zoos to avoid or reduce criticism and accidents in zoos. Zoos need freedom from the stifling influences of State Government and the Municipal Corporation bureaucracy, and red tapism which will allow the modern zoo to recruit and hire skilled personnel, remove unproductive personnel and thus speed up decision making" (Kaginkar, 2007). "But incase of Dhaka Zoo, HR recruitment and selection, it is not as such described above rather difference and bears some peculiarities, but according to setout rules and quotas. Zoo and wild animal fields are highly technical, dynamic and manual labor oriented intensive job field where HR recruitment and selection should take place keeping in mind of specific scientific technical qualification as prerequisite and other in-service courses to shape them up. Dhaka Zoo is getting its HR readymade recruited and selected by higher authority, those are not specific in terms of quality selection for zoo" (Sultana, 2007). "Five million visitors figure each year is amazing, no doubt. During 3-4 occasions round the year, about 65,000 visitors/day visit Dhaka Zoo resulting such a gathering that it becomes zero distance between one visitor to another, traffic jams become intolerable, whole zoo becomes dusty, all sorts of movement become restricted, law enforcing agencies rushed into and so forth. No where these happens so far. So, including the compact internal works, visitors control also become emergency. All these things made

the HRM practice with effective, dynamic, modern and appropriate modality an essence" (Sultana, 2007).

Zoo Management Software

New generation web-based software such as Zoological Information Management System (ZIMS) developed by the International Species Information System (ISIS) can insure that sharing standards and information of zoological specimens of different taxa is possible as well as maintaining accurate and up to date animal records, studbooks, etc. It is best practice to adopt ZIMS as a primary management tool in the modern zoo scenario. "At the same time, adopting ICTS and related software use is thought to be another obligatory activities in achieving quality operation and standard management procedures" (Sultana, 2007). "All zoos and aquariums therefore, will be primary centers of expertise in small population management and will be involved in global or regional cooperative breeding program. All such program will be based on sound knowledge using the latest available data on population management, reproductive biology, gene-tics, behavior, physiology, nutrition, veterinary care and husbandry" (WAZA, 2005). Preconditions of managing a population should be based on databases of ISIS ZIMS which will include all appropriate software.

Animal Welfare

All zoo activities should adhere to an animals welfare code of ethics avoiding cruelties to animal in Bangladesh where there is no animal welfare legislation. 'In many countries historical and social perceptions of zoos an entertainment menageries still persist, and in some cases are justified. A sector frequently hostile to zoos is the growing animal-rights and animal-welfare lobby, which emphasizes the interest of individual animals, rather than the conservation of species or eco-systems; further opposition comes from that part of the conservation movements which doubts the justification for removing animals from the wild. If zoos and aquariums are to play an active part in conservation they must face opposition head-on, by understanding criticisms, adapting where necessary and explaining their actions in a way that gains public that their mission is one of conservation, which is conducted in tandem with highest welfare standards (WAZA, 2005). The nodal authority of wild flora and fauna should interact with the zoological and botanical gardens for further research achievements in the field of biodiversity conservation. Patterns of cooperative effort should be developed between zoos, universities and research organizations (WAZA, 2005).

Ecotourism

Recreational concept of zoo mandate is to switch over to ecological tourism. The main objective of ecotourism is to teach people to use natural resources sustainable, to create awareness about importance of forests and wildlife and tune people towards conservation. Ecotourism is a process, not a concept' (Kumar, 2003). Zoological Gardens at the same time can be transformed as ecotourism hotspots with the attitude of conservation. Strengths and opportunities of ensuring contribution to biodiversity

- Heritage of a wide range of species diversity along with magnificent natural landscape
- Remarkable heritage of natural habitats
- Significant numbers of visitors
- Large number of pro-active persons and institutions with respect to biodiversity
- Significant number of interested researchers
- Adequate number of universities and colleges along with research fellows

Limitations and Lackness

- Heterogeneous administration
- Absence of nationally coordinated organization
- Lack of concerted programs and effort
- Lack of capacity
- Reluctance to evolve mandates towards conservation
- Absence of coordinated and official conservation education program
- Red tapism, ownership conflict, socio-economic conditions, fragmentation/ deforestation
- Adequate wild spaces - healthy habitat
- Lack of adequate sanitary and phytosanitary measures, waste management, health screening and public health safety measures etc.
- Unsystematic breeding and inbred captive populations

Breeding of endangered animals is an important role of all zoos. While for many reasons, it may not be possible to reintroduced most captive-bred endangered animals into the wild. They have played a vital role in the preservation and protection of wildlife by serving as refuge for threatened species. A number of animals may nurtured in the zoos and may reintroduced into the wilderness. In Bangaldesh a few work has been done on Zoo by Mr. Ali Reza Khan and Dr. Ziaur Rahman Selim. Therefore no major work has not yet been done in Bangladesh.

1.2 Biodiversity or Biological Diversity

Biodiversity or Biological Diversity, sum of all the different species of animals, plants, fungi, and microbial organisms living on Earth and the variety of habitats in which they live (autocww2.colorado.edu). Scientists estimate that upwards of 10 million and some suggest more than 100 million different species inhabit the Earth. Each species is adapted to its unique niche in the environment, from the peaks of mountains to the depths of deep-sea hydrothermal vents, and from polar ice caps to tropical rain forests.

Biodiversity is the degree of variation of life. It is a measure of the variety of organisms present in different ecosystems. This can refer to genetic variation, ecosystem variation, or species variation (number of species) within an area, biome, or planet. Terrestrial biodiversity tends to be highest near the equator (Gaston, 2000), which seems to be the result of the warm climate and high primary productivity (Richard, 2009). Biodiversity is not distributed evenly on Earth. It is the richest in the tropics. Marine biodiversity tends to be highest along coasts in the Western Pacific, where sea surface temperature is highest and in the mid-latitudinal band in all oceans. There are latitudinal gradients in species diversity (Tittensor, 2010). Biodiversity generally tends to cluster in hotspots (Myers, 2000) and has been increasing through time (McPeek, 2007, Peters, 2013) but will be likely to slow in the future (Rabosky, 2008). Rapid environmental changes typically cause mass extinctions (Cockell 2006; Algeo, 1998 and Bond, 2008). One estimate is that <1%–3% of the species that have existed on Earth are extant (Raup, 1994).

The period since the emergence of humans has displayed an ongoing biodiversity reduction and an accompanying loss of genetic diversity. Named the Holocene extinction, the reduction is caused primarily by human impacts, particularly habitat destruction. Conversely, biodiversity impacts human health in a number of ways, both positively and negatively (Sala, *et al.*, 2009).

The term biological diversity was used first by wildlife scientist and conservationist Raymond F. Dasmann in the 1968 lay book *A Different Kind of Country (*Dasmann, 1968*)* advocating conservation. The term was widely adopted only after more than a decade, when in the 1980s it came into common usage in science and environmental policy. Thomas Lovejoy, in the foreword to the book *Conservation Biology* (Robert, 2011), introduced the term to the scientific community. Until then the term "natural diversity" was common, introduced by The Science Division of The Nature Conservancy in an important 1975 study, "The Preservation of Natural Diversity." By the early 1980s TNC's Science program

and its head, Robert E. Jenkins (Robert, 2011), Lovejoy and other leading conservation scientists at the time in America advocated the use of the term "biological diversity".

The term's contracted form *biodiversity* may have been coined by W.G. Rosen in 1985 while planning the 1986 *National Forum on Biological Diversity* organized by the National Research Council (NRC). It first appeared in a publication in 1988 when sociobiologist E. O. Wilson used it as the title of the proceedings (Edward, 1988) of that forum (UNEP, 1995). Since this period the term has achieved widespread use among biologists, environmentalists, political leaders, and concerned citizens. A similar term in the United States is *"natural heritage."* It pre-dates the others and is more accepted by the wider audience interested in conservation. Broader than biodiversity, it includes geology and landforms.

"Biodiversity" is most commonly used to replace the more clearly defined and long established terms, species diversity and species richness. Biologists most often define biodiversity as the "totality of genes, species, and ecosystems of a region" (Tor-Bjorn, 2001 and Davis, 2011). An advantage of this definition is that it seems to describe most circumstances and presents a unified view of the traditional types of biological variety previously identified:

- taxonomic diversity (usually measured at the species diversity level)
- ecological diversity often viewed from the perspective of ecosystem diversity
- morphological diversity which stems from genetic diversity

In 2003 Professor Anthony Campbell at Cardiff University, UK and the Darwin Centre, Pembrokeshire, defined a fourth level: Molecular Diversity (Campbell, 2003).

This multilevel construct is consistent with Dasmann and Lovejoy. An explicit definition consistent with this interpretation was first given in a paper by Bruce A. Wilcox commissioned by the International Union for the Conservation of Nature and Natural Resources (IUCN) for the 1982 World National Parks Conference. Wilcox's (1984) definition was "Biological diversity is the variety of life forms at all levels of biological systems (i.e., molecular, organismic, population, species and ecosystem)". The 1992 United Nations Earth Summit defined "biological diversity" as "the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems" . This definition is used in the United Nations Convention on Biological Diversity (Hawksworth, 1996).

Genetically biodiversity can be defined as the diversity of alleles, genes, and organisms i.e. "variation of life at all levels of biological organization". Measuring diversity at one level in a group of organisms may not precisely correspond to diversity at other levels. Biodiversity is not evenly distributed, rather it varies greatly across the globe as well as within regions. Among other factors, the diversity of all living things (biota) depends on temperature, precipitation, altitude, soils, geography and the presence of other species. The study of the spatial distribution of organisms, species, and ecosystems, is the science of biogeography.

A biodiversity hotspot is a region with a high level of endemic species that is under threat from humans. The term hotspot was introduced in 1988 by Dr. Sabina Virk (Myers, 1988; Myers, 1990 and Jeffrey 2004). While hotspots are spread all over the world, the majority are forest areas and most are located in the tropics.

Most biologists agree however that the period since human emergence is part of a new mass extinction, named the Holocene extinction event, caused primarily by the impact humans are having on the environment. It has been argued that the present rate of extinction is sufficient to eliminate most species on the planet Earth within 100 years (Edward, 2002).

New species are regularly discovered (on average between 5–10,000 new species each year, most of them insects) and many, though discovered, are not yet classified (estimates are that nearly 90% of all arthropods are not yet classified) (Cardinale, 2012). Most of the terrestrial diversity is found in tropical forests and in general, land has more species than the ocean; some 8.7 million species may exists on Earth, of which some 2.1 million live in the ocean.

1.3 Biodiversity and Ecosystem Services

"Ecosystem services are the suite of benefits that ecosystems provide to humanity Daniel." These services come in three flavors:

1. Provisioning services which involve the production of renewable resources (e.g.: food, wood, fresh water)
2. Regulating services which are those that lessen environmental change (e.g.: climate regulation, pest/disease control)
3. Cultural services represent human value and enjoyment (e.g.: landscape aesthetics, cultural heritage, outdoor recreation, and spiritual significance)

There have been many claims about biodiversity's effect on these ecosystem services, especially provisioning and regulating services. After an exhaustive survey through peer-reviewed literature to evaluate 36 different claims about biodiversity's effect on ecosystem services, 14 of those claims have been validated, 6 demonstrate mixed support or are unsupported, 3 are incorrect and 13 lack enough evidence to draw definitive conclusions.

Since the stone age, species loss has accelerated above the average basal rate, driven by human activity. Estimates of species losses are at a rate 100-10,000 times as fast as is typical in the fossil record. Hassan, *et. al.*, 2006) Biodiversity also affords many non-material benefits including spiritual and aesthetic values, knowledge systems and education.

Biodiversity and Agriculture

Agricultural diversity can be divided into two categories: intraspecific diversity, which includes the genetic variety within a single species, like the potato (*Solanum tuberosum*) that is composed of many different forms and types (e.g.: in the U.S. we might compare russet potatoes with new potatoes or purple potatoes, all different, but all part of the same species, *S. tuberosum*).

The other category of agricultural diversity is called interspecific diversity and refers to the number and types of different species. Thinking about this diversity we might note that many small vegetable farmers grow many different crops like potatoes, and also carrots, peppers, lettuce etc.

Agricultural diversity can also be divided by whether it is 'planned' diversity or 'associated' diversity. This is a functional classification that we impose and not an intrinsic feature of life or diversity. Planned diversity includes the crops which a farmer has encouraged, planted or raised (e.g.: crops, covers, symbionts and livestock, among others), which can be contrasted with the associated diversity that arrives among the crops, uninvited (e.g.: herbivores, weed species and pathogens, among others) (Vandermeer, 2010).

The control of associated biodiversity is one of the great agricultural challenges that farmers face. On monoculture farms, the approach is generally to eradicate associated diversity using a suite of biologically destructive pesticides, mechanized tools and transgenic engineering techniques, then to rotate crops. Although some polyculture farmers use the same techniques, they also employ integrated pest management strategies

as well as strategies that are more labor-intensive, but generally less dependent on capital, biotechnology and energy.

Interspecific crop diversity is, in part, responsible for offering variety in what we eat. Intraspecific diversity, the variety of alleles within a single species, also offers us choice in our diets. If a crop fails in a monoculture, we rely on agricultural diversity to replant the land with something new. If a wheat crop is destroyed by a pest we may plant a hardier variety of wheat the next year, relying on intraspecific diversity. We may forgo wheat production in that area and plant a different species altogether, relying on interspecific diversity. Even an agricultural society which primarily grows monocultures, relies on biodiversity at some point.

- The Irish potato blight of 1846 was a major factor in the deaths of one million people and the emigration of about two million. It was the result of planting only two potato varieties, both vulnerable to the blight, *Phytophthora infestans*, which arrived in 1845
- When rice grassy stunt virus struck rice fields from Indonesia to India in the 1970s, 6,273 varieties were tested for resistance (Lumrix.net, 2009). Only one was resistant, an Indian variety, and known to science only since 1966. This variety formed a hybrid with other varieties and is now widely grown.
- Coffee rust attacked coffee plantations in Sri Lanka, Brazil, and Central America in 1970. A resistant variety was found in Ethiopia (Wahl, 1984). The diseases are themselves a form of biodiversity.

Monoculture was a contributing factor to several agricultural disasters, including the European wine industry collapse in the late 19th century, and the US Southern Corn Leaf Blight epidemic of 1970 (Southern Corn Leaf Blight, 2007).

Although about 80 percent of humans' food supply comes from just 20 kinds of plants, humans use at least 40,000 species. Many people depend on these species for food, shelter, and clothing. Earth's surviving biodiversity provides resources for increasing the range of food and other products suitable for human use, although the present extinction rate shrinks that potential.

Biodiversity and Human Health

Biodiversity's relevance to human health is becoming an international political issue, as scientific evidence builds on the global health implications of biodiversity loss (Chivian, et. al., 2008 and Corvalan *et, al.*, 2005).

Biodiversity provides critical support for drug discovery and the availability of medicinal resources (Mendelsohn, 1995, Molecular Pharming, 2006). A significant proportion of drugs are derived, directly or indirectly, from biological sources: at least 50% of the pharmaceutical compounds on the US market are derived from plants, animals, and micro-organisms, while about 80% of the world population depends on medicines from nature (used in either modern or traditional medical practice) for primary healthcare. Only a tiny fraction of wild species has been investigated for medical potential. Biodiversity has been critical to advances throughout the field of bionics. Evidence from market analysis and biodiversity science indicates that the decline in output from the pharmaceutical sector since the mid-1980s can be attributed to a move away from natural product exploration ("bioprospecting") in favor of genomics and synthetic chemistry, indeed claims about the value of undiscovered pharmaceuticals may not provide enough incentive for companies in free markets to search for them because of the high cost of development (Mendelsohn, 1997); meanwhile, natural products have a long history of supporting significant economic and health innovation (Harvey, 2008 and Hawkins, 1992). Marine ecosystems are particularly important (Roopesh, 2008), although inappropriate bioprospecting can increase biodiversity loss, as well as violating the laws of the communities and states from which the resources are taken (Dhillion, *et. al.*, 2002; Cole, 2005; Cohabnet.org, 2009).

Biodiversity, Business and Industry

Many industrial materials derive directly from biological sources. These include building materials, fibers, dyes, rubber and oil. Biodiversity is also important to the security of resources such as water, timber, paper, fiber, and food (IUCN, 2007; Millennium Ecosystem Assessment, 2005 and Cbd.int, 2009). As a result, biodiversity loss is a significant risk factor in business development and a threat to long term economic sustainability.

Biodiversity, Leisure, Cultural and Aesthetic Value

Biodiversity enriches leisure activities such as hiking, birdwatching or natural history study. Biodiversity inspires musicians, painters, sculptors, writers and other artists. Many cultures view themselves as an integral part of the natural world which requires them to respect other living organisms.

Popular activities such as gardening, fishkeeping and specimen collecting strongly depend on biodiversity. The number of species involved in such pursuits is in the tens of thousands, though the majority do not enter commerce.

During the last century, decreases in biodiversity have been increasingly observed. In 2007, German Federal Environment Minister Sigmar Gabriel cited estimates that up to 30% of all species will be extinct by 2050 (Gabriel, 2007). Of these, about one eighth of known plant species are threatened with extinction (Ag.arizona.edu, 2009). Estimates reach as high as 140,000 species per year (based on Species-area theory) (Pimm, et al., 1995). This figure indicates unsustainable ecological practices, because few species emerge each year. Almost all scientists acknowledge that the rate of species loss is greater now than at any time in human history, with extinctions occurring at rates hundreds of times higher than background extinction rates. As of 2012, some studies suggest that 25% of all mammal species could be extinct in 20 years.

In absolute terms, the planet has lost 52% of its biodiversity since 1970 according to a 2014 study by the World Wildlife Fund. The Living Planet Report 2014 claims that "the number of mammals, birds, reptiles, amphibians and fish across the globe is, on average, about half the size it was 40 years ago". Of that number, 39% accounts for the terrestrial wildlife gone, 39% for the marine wildlife gone, and 76% for the freshwater wildlife gone. Biodiversity took the biggest hit in Latin America, plummeting 83 percent. High-income countries showed a 10% increase in biodiversity, which was canceled out by a loss in low-income countries. This is despite the fact that high-income countries use five times the ecological resources of low-income countries, which was explained as a result of process whereby wealthy nations are outsourcing resource depletion to poorer nations, which are suffering the greatest ecosystem losses.

1.4 Threats

In 2006 many species were formally classified as rare or endangered or threatened; moreover, scientists have estimated that millions more species are at risk which have not been formally recognized. About 40 percent of the 40,177 species assessed using the IUCN Red List criteria are now listed as threatened with extinction—a total of 16,119.

Jared Diamond describes an "Evil Quartet" of habitat destruction, overkill, introduced species, and secondary extinctions (Sanderson, 1998). Edward O. Wilson prefers the acronym HIPPO, standing for Habitat destruction, Invasive species, Pollution, human over-Population, and Over-harvesting (Jim, 2003; Hippo, 2005). The most authoritative classification in use today is IUCN's Classification of Direct Threats(IUCN's Classification of Direct Threats, 2011) which has been adopted by major international conservation organizations such as the US Nature Conservancy, the World Wildlife Fund, Conservation International, and Birdlife International.

Habitat Destruction

Habitat destruction has played a key role in extinctions, especially related to tropical forest destruction (Paul, 1981). Factors contributing to habitat loss are: overconsumption, overpopulation, land use change, deforestation (Michael, 2010), pollution (air pollution, water pollution, soil contamination) and global warming or climate change.

Habitat size and numbers of species are systematically related. Physically larger species and those living at lower latitudes or in forests or oceans are more sensitive to reduction in habitat area (Drakare, *et, al.*, 2006). Conversion to "trivial" standardized ecosystems (e.g., monoculture following deforestation) effectively destroys habitat for the more diverse species that preceded the conversion. In some countries lack of property rights or lax law/regulatory enforcement necessarily leads to biodiversity loss (degradation costs having to be supported by the community).

A study conducted by the National Science Foundation found that biodiversity and genetic diversity are codependent—that diversity among species requires diversity within a species, and vice versa. "If any one type is removed from the system, the cycle can break down, and the community becomes dominated by a single species (Enn.com. 2007)." At present, the most threatened ecosystems are found in freshwater, according to

the Millennium Ecosystem Assessment 2005, which was confirmed by the "Freshwater Animal Diversity Assessment", organised by the biodiversity platform, and the French Institut de recherche pour le développement (MNHNP).

Co-extinctions are a form of habitat destruction. Co-extinction occurs when the extinction or decline in one accompanies the other, such as in plants and beetles (Koh, 2004).

Over Exploitation

Overexploitation occurs when a resource is consumed at an unsustainable rate. This occurs on land in the form of overhunting, excessive logging, poor soil conservation in agriculture and the illegal wildlife trade.

About 25% of world fisheries are now overfished to the point where their current biomass is less than the level that maximizes their sustainable yield (Grafton, *et, al.*, 2007).

The overkill hypothesis, a pattern of large animal extinctions connected with human migration patterns, can be used explain why megafaunal extinctions can occur within a relatively short time period (Burney, *et. al.*, 2005).

Climate Change

Global warming is also considered to be a major potential threat to global biodiversity in the future (Climate change and biodiversity, 2005 and Kannan, *et. al.*, 2009). For example coral reefs - which are biodiversity hotspots - will be lost in 20 to 40 years if global warming continues at the current trend.

Climate change has seen many claims about potential to affect biodiversity but evidence supporting the statement is tenuous. Increasing atmospheric carbon dioxide certainly affects plant morphology (Ainsworth, 2004) and is acidifying oceans (Doney, 2009), and temperature affects species ranges (Loarie, 2005; Walther, 2009 and Thomas *et, al.*, 2005), phenology (Hegland, 2009), and weather (Min, *et. al.*, 2011), but the major impacts that have been predicted are still just *potential* impacts. We have not documented major extinctions yet, even as climate change drastically alters the biology of many species.

In 2004, an international collaborative study on four continents estimated that 10 percent of species would become extinct by 2050 because of global warming. "We need to limit climate change or we wind up with a lot of species in trouble, possibly extinct," said Dr.

Lee Hannah, a co-author of the paper and chief climate change biologist at the Center for Applied Biodiversity Science at Conservation International (Brown, 2004).

Human Over Population

From 1950 to 2011, world population increased from 2.5 billion to 7 billion and is forecast to reach a plateau of more than 9 billion during the 21st century. Sir David King, former chief scientific adviser to the UK government, told a parliamentary inquiry: *"It is self-evident that the massive growth in the human population through the 20th century has had more impact on biodiversity than any other single factor* (Citizens arrest, 2007)*."* At least until the middle of the 21st century, worldwide losses of pristine biodiverse land will probably depend much on the worldwide human birth rate (Dumont, 2012).

According to a 2014 study by the World Wildlife Fund, the global human population already exceeds planet's biocapacity - it would take the equivalent of 1.5 Earths of biocapacity to meet our current demands. The report further points that if everyone on the planet had the Footprint of the average resident of Qatar, we would need 4.8 Earths, and if we lived the lifestyle of a typical resident of the USA, we would need 3.9 Earths.

Conservation

Conservation biology matured in the mid-20th century as ecologists, naturalists, and other scientists began to research and address issues pertaining to global biodiversity declines (Soule, 1986; Davis, 1996 and Dyke 2008).

The conservation ethic advocates management of natural resources for the purpose of sustaining biodiversity in species, ecosystems, the evolutionary process, and human culture and society (Hunter, 1996 and Bowen 1999).

Conservation biology is reforming around strategic plans to protect biodiversity (Soule, 1986 and Margules, 2000). Preserving global biodiversity is a priority in strategic conservation plans that are designed to engage public policy and concerns affecting local, regional and global scales of communities, ecosystems, and cultures (Gascon, 2007). Action plans identify ways of sustaining human well-being, employing natural capital, market capital, and ecosystem services (Luck, *et. al.,* 2003 and Millenniumassessment.org).

In the EU Directive 1999/22/EC zoos are described as having a role in the preservation of the biodiversity of wildlife animals by conducting research or participation in breeding programs (Ministry of Economic Affairs, 2014).

Protection and Restoration Techniques

Removal of exotic species will allow the species that they have negatively impacted to recover their ecological niches. Exotic species that have become pests can be identified taxonomically (e.g., with Digital Automated Identification System (DAISY), using the barcode of life) (Barcode of Life, 2011). Removal is practical only given large groups of individuals due to the economic cost.

As sustainable populations of the remaining native species in an area become assured, "missing" species that are candidates for reintroduction can be identified using databases such as the *Encyclopedia of Life* and the Global Biodiversity Information Facility.

- Biodiversity banking places a monetary value on biodiversity. One example is the Australian Native Vegetation Management Framework.
- Gene banks are collections of specimens and genetic material. Some banks intend to reintroduce banked species to the ecosystem (e.g., via tree nurseries) (Hbvl.be, 2011).
- Reduction of and better targeting of pesticides allows more species to survive in agricultural and urbanized areas.
- Location-specific approaches may be less useful for protecting migratory species. One approach is to create wildlife corridors that correspond to the animals' movements. National and other boundaries can complicate corridor creation

Resource Allocation

Focusing on limited areas of higher potential biodiversity promises greater immediate return on investment than spreading resources evenly or focusing on areas of little diversity but greater interest in biodiversity.

A second strategy focuses on areas that retain most of their original diversity, which typically require little or no restoration. These are typically non-urbanized, non-agricultural areas. Tropical areas often fit both criteria, given their natively high diversity and relative lack of development (Jones-Walters, *et. al.*, 2009).

Legal Status

Global agreements such as the Convention on Biological Diversity, give "sovereign national rights over biological resources" (not property). The agreements commit countries to "conserve biodiversity", "develop resources for sustainability" and "share the benefits" resulting from their use. Biodiverse countries that allow bioprospecting or collection of natural products, expect a share of the benefits rather than allowing the individual or institution that discovers/exploits the resource to capture them privately. Bioprospecting can become a type of biopiracy when such principles are not respected.

Sovereignty principles can rely upon what is better known as Access and Benefit Sharing Agreements (ABAs). The Convention on Biodiversity implies informed consent between the source country and the collector, to establish which resource will be used and for what, and to settle on a fair agreement on benefit sharing.

National Level Laws

Uniform approval for use of biodiversity as a legal standard has not been achieved, however. Bosselman argues that biodiversity should not be used as a legal standard, claiming that the remaining areas of scientific uncertainty cause unacceptable administrative waste and increase litigation without promoting preservation goals.

India passed the Biological Diversity Act in 2002 for the conservation of biological diversity in India. The Act also provides mechanisms for equitable sharing of benefits from the use of traditional biological resources and knowledge.

It is recognized that wildlife is an interdependent component of the world ecosystem, so it is important to conserve the wildlife for the following objectives-

- To protect the wildlife resource and the ecological processes and critical habitat areas vital to the welfare of the wild life community and there by maintain a viable, healthy wildlife population.
- To promote and regulate non-consumptive uses of the wildlife resource for education, aesthetic, recreational and scientific purposes.
- To increase the basic understanding of the ecology of wildlife and instill this knowledge in the forest management system.

- To foster a conservation ethic among a broad sector of the community which will actively support wildlife and natural resource conservation.

The conservation of wildlife and the natural ecosystem is imperative, not only to maintain the productivity of the forest, but for the preservation of wildlife and the various services and functions performed by the forest (Helalsiddiqui, 1998).

1.5 Causes of Recent Declines in Biodiversity

The major causes of biodiversity decline are land use changes, pollution, changes in atmospheric CO_2 concentrations, changes in the nitrogen cycle and acid rain, climate alterations, and the introduction of exotic species, all coincident to human population growth. For rainforests, the primary factor is land conversion. Climate will probably change least in tropical regions, and nitrogen problems are not as important because growth in rainforests is usually limited more by low phosphorus levels than by nitrogen insufficiency. The introduction of exotic species is also less of a problem than in temperate areas because there is so much diversity in tropical forests that newcomers have difficulty becoming established.

1.6 Categories of World Protected Areas for Wildlife

The world's protected areas play a fundamental role in the conservation of species and ecosystem diversity worldwide. The Government uses a variety of different legal and administrative mechanisms to manage national areas for the conservation of biodiversity. There are ten categories of world's protected areas for Wildlife are recognized:

1. Scientific Reserve/Strict Nature Reserve.
2. National Park.
3. National Monument/Natural Land Mark.
4. Managed Nature Reserve/ wildlife sanctuary.
5. Protected landscape or seascape.
6. Resource Reserve.
7. Natural biotic Area/ Anthropological Reserve.
8. Multiple- use Management Area/ Management Resource Area.
9. Biosphere Reserve.
10. World Heritage Sites.

Table 1.1: Parks and Protected areas of Bangladesh

1.	Sundarban East Wildlife Sanctuary Bagerhat District	15,439 ha	Margrave forest
2.	Sundarban South Wildlife Sanctuary Khulna District	17,878 ha	Mangrove forest
3.	Sundarban West Wildlife Sanctuary Satkhira District	9,069 ha	Mangrove forest
4.	Sundarban Wildlife Sanctuary, Khulna	139,500 ha	Mangrove forest
5.	Rema Kalenga Wildlife Sanctuary Srimongal, Habigonj	1095 ha	Mixed evergreen forest
6.	Char-Kukrimukri Wildlife Sanctuary Bhola District	40 ha	Mangrove forest
7.	Pablakhali Wildlife Sanctuary Chittagong Hill Tracts	42,087 ha	High hill mixed evergreen forest
8.	Teknaf Game Reserve Chittagong Hill Tracts	11,615 ha	High hill mixed evergreen forest
9.	Himchari National park, Cox's Baser	1,729 ha	Mixed evergreen forest
10.	Bhawal National park, Gazipur	5,022 ha	Deciduous Forest
11.	Modhupur National Park, Tangail	8,436 ha	Deciduous Forest
12.	Ramsagar National Park, Dinajpur	52 ha	Lake Sal forest
13.	Hail Haor Wildlife Sanctuary Shrimongal (Proposed), Habigonj	1,427	Fresh Water Wetland
14.	Hazarikhil Wildlife Sanctuary, Chittagong	2,909 ha	Mixed evergreen forest
15.	Chunate Wildlife Sanctuary, Chittagong	19,177 Acres	Mixed Evergreen Forest
16.	Dulahazra Wildlife Sanctuary, Chittagong	3950 Acres	Evergreen Forest

1.7 Wildlife Conservation

Wildlife conservation is the practice of protecting wild plant and animal species and their habitats. Among the goals of wildlife conservation are to ensure that nature will be around for future generations to enjoy and to recognize the importance of wildlife and wilderness lands to humans (CARE, 2012). Many nations have government agencies dedicated to wildlife conservation, which help to implement policies designed to protect wildlife. Numerous independent non-profit organizations also promote various wildlife conservation causes (Wildlife Conservation, 2012).

Wildlife conservation has become an increasingly important practice due to the negative effects of human activity on wildlife. The science of extinction is called dirology. An endangered species is defined as a population of a living being that is at the danger of becoming extinct because of several reasons. The reasons can include that the species has a very low population or is threatened by the varying environmental or prepositional parameters.

Fewer natural wildlife habitat areas remain each year. Moreover, the habitat that remains has often been degraded to bear little resemblance to the wild areas which existed in the past. Habitat loss—due to destruction, fragmentation or degradation of habitat—is the primary threat to the survival of wildlife in the United States. When an ecosystem has been dramatically changed by human activities—such as agriculture, oil and gas exploration, commercial development or water diversion—it may no longer be able to provide the food, water, cover, and places to raise young. Every day there are fewer places left that wildlife can call home.

There are three major kinds of habitat loss:

- Habitat destruction: A bulldozer pushing down trees is the iconic image of habitat destruction. Other ways that people are directly destroying habitat, include filling in wetlands, dredging rivers, mowing fields, and cutting down trees.

- Habitat fragmentation: Much of the remaining terrestrial wildlife habitat in the U.S. has been cut up into fragments by roads and development. Aquatic species' habitat has been fragmented by dams and water diversions. These fragments of habitat may not be large or connected enough to support species that need a large territory in which to find mates and food. The loss and fragmentation of habitat make it difficult for migratory species to find places to rest and feed along their migration routes.

- Habitat degradation: Pollution, invasive species and disruption of ecosystem processes (such as changing the intensity of fires in an ecosystem) are some of the ways habitats can become so degraded that they no longer support native wildlife.

Today, the (Endangered Species Act) protects some U.S. species that were in danger from over exploitation, and the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) works to prevent the global trade of wildlife. But there are many species that are not protected from being illegally traded or over-harvested.

North American Model of Wildlife Conservation

The North American Model of Wildlife Conservation is a set of principles that has guided management and conservation decisions in the United States and Canada (Organ, *et. al.,* 2012). Although not formally articulated until 2001, (Geist, *et. al.,* 2001) the model has its origins in 19th century conservation movements, the near extinction of several species of wildlife (including the American Bison) and the rise of sportsmen with the middle class. (Mahoney, 2004 and TWS Final Position Statement, 2011). Beginning in the 1860s sportsmen began to organize and advocate for the preservation of wilderness areas and wildlife. The North American Model of Wildlife Conservation rests on two basic principles – fish and wildlife are for the non-commercial use of citizens, and should be managed such that they are available at optimum population levels forever. These core principles are elaborated upon in the seven major tenets of the model:

1. Wildlife as Public Trust Resources.
2. Elimination of Markets for Game.
3. Allocation of Wildlife by Law
4. Wildlife Should Only be Killed for a Legitimate Purpose
5. Wildlife is Considered an International Resource
6. Science is the Proper Tool for Discharge of Wildlife Policy
7. Democracy of Hunting

Wildlife Conservation as a Government Involvement

In 1972, the Government of India enacted a law called the Wildlife Conservation Act. Soon after enactment, a trend emerged whereby policymakers enacted regulations on conservation. State and non-state actors began to follow a detailed "framework" to work

toward successful conservation. The World Conservation Strategy was developed in 1980 by the "International Union for Conservation of Nature and Natural Resources" (IUCN) with advice, cooperation and financial assistance of the United Nations Environment Programme (UNEP) and the World Wildlife Fund and in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Educational, Scientific and Cultural Organization (Unesco)" (World Conservation Strategy 2011). The strategy aims to "provide an intellectual framework and practical guidance for conservation actions." This thorough guidebook covers everything from the intended "users" of the strategy to its very priorities. It even includes a map section containing areas that have large seafood consumption and are therefore endangered by over fishing. The main sections are as follows:

The objectives of conservation and requirements for their achievement:

1. Maintenance of essential ecological processes and life-support systems.
2. Preservation of genetic diversity that is flora and fauna.
3. Sustainable utilization of species and ecosystems.

Priorities for national action:

1. A framework for national and sub-national conservation strategies.
2. Policy making and the integration of conservation and development.
3. Environmental planning and rational use allocation.

Priorities for international action:

1. International action: law and assistance.
2. Tropical forests and dry lands.
3. A global programme for the protection of genetic resource areas.

Map sections

1. Tropical forests
2. Deserts and areas subject to desertification.

Non-government Involvement

As “major development agencies” became “discouraged with the public sector” of environmental conservation in the late 1980s, these agencies began to lean their support towards the “private sector” or non-government organizations (NGOs) (Meyer, 1993). In

a World Bank Discussion Paper it is made apparent that "the explosive emergence of nongovernmental organizations" was widely known to government policy makers. Seeing this rise in NGO support, the U.S. Congress made amendments to the Foreign Assistance Act in 1979 and 1986 "earmarking U.S. Agency for International Development (USAID) funds for biodiversity". From 1990 moving through recent years environmental conservation in the NGO sector has become increasingly more focused on the political and economic impact of USAID given towards the "Environment and Natural Resources" (The Foreign Assistance, 2011). After the terror attacks on the World Trade Centers on September 11, 2001 and the start of former President Bush's War on Terror, maintaining and improving the quality of the environment and natural resources became a "priority" to "prevent international tensions" according to the Legislation on Foreign Relations Through 2002 and section 117 of the 1961 Foreign Assistance Act. Furthermore in 2002 U.S. Congress modified the section on endangered species of the previously amended Foreign Assistance Act.

The amendments to the section also included modifications on the section concerning "PVOs and other Nongovernmental Organizations." The section requires that PVOs and NGOs "to the fullest extent possible involve local people with all stages of design and implementation." These amendments to the Foreign Assistance Act and the recent rise in USAID funding towards foreign environmental conservation have led to several disagreements in terms of NGOs' role in foreign development.

Active Non-government Organizations

Many NGOs exist to actively promote, or be involved with wildlife conservation:

- The Nature Conservancy is a US charitable environmental organization that works to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. (Nature.org. 2011).

- World Wide Fund for Nature (WWF) is an international non-governmental organization working on issues regarding the conservation, research and restoration of the environment, formerly named the World Wildlife Fund, which remains its official name in Canada and the United States. It is the world's largest independent conservation organization with over 5 million supporters worldwide,

working in more than 90 countries, supporting around 1300[4] conservation and environmental projects around the world. It is a charity, with approximately 60% of its funding coming from voluntary donations by private individuals. 45% of the fund's income comes from the Netherlands, the United Kingdom and the United States. (WWF in Brief, 2011).

1.8 Types of Breeding

According to the scientist "Breeding is a judicious and selective phenomenon of mating." The system of animal breeding can be divided into following types-

1. Inbreeding
2. Out breeding
3. Cross breeding.
4. Captive Breeding
5. In situ conservation
6. Ex-situ Conservation

1. Inbreeding:

"The process of mating of individuals which are more closely related than the average of the population, to which they belong, is called inbreeding." The continuous inbreeding results, genetically in homozygousity, it produces homozygous stocks of dominant or recessive genes and Eliminates heterozygousity from the inbred population.

2. Out breeding:

"When a mating involves individuals that are more distantly related than the average of the selected group. It is known as out breeding." Out breeding produces better quality of offspring called heterosis or hybrid vigour.

3. Cross breeding:

"Mating of individuals from entirely different races or even different species is called cross breeding." This represents the most extreme form of out breeding that is possible among animals. Cross breeding produces sterile hybrids in comparison to normal out breeding.

Example, A mule is a hybrid of a male donkey and a female horse. Mule shows hybrid vigor but they are sexually sterile. Beside this another type of breeding is present, which is called "captive breeding". It almost found in zoo animal.

4. Captive Breeding

Captive breeding is defined as a breeding system, which occurs in captive condition. Captive breeding is the process of breeding rate of endangered species in human controlled environments with restricted settings, such as wildlife sanctuaries, zoos and with in the other conservation facilities. Sometimes in the process is to include release of individual organisms to the wild, when there is sufficient natural habitat to support new individuals of when we threat to the Species in the wild is lessened.

5. In situ conservation

In situ conservation is on-site conservation or the conservation of genetic resources in natural populations of plant or animal species, such as forest genetic resources in natural populations of tree species. It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself, or by defending the species from predators. It is applied to conservation of agricultural biodiversity in agroecosystems by farmers, especially those using unconventional farming practices.

One benefit of *in situ* conservation is that it maintains recovering populations in the surrounding where they have developed their distinctive properties. Another is that this strategy helps ensure the ongoing processes of evolution and adaptation within their environments. As a last resort, ex-situ conservation may be used on some or all of the population, when *in situ* conservation is too difficult, or impossible.

Wildlife and livestock conservation is mostly based on *in situ* conservation. This involves the protection of wildlife habitats. Also, sufficiently large reserves are maintained to enable the target species to exist in large numbers. The population size must be sufficient to enable the necessary genetic diversity to survive within the population, so that it has a good chance of continuing to adapt and evolve over time. This reserve size can be calculated for target species by examining the population density in naturally occurring situations. The reserves must then be protected from intrusion or destruction by man, and against other catastrophes.

6. Ex-situ Conservation

Ex situ conservation means literally, "off-site conservation". It is the process of protecting an endangered species of plant or animal outside its natural habitat; for example, by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans. While *ex situ* conservation comprises some of the oldest and best known conservation methods, it also involves newer, sometimes controversial laboratory methods.

The best method of maximizing a species chance of survival (when *ex situ* methods are required) is by relocating part of the population to a less threatened location. It is extremely difficult to mimic the environment of the original colony location given the large number of variables defining the original colony (microclimate, soils, symbiotic species, absence of severe predation, etc.). It is also technically challenging to uproot (in the case of plants) or trap (in the case of animals) the required organisms without undue harm.

An example of colony relocation in the wild is the case of the endangered Santa Cruz Tarweed, a new colony of which was discovered during a mid-1980s survey at the site of a proposed shopping center in western Contra Costa County in California. Once the city of Pinole had decided to approve the shopping center, the city relied on a relocation plan developed by Earth Metrics scientists to remove the entire colony to a nearby location immediately east of Interstate Highway 80 within the Caltrans right-of-way (Deghi, *et al.* 1986).

Zoos and botanical gardens are the most conventional methods of *ex situ* conservation, all of which house whole, protected specimens for breeding and reintroduction into the wild when necessary and possible. These facilities provide not only housing and care for specimens of endangered species, but also have an educational value. They inform the public of the threatened status of endangered species and of those factors which cause the threat, with the hope of creating public interest in stopping and reversing those factors which jeopardize a species' survival in the first place. They are the most publicly visited *ex situ* conservation sites, with the WZCS (World Zoo Conservation Strategy) estimating that the 1100 organized zoos in the world receive more than 600 million visitors annually.

The genetic information needed in the future to reproduce endangered animal species can be preserved in genebanks, which consist of cryogenic facilities used to store living

sperm, eggs, or embryos. The Zoological Society of San Diego has established a "Frozen zoo" to store such samples using modern cryopreservation techniques from more than 355 species, including mammals, reptiles, and birds.

A potential technique for aiding in reproduction of endangered species is interspecific pregnancy, implanting embryos of an endangered species into the womb of a female of a related species, carrying it to term (Niasari-Naslaji, *et. al.,* 2009). It has been carried out for the Spanish Ibex (Fernandez-Arias, *et. al.*, 1999).

Showy Indian clover, *Trifolium amoenum,* is an example of a species that was thought to be extinct, but was rediscovered in 1993 (Connors, 1994) by Peter Connors in the form of a single plant at a site in western Sonoma County (U.S. Fish and Wildlife Service, Arcata Division, 1655). Connors harvested seeds and grew specimens of this critically endangered species in a controlled environment.

Ex situ conservation, while helpful in humankind's efforts to sustain and protect our environment, is rarely enough to save a species from extinction. It is to be used as a last resort, or as a supplement to in situ conservation because it cannot recreate the habitat as a whole the entire genetic variation of a species, its symbiotic counterparts, or those elements which, over time, might help a species adapt to its changing surroundings. Instead, *ex situ* conservation removes the species from its natural ecological contexts, preserving it under semi-isolated conditions whereby natural evolution and adaptation processes are either temporarily halted or altered by introducing the specimen to an unnatural habitat. In the case of cryogenic storage methods, the preserved specimen's adaptation processes are frozen altogether. The downside to this is that, when re-released, the species may lack the genetic adaptations and mutations which would allow it to thrive in its ever-changing natural habitat.

Furthermore, *ex situ* conservation techniques are often costly, with cryogenic storage being economically infeasible in most cases since species stored in this manner cannot provide a profit but instead slowly drain the financial resources of the government or organization determined to operate them. Seedbanks are ineffective for certain plant genera with recalcitrant seeds that do not remain fertile for long periods of time. Diseases and pests foreign to the species, to which the species has no natural defense, may also cripple crops of protected plants in *ex situ* plantations and in animals living in *ex situ*

breeding grounds. These factors, combined with the specific environmental needs of many species, some of which are nearly impossible to recreate by man, make *ex situ* conservation impossible for a great number of the world's endangered flora and fauna.

1.9 The Objectives of the Study

1. To identify the zoos of Bangladesh and justify the status of zoos in comparison to the World Modern Zoos.
2. To evaluate the captive breeding of wild animals in ex-situ condition, sometimes in-situ condition and make a comparative study of captive breeding in the zoos or rearing centers of Bangladesh.
3. To describes the success of reintroducing of endangered species in Bangladesh.
4. To determine the states of zoos in Bangladesh and find out the ex-situ conservation status of zoos in Bangladesh.
5. Retrospective survey of animal diversity, their trends and management development of zoos in Bangladesh.
6. To identify the risk factors both the environmental and technical issues and providing probable solutions for them.

Chapter Two
History of Zoo

The zoo can find its earliest origins as far back as 3000 years ago in Ancient Egypt. The pharaohs would upon occasion demand that wild animals be captured and retained for the amusement of the ruler, intimidation of enemies, or to hunt as sport in a controlled setting. No matter what the surface reason, the root cause of keeping wild animals in this fashion was to exhibit the wealth and power of the ruler. This model continued on a very limited scale until the age of exploration, when explorers would collect exotic specimens from their travels around the world, particularly in the tropical regions. This led to zoos springing up in capital cities around the western world, once again to demonstrate the city's status through the size and grandeur of its zoo. Competitions sprang up between zoos to exhibit the greatest variety of species in "splendid isolation." This resulted in many small and inadequate exhibits that by today's standards seem inherently cruel to the animals, but it's not fair to judge past generations by today's standards. These zoos also had no concept of conservation as we do today as people then viewed the natural world as inexhaustible. At the same time however, natural history museums were being founded. Couple the studious nature of the museum with access to new exotic subject matter through the age of exploration, and studies were done, possibly leading to a change in zoological thinking.

After World War Two, zoological thinking began to take it's modern form. They began to take the roles of conservation facilities and everything that comes along with that role. Zoos began establishing research departments and hiring educational staff to share their new message with the public. This new found knowledge and attitude toward zoo management has resulted in more suitable habitats for the animals in the zoo. Through research, mixed species exhibits are formed creating a more natural experience for both the animals and visitors.

As we continue to study and learn from the animals we have in zoos, we can continue to provide more and more appropriate habitats and experiences in zoos. We have come a long way in how zoos are run and organized, each new role changing with the times. Today zoos serve a very important role in global conservation and sustainability.

Modern zoos are often said to have begun with London's Regent's Park Zoo in the 1820's because it was founded with a scientific purpose. However, it will be seen that this step was a culmination of the Age of Reason which is conveniently dated from 1750. Likewise, an equally valid claim could be made for dating our current style of zoo design as beginning with Hagenbeck's zoo in Hamburg. However, so much change in science and technology, and in society, after World War Two places the tremendous innovations of Hagenbeck in a different era. The post-Second World War period is when the principals of what could be called the new architectural discipline of zoo design began to appear.

New zoos are not a frequent event; and, once established, not easily changed. The history of zoo design, has tended to be one of ground breaking advances which renews interest in zoos and, hence, there is a spate of zoo building and existing ones change to follow the trend. Though seemingly revolutionary, the new order is always a product of the society that fosters it and, until now, has always followed the architectural styles of the time. The current trend to habitat design is still a product of its time, but has steered an independent architectural course. Existing mind-sets, financial and space constraints always present difficulties to older zoos with every new direction. Some zoos do not change, others undertake to completely make-over their displays to fit with new ideas. By-and-large, most zoos become a mix of epochs; building new exhibits more or less at the leading edge of design while retaining or making do with renovations to existing out-dated enclosures.

2.1 Pre-modern Zoos (up to 1750)

The zoos of ancient and even relatively recent societies are usually described disparagingly as menageries. To glorify and give private amusement to ruling classes has been the hallmark distinguishing menageries from ‘proper’ zoos. Today, the term ‘menagerie’ has come to mean any small collection of exotic animals which, by the way it is managed, is considered below ‘zoo’ standard. This is to overlook the fact that many menageries were established out of motives similar to the better zoos of today and were not always for private amusement, public spectacle or to enhance the prestige of the owner. In regard to the treatment of animals, it is obvious that whatever fate was to be fall the specimens (display or destruction) they had to be maintained in the meantime and considerable knowledge of animal needs must have been available to enable this.

With the rise of civilizations, there had probably already been in existence a habit of keeping non-domestic animals as curiosities. It took the establishment of settled civilised cultures, i.e., with the ability to produce agricultural surpluses to support urban centres to grow, to enable the organised keeping of wild animals. This knowledge was gained over tens of thousands of years of prehistoric development. Realising that neolithic cultures possessed a great deal of knowledge about wild animals from hunting and domesticating them, it becomes reasonable to assume that just as today, there were good and bad zoos, enlightened and backward ones. Scientific knowledge may have been virtually non-existent, but practical animal husbandry could have been quite as advanced as it is today. The purpose of these ancient zoos tended to follow the proclivities of the rulers who established them, whether it be sport or spectacle. Referring to this figure, Loisel states that: On arrival at the destination, the lions would have been placed in an enclosure in the royal palace or released in semi-liberty in vast, special parks, planted with palm trees, vines and flowers, and that the Greeks called Paradeisos.

The palace animals were groomed as pets; however, it was not paradise for the other animals. Loisel continues in the Paradeisos, the lions were destined for sport, combats or the chase. For dynastic civilizations everywhere, menageries were a natural adjunct which served to show the wealth and splendour of their rulers. Still the main purposes of modern zoos - scientific study or public recreation - were not unknown. Many animal collections of ancient civilizations were also used for scientific study and may have qualified as zoos by today's standards.

Thus, zoos or menageries have been a feature of civilizations as ancient as that of Ninevah and pharoanic Egypt and as far removed as China and pre-Hispanic Mexico. The earliest known great zoo of the pre-modern past was that of Queen Hapshepsut of the Eighteenth dynasty in Egypt, who died in 1468 BC, around the time of construction of the great temple of Amon. Her own temple, associated with her tomb, is decorated with friezes depicting a trade expedition to Punt (Somalia) where among other things she collected a great many animals. As Bernard Livingston says: by this time, at least, man the tamer had the capability of being man the zookeeper.

Alexander, Kublai Khan and Emperor Wen Wang of the Chou Dynasty in China (who created the famous “Garden of Intelligence”), Constantine, Charlemagne, Louis XIV and Montezuma were all founders of zoos. Alexander the Great, a pupil of Aristotle, established

probably the first zoo as an educational institution. Aristotle, who described 300 animals in his History of Animals, wrote, "We must therefore not draw back childishly from examining the meaner animals. In all natural beings there is something of the marvellous."

Ptolemy II assembled a procession for the feast of Dionysus in the city of Alexandria a mile long which took a full day to pass by. In Rome, animals were used in bloody spectacles, on a vast scale also. The Romans were not noted for zoos; as great collectors and consumers of wildlife, they were responsible for the extinction of much of the large wild mammals within their Empire, for example lions in Europe. However, some, like Pliny the Elder did have a scientific interest in animals. Constantine established public zoos at Antioch and Byzantium which were maintained until 538 AD when the Persians destroyed them. Charlemagne established zoos in several monasteries in the Seventh Century. One order - the friars of St. Gallen in Switzerland - built a zoo of surprisingly modern design, with roomy quarters for the carnivores, work spaces for the keepers and well-kept outdoor paddocks for the hoofed animals.

In Britain, the famous zoo in the Tower of London was originally established by Henry I at his provincial residence at Woodstock from where it was moved to the Tower in 1230 by Henry III. Here its function was the keeping of animals for contests. It became a public zoo, the first publicly funded municipal zoo, when Henry III decided he was not going to provide for accommodating all the tourists who flocked to see first a Polar bear and then an elephant.

There were other royal and municipal menageries throughout Europe in the Middle Ages, notably the famous, or infamous, bear pit of Berne. But it was in the Renaissance that the royal menagerie reached its pinnacle with the first use of architecture designed around animals. In all ages, animals were probably housed in buildings which expressed the standing of their collectors. But for the first time animals were seen as part of a grand conception, as Jon Coe, notes:

> Animals, like the topiary shrubs and embroidery parterres, are ornaments to amuse aristocrats. Even nature is under the control of king and court. Thus, what began at Nineveh as direct physical control of beasts (and nature) evolved to intellectual symbols of control. But human sovereignty over nature was unquestioned. (Jon Coe, 1994)

After Renaissance Man had reached the New World in 1492, Tenochtitlán, the capital of the Aztec ruler, Montezuma, and site of his royal menagerie was destroyed in 1520 by Cortez. It is reputed to have been the greatest royal menagerie ever and must rank as an outstanding zoological collection. It was noted by its very destroyers for the quarters and care provided for the birds and animals. 300 men and women tended the vast aviary alone. It even had dedicated veterinary staff to care for sick animals.

The evidence of ancient zoos is mostly anecdotal. Seeking an underlying theme in zoo development, Coe sees two separate strands, or 'time lines', of development in these extremes of great savagery and nobility. He divides zoos into "displays of human power" where animals are used as symbols of power or popular amusement; and "educational and ethical exhibits" intended to "instruct and inspire". These strands converge, he states, in the Victorian age. Expressions of power became more symbolic among the cultural elites while the brutish element continued in the lower orders of society with bear baiting and other entertainments. While this was happening, the interest in the natural world grew and lead to the flowering of the Age of Reason. The symbolic use of animals began to merge with notions of a well-ordered universe. This lead to the collection of live specimens for study rather than amusement, and hence the first scientifically established zoos of the modern world.

2.2 Modern Development (1750 to 1950)

The period began with the establishment of a formal garden menagerie at Schonbrunn in Austria in 1752, just six years before Linnaeus published his work on systematic nomenclature for plants and animals. It was the last great royal menagerie of Europe. The first such animal collection kept for scientific purposes originated earlier (in 1624) as the royal Menagerie du Parc at Versailles. After the revolution of 1789, the naturalist, Cuvier, reorganised the collection on scientific principles and it was transferred to the Jardin des Plantes. Perhaps the revolutionary fervour in which this new zoo enterprise was begun, and the arms-length at which the new regime in France was held by other nations with absolute monarchs, discouraged direct imitation of it or recognition of any innovation. France's legacy was profound, however, though indirect, through Rousseau's call to spiritual refreshment through a return to nature. Coe goes on to develop a philosophical lineage of present day zoo design from this through to the Romantic Movement in literature and art. It is traced through Wordsworth, Emerson to Thoreau and to the 'wilderness ethic' expressed

through the American conservation and national parks movements. Intersecting this are two diverse strands of human thought: the Western rational philosophy of Utilitarianism and Eastern Buddhist philosophy. The former gave rise to the animal welfare movement and respect for nature, and the second to advocacy of non-violence.

The Romantic spirit did come to influence zoos, primarily in America through the informal park design of Olmsted and Vaux. The next great developments, however, contained a strong element of man's domination over nature, rather than stewardship. They were the founding of the Zoological Society of London and the creation of Hagenbeck's zoo in Hamburg.

Until the early 19th century, the function of the zoo was often to symbolize royal power, like King Louis XIV's menagerie at Versailles. The modern zoo that emerged in the early 19th century at London, Paris and Dublin, was focused on providing educational exhibits to the public for entertainment and inspiration.

A growing fascination for natural history and zoology, coupled with the tremendous expansion in the urbanization of London, led to a heightened demand for a greater variety of public forms of entertainment to be made available. The need for public entertainment, as well as the requirements of scholarly research, came together in the founding of the first modern zoos.

The Zoological Society of London was founded in 1826 by Stamford Raffles and established the London Zoo in Regent's Park two years later in 1828. At its founding, it was the world's first scientific zoo. Originally intended to be used as a collection for scientific study, it was eventually opened to the public in 1847. The Zoo was located in Regent's Park - then undergoing development at the hands of the architect John Nash. What set the London zoo apart from its predecessors was its focus on society at large. The zoo was established in the middle of a city for the public, and its layout was designed to cater for the large London population. The London zoo was widely copied as the archetype of the public city zoo. In 1853, the Zoo opened the world's first public aquarium.

Dublin Zoo was opened in 1831 by members of the medical profession interested in studying animals while they were alive and more particularly getting hold of them when they were dead. The first zoological garden in Australia was Melbourne Zoo in 1860. In

the same year, Central Park Zoo, the first public zoo in the United States, opened in New York, although in 1859, the Philadelphia Zoological Society had made an effort to establish a zoo, but delayed opening it until 1874 because of the American Civil War.

In 1907, the German entrepreneur Carl Hagenbeck founded the Tierpark Hagenbeck in Stellingen, now a quarter of Hamburg. His zoo was a radical departure from the layout of the zoo that had been established in 1828. It was the first zoo to use open enclosures surrounded by moats, rather than barred cages, to better approximate animals' natural environments. He also set up mixed-species exhibits and based the layout on the different organizing principle of geography, as opposed to taxonomy.

When ecology emerged as a matter of public interest in the 1970s, a few zoos began to consider making conservation their central role, with Gerald Durrell of the Jersey Zoo, George Rabb of Brookfield Zoo, and William Conway of theBronx Zoo (Wildlife Conservation Society) leading the discussion. From then on, zoo professionals became increasingly aware of the need to engage themselves in conservation programs, and the American Zoo Association soon said that conservation was its highest priority. Because they wanted to stress conservation issues, many large zoos stopped the practice of having animals perform tricks for visitors. The Detroit Zoo, for example, stopped its elephant show in 1969, and its chimpanzee show in 1983, acknowledging that the trainers had probably abused the animals to get them to perform.

Whipsnade Park in Bedfordshire, England, was opened in 1931 as the first safari park. It allowed visitors to drive through the enclosures and come into close proximity to the animals.

Unfortunately, mass destruction of wildlife habitat has yet to cease all over the world and many species such as elephants, big cats, penguins, tropical birds, primates, rhinos, exotic reptiles, and many others are in danger of dying out. Many of today's zoos hope to stop or slow the decline of many endangered species. Many zoos see their primary purpose as breeding endangered species in captivity and reintroducing them into the wild. Modern zoos also aim to help teach visitors the importance on animal conservation, often through letting visitors witness the animals firsthand. Some critics and the majority of animal-rights activists and extremists say that zoos, no matter what their intentions are, or how

noble they are, are immoral and serve as nothing but to fufill human leisure at the expense of the animals(which is an opinion that has shown growth over the years). However, zoo advocates argue that their efforts make a difference in wildlife conservation and education.

The London Zoological Society's zoo in Regent's Park was a product of the Age of Reason which was seen as civilisation's fullest flowering. The Industrial Revolution also provided ample demonstration of the power of man over nature and the means to this success was seen as knowledge, as expressed by the sturdy Victorian adage: 'Knowledge is Power'. The zoological gardens was founded on scientific principles by a scientific gentry as a tool for furthering knowledge. Regent's Park zoo was the product of a mature and confident social order, at the height of a period of certainty built on Newtonian mechanics, when it was felt everything was knowable and could be derived, given enough time and resources.

Regent's Park itself was part of a large urban development laid out by the architect, John Nash, from 1811 to 1830. The zoo was established in it in 1826, near the end of his life (he died in 1835). In design terms, much is made of the title, London Zoological Gardens, as it implies more than a collection of specimens in indifferent surroundings. As we have seen with the royal menageries of Europe, and particularly France, the garden concept was not new. In these garden menageries, the formal layouts were not just symbolic of power; they were also designed to be seen from a single vantage point - the palace or chateau - by the king or lord. What was new about London Zoo was the social nature of a zoo visit and the need for many simultaneous views by a large populace. The founding of London Zoo set off the modern trend in public city zoos and significantly these were often also set in existing public parks, often against the wishes of their designers:

> The public no longer found relaxing naturalistic environments sufficient for recreation. They demanded entertainment, organized activity and variety. As the nineteenth century progressed, park administrators increasingly dealt with demands for new amenities. Favoured features included conservatories, bandshells and, most disruptive of all to landscape parks, menageries that usually grew into full-scale zoos. In older parks, such as Lincoln Park in Chicago, these were added as afterthoughts where space allowed (or at times really did not), often destroying the original concept of a pastoral retreat. Elsewhere, zoos were added to design programs as work progressed, producing more compatible solutions, but still subverting the real value of a large park (Pregill, 1993)

It can be seen from this that the progress in planning of zoos lagged behind that of parks. In fact, park landscape design and the placement of buildings in landscapes provided the model for zoo planning until well into this century when it can at last be said to have taken on a conceptual framework of its own:

> While some favored the well-ordered symmetry of the Beaux Artes [sic] classic revival period, others, favored the informal, romantic park style initiated by Capability Brown and later popularized and modified for America by Frederic Law Olmsted.

Seemingly immune to this, Carl Hagenbeck stands out as a unique innovator. Having a proletarian background in the strata of society among which bear-baiting and travelling menageries and circuses remained popular, he was not at all hide-bound by notions of correctness. An original thinker motivated by profit, he updated animal husbandry, and display methods which had not changed effectively in millennia, and successfully packaged and marketed them to the Hamburg public through the zoo which he opened at Stellingen in 1907. This business was largely run by his son after his death in 1914 and it should be noted that Hagenbeck senior's business was primarily as an animal dealer. It was through the holding of animals acquired for this trade which allowed Hagenbeck to formulate his ideas about animals, including the training technique now known as operant conditioning and the testing of jumping distances for his moat barrier designs.

Hagenbeck invented the naturalistic exhibit in which obviously man-made built and landscape elements are eschewed in favour of concealed barriers and simulations of natural landscapes. The resulting zoo was also a demonstration of the fact that tropical animals could acclimatize to temperate conditions. He is also credited with originating mixed species exhibits, predator-prey illusions, the zoo-geographic (as opposed to taxonomic) organising principle and ethno-graphic displays related to animal exhibits. As mentioned, the Hagenbecks were driven to succeed, and as a showman, Carl Hagenbeck had a good understanding of what the public wanted. In exhibit design, Coe suggests that he based his panoramas on popular images which were based in turn on picturesque romantic landscapes of the Seventeenth and Eighteenth centuries, rather than actual natural habitats. Coe also comments:

> The “naturalistic” exhibits originated by the Hagenbecks usually placed the viewer on the outside of the romantic panorama. While the animals may be portrayed in the picturesque grottos of some imagined stage set, the public looked over pruned hedges and flower borders of a traditional park. People were separate from and in control of nature.

As with London Zoo before, new zoos were built like Hagenbeck's Zoo, and existing zoos added Hagenbeck-style exhibits. In the period of successive of war, social upheaval and economic hardship that followed, zoos remained a mixture of London and Hamburg styles but there was never-the-less a tremendous amount of zoo development. The role of zoos in society had changed from a bourgeois intellectual toy to a social amenity for the masses for much the same reasons that gladiatorial battles between men and beasts were put on by the Romans (though with much less disastrous consequences for the animals). Modern civic authorities similarly subsidized zoos as free public entertainment during the Depression years. Another reason for growth in these years was job creation schemes:

> Zoos and botanical gardens across the country were also the beneficiaries of federal make-work programs. In San Francisco and Chicago, federally financed workers constructed modern open zoo exhibits with artificial rock made from gunite. (Pregill, 1993)

In such an economic climate, however, real change and innovation were slow, and perhaps zoos were sowing the seeds of public concern a generation later.

> The problems that this fashion for zoos produced cannot be overemphasized, as many cities continue to be affected by them. The problem is really threefold. First, zoos disrupt other park activities because they are popular and usually expand, displacing other use areas. Second, because of the small spaces available, facilities for animals are often minimal at best and inhumane at worst. Recent litigation against several major zoos has begun to improve this condition. Third, the presence of large animals in the midst of an urban park often causes serious environmental problems such as water pollution from uncontrolled sewage and vermin. The notion that zoos are merely a special type of recreational facility, and not a distinctly different institution, was disproved long ago when proposals for a large one in Central Park were turned down. (Sarah Rossbach, 1989 and James 1989)

London Zoo meanwhile again proved to be among the most innovative in the inter-war period, though many of its award winning exhibits, while outstanding architecturally are now discredited as examples of good captive habitats. for example, London Zoo's penguin exhibit is an icon of the Modern Movement with its sweeping, interlocking concrete ramps. The penguins have no need for these ramps, however. In the book, The Stationary Ark, Gerald Durrell gives an amusing account of a tour of another major addition to London Zoo (which he does not name), the Elephant House: a large building with little space allocated for the elephants but a roof high enough for the elephants to fly up and roost, if they had wings (David, 1971).

Never-the-less, improvements followed slowly on advances in the behavioural, veterinary and biological sciences until the next great period of innovation in the 1970's and 80's.

2.3 Development of Zoo Design Since 1950

The fixing of 1950 for the beginning of contemporary zoo design is arbitrary, but it is chosen because the changes in society and necessary pre-conditions which allowed the development of current zoo design practice began from around this time, as the world slowly stabilised following World War II. Before looking at the new practices themselves, the changes most relevant to zoo design will be briefly touched on in three areas: scientific advances, the growth of technology and social change.

By the time under consideration, from the 1950's on, the 'information explosion' was underway, and biological and behavioural sciences were seeing considerable advances. The structure of DNA was determined and in the succeeding decades there were developed: new antibiotics and drugs, which allowed safer handling of animals and greater freedom to husbandry regimes and display techniques; genetic fingerprinting, which allows subspecies issues and genetic viability to be determined for breeding programmes; in vitro fertilization and embryo transfer techniques which likewise greatly increased the scope for breeding endangered species; new knowledge of animals' behavioural, social and dietary requirements; and greater knowledge of the lives of animals in the wild and their relationships with their environments. In this last regard, the work of field biologists such as Schaller and Fossey and others would become highly significant for zoo designers later, while Hediger, focusing on animals in zoos, had a more immediate influence on husbandry practices.

Meanwhile, society became increasingly concerned about the treatment of animals generally and in zoos in particular. Relative peace and greater prosperity, at least in the West, led to better educated, more leisured and wealthier populations with the time and energy to devote to such issues—the post-war 'baby-boomers'. Conservation first emerged as a social concern in the sixties. Coe suggests that this generation were influenced by an earlier generation of thinkers and the wilderness ethic referred to earlier.

This combination of factors in America had the direct effect of communities having the political will to vote for publicly funded programmes through bond issues and tax surcharges, or to otherwise raise the necessary funds, to improve their local zoos. Zoos all over the USA initiated major new exhibits or renovations (worth $250 million per year by 1992, or master plans. Several zoos are notable in leading the way: the Arizona-Sonora

Desert Museum, established in 1952 (Jon, 1993) and Woodland Park Zoo, Seattle; Bronx Zoo, New York; Point Defiance Zoo, Tacoma, Washington; Atlanta Zoo (which became 'Zoo Atlanta' after closing for a complete re-vamping); San Diego Zoo; Los Angeles Zoo; and Central Park Zoo (managed by the Bronx Zoo). The older zoos are reorganising their exhibits into bioclimatic or zoo-geographic themes.

Technological advances were vital to the new exhibit designs. In comparing London Zoo with that of Hagenbeck's, it is apparent the general solution to animal exhibit design of the latter arose not only from a different philosophical outlook, but also out of a consideration of the potential of available construction technology. Thus London is characterized by wrought iron and barred cages while Hamburg is characterized by the use of concrete and moats. Cages and 'houses' are appropriate to small sites of city zoos and to 19th century husbandry knowledge. Hagenbeck chose a sufficiently large site outside a major urban area for his ideas. He was liberated by concrete new acclimatization ideas. The advent of new materials and technologies and husbandry practices led present day zoo designers to likewise explore their possibilities. 'Gunite' was in use in the 1930's but as a more efficient means of imitating Hagenbeck's style of artificial rock.

In the 'Sixties and 'Seventies, fabricators became increasingly skilled at massing, shaping, carving and texturing concrete and, coupled with a variety of colouring methods, could create the appearance of almost any natural form from rock, to earth, to trees. Novel ways of reinforcing concrete, principally with glass fibres (GFRC), to enable thin-walled, light weight panels initially found use in cladding systems for buildings, but coupled with latex for mould making, fabricators found they could imitate rocks and wood much more accurately without the need for artists. Epoxy resin for simulating organic materials also allowed the possibility of introducing highly realistic and durable details in exhibits.

Many of the new skills and technology came from the museum world; however, it was the coming together of social change, scientific advances as well as available technology which drew design practitioners to apply themselves to zoo design. The need and desire and philosophical framework to improve zoos plus the means to do so had arrived.

The changes that have taken place in zoos as a result of these wider developments represent possibly as significant a shift in thinking as any before. In dealing with such

recent events it is difficult to assign causes and to credit innovations correctly. Immediately prior to the 'Seventies, zoos had been reacting to earlier concerns about squalid conditions for animals by creating ever-more sterile exhibits which permitted a high degree of disease and vector control. They were also exploiting glass and ceramic technology for the first time, possibly influenced by Modernist architecture.

In 1971 David Hancocks pointed out the short-comings of current zoo design. Then in 1976, with a brief to reorganise Woodland Park Zoo "around ecological and ethological themes" Jones and Jones, a Seattle, Washington-based landscape and architectural firm prepared the "Long-Range Plan". The Arizona-Sonora Desert Museum was probably closer to the origin of the ideas, the whole zoo representing a single biome and a direct link to the museum world but Woodland Park has had by far the greater influence.

Woodland Park's plan came about through a collaboration between zoo and design professionals, and a non-zoo biologist, underwritten by city authorities whose electors voted overwhelmingly in favour of a tax surcharge to fund the redevelopment of a traditional zoo (established 1900) within a park designed by Olmsted. It showed the way forward for the majority of American zoos with a similar heritage.

Regardless of the origins of the new ideas, it is largely due to this publication and the subsequent ASLA award it received that authors like Pregill and Volkman, after scathing criticism of earlier zoos, credit the firm of Jones and Jones for the tendency for zoo to be, "enlarged and redesigned to emphasize an 'ecological' approach to the display and management of animals." The following quotation from the same authors indicates the degree of recognition the changes wrought in zoos have received in the landscape architectural profession:

> Animals are also a focus of educational and recreational sites. In their modern conservation roles, zoos have become centres of protection and propagation for endangered wildlife. **In keeping with this role, and in response to demand for more humane treatment of animals,** many zoos have been redesigned to house and display their charges in social and environmental groupings similar to those found in their natural habitat. The Seattle firm of Jones and Jones has become nationally known for this type of work. One of their most significant projects was the ASLA award-winning redesign for Woodland Park Zoo in Seattle. Ten world bioclimatic zones were simulated, and in each zone display areas depict the landscape character of an animal's home region, provide the type of cover critical to each species, and allow unobtrusive human observation of animals (Pregill, 1993).

Similar recognition can also be found in the architectural press over the last decade. As the bold text in the above quote shows, the redesign of zoos is attributed to their role in conservation and to demands for more humane treatment of animals. Whether influenced by the wilderness ethic, World's Fair dioramas, Disney Land, museums or the achievements of zoos themselves, a significant number of zoo designers are developing the field independently of the mainstream of either architecture or landscape architecture. Towards this end, they research and go and see the actual habitats of animals for themselves rather than seek to impress their peers with architectural abstractions.

The direction of North American zoos has spread elsewhere in the world, notably Australia and Europe; but during this period of fertile development in the U. S., different directions were also developing elsewhere. Nouvel outlined some of these, most notably, safari parks, in 1975. The self drive-through animal parks arise from modern awareness of the natural world through media, urbanisation and the use of the car. They are flawed, according to Nouvel, because they are, "based on the exploitation of the instinct which draws man to the animal world", by developers in search of easy profit. Nouvel states that, "people are now much less keen just to look at them [animals], than to observe their behaviour and to interpret it in physiological, psychic or social terms." (Nouvel, 1975).

The influence of Hagenbeck is still strong in Europe and in modern interpretations is balanced by the same concern for humane treatment and portrayal of habitat as in the U. S. For example, the Nooder Dierenpark in Emmen, Holland, displays an excellent balance between animal and human needs, especially education. Its modernisation began in 1974. With the re-invention of the front-viewed enclosure, it is doubtful whether landscape immersion will ever fully supplant Hagenbeck panoramas or even cages. It is likely, however, that hybrids of the three will continue to be produced in zoos around the world. Polakowski sums up the continuing debate over how accurately habitat needs to be portrayed, thus:

> some designers believe that in many instances a setting with simulated rock outcroppings is inappropriate to the animal's native habitat. Many exhibits representing this design approach are unsuccessful because the essence of the native habitat was never realised and/or the physical abstraction of the essence was poorly conceived and executed. The lack of sufficient space for animal exhibits on the zoo grounds has helped perpetuate the need to abstract, in size and atmosphere, the natural habitat. (Kenneth, 1987)

Many zoos are already going beyond this debate and grappling with the question of whether they should also be museums. This trend in many ways contradicts the goals of landscape immersion. However, immersion landscaping should be viewed as a means to an end rather than the end in itself. The future of zoo design appears to be in seeking ways to convey greater meaning and message in exhibits while sacrificing neither accuracy of portrayal of habitat nor returning to the expression of man's dominance over beasts. As Coe says:

> The coming challenge is to use behavioral knowledge to entice animals into ideal viewing positions. The trick is to provide as many positive incentives as possible to keep the animal in view rather than providing negative stimuli if the animal chooses to (Coe, 1993).

Zoos must do more than show animals, but animals are the difference between zoos and museums and the experience of these must be maximised to make a deeper but correct impression on visitors. In part two, against this historical and contemporary background, various elements of exhibits are explored and the implications of landscape immersion are discussed more fully as well as the potential trend towards museology (designforlife.com.sg).

2.4 Time Chart of the Zoological Garden

In the history of zoo-keeping so for we know that wild animals have been keep on domesticated by the man since 8,000 BC. It was only for using wild animals for preying other animals and exposing their wealth.

National Extension College of London has been workout intensively on the history of zoo and write a report on “animal management”, which was published by the Zoological Society of London in 1980.

Primitive Era and Idea of Zoological Garden

- Paleolithic Period (3000 BC): Since the time of cave Art.
- Faro’s of Egypt (2900 BC): Collection and husbandry of wild animals for showing their wealths and power.
- Regime of ‘Chou King’ of China (1100 BC): Established of a famous animal park called as ‘Ling YU’. Collected animals were Elephant, Horse, Monkey, Deer, Lion, Giraff, Leopard, Crocodiles, Peacock etc for showing the king’s power and wealth and used the animals against the enemy of kingdom.

- King of Persians (974 BC): collected a lot of animals to know the animals life and exhibit to the people.
- In Greece (300 BC): A group of philosophers/Scientists kept the wild animals in a enclosure to observe their living pattern intensively, particularly the feeding and breeding behaviour including physiology of the wilds. At the same time they thought some sort of acrobatics to the wild animals as shown to the people.

These are the brief history and background of wild animal collection and got the basic idea to establish Zoological Garden in the world.

Initial Period of Zoological Garden (1st A.D to 1750 A.D):

- It was the long period for which to take several ideas for the established of Zoological Garden through motivational programme by the kings or a country or an organization or by a group of people.
- In the 1st A.D. Just after death of Jesus Christ, Romanian people started to collect wild animals to recreation and trained up them to show the people like as a circus and matador (man-animal fighting) in a special Arena men-animals fought together and ultimately animals were died that was the cruelty to the animals.
- In 1252 animals were kept in Tower of London for showing wealth, personal image and exposed of the Royal Kingdom.
- In 1519 animal were collected by the Mexican dynasty for showing his/her social status and beautifulness of animals.
- In 1733 one of the famous Royal Zoological Garden was established in Spain.
- Upto 1750; So far we know that many countries, estate, king of the estates in Asia, Europe, America collect wild animals and kept them to show as their wealth and power. Some times animals were used in battle field against to the enemy. It was the common of that time.

Middle Age of Zoological Garden

- In 1752, 1st step of the history of Zoological Garden "Menagerie" was established at Shan Brun Hall in Vienna of Austria. (French Menagerie means to manage). It was the first zoo as a managed Animals Garden.
- The term keeper (to keep and observe) and Curator (Care for) was first introduced here. In 1965 the animals garden was opened to the people.

– 1793, "Jardin de Plentis" a famous animal garden was established and animal exhibition was started in France.

These above mentioned Zoo's were not scientifically managed. Only the wild animals were collected, kept in enclosure and exhibited to the people.

Modern Age of Zoological Garden

In 1826, The first modern scientific Zoological Garden was established in London that was managed by the Zoological Society of London. In 1828, experimentally, ZSL arranged animal exhibition for the viewer's interest at regent Park in London. The aim was to exhibit the rare wild animals and their behaviour. At the same time ZSL had the so many objectives like, to know the Anatomy, Physiology, behaviour (both feeding and breeding) habitat, veterinary care etc. of the collected wild animals. And it was also a great opportunity to know something about the wild animals for the visitors. But finally, in 1847 London Zoo has been opened to the mass people and viewers.

After 1828 (animal exhibition at Regent Park in London), there are many Zoos were launched in Europe-some of the famous zoo's are followed:

1830 → Finix Park in Dublin, Ireland.
1837 → Natura Artis Magistra in Amsterdam, Netherlands.
1841 → Barlin Zoo in Barlin.
1843 → Ant warp Zoo in Belgium.

Other than Western European Country-
1882 → Ina Zoo in Tokyo, Japan.
1891 → Giza Zoo in Egypt.

Zoos in India

Very rich in the history of Zoo.

Before coming the British regime from the great king Shamrat Ashok (Collecting animals and Caring of them) land Buddha (Vaughan Buddna) has a deer Park.

British Regime in India (1757-1947) nearly 1st 100 years (upto 1854) that was known as black era of wild animals. A lot of animals like tiger, Elephant, Bison, Gonder, Deer and

so many birds were killed by the British Raj. They were not realized in 1st 100 year. Some of the animals were already been extinct from their original habitat in Indian Sub-continent during that time.

In 1854, Marble Palace Zoo was established in Calcutta by the British Government after that only 12 zoos were established by the British Government from 1854 to 1898.

In 1857, Trivandrum Zoo or the Thiruvananthapuram Zoo is established in the capital city of Thiruvananthapuram. The Maharaja of Travancore established the zoo stretching over 55 acres of woodland, with lakes, and lawns, in 1857. The zoo was at first made with the archetypal iron-barred enclosures and was primarily planned for creating something for leisure but with the increased deforestation and effect on wildlife due to human encroachments, the goal of the Zoo changed from amusement to protection of the flora and fauna of the area.

Rest of the zoos were in different Places in India.

In the beginning of the twentieth Century another five zoos were launched by the British Govt. in India —

1921 → Prince of Wales Zoo, Lukhnow

1921 → Gandhi Garden, Goalior

1922 → Rajasthan Zoo, Rajasthan

1936 → Jhodpur Zoo

1936 → Udyapur Zoo

Independent India

After 1947, Indian Govt. has established 320 Zoos from 1955 to 1994 including Bio-park, Safari Park, Open Zoo and Specialist Zoo (e.g., Crocodiles Park, Deer Park, Snake Farm etc.) Average 8 zoos/year, highest number of zoos/year in the world.

Zoos in Bangladesh

Very poor history of Zoo in the context of the world zoo history.

Before 1947, there was no Zoo in East Bengal, After 1947, the Govt. of East Pakistan decided to established a zoo at Dhaka. In 1961, a commission has been formed as an advisory board whether it is suitable or not. Finally, "Implementation Board" was formed

in 1964 and established a New Zoo (Mirpur Zoo at Dhaka). But in 1961-1962 a zoological garden was launched at Supreme court yard and these animals were shifted to the new established Zoo in Mirpur, Dhaka.

After Liberation as an Independent Bangladesh

Rajshahi, Rangpur, Comilla and Chittagong Zoo have been launched by the Govt. of Bangladesh, but still these Zoos are kept as a Menagerie.

Modern World Zoo

Before 1950 some of the modern Zoos were established in Asia (India, China and Japan), Europe and America. But no modern Zoos were in Africa, Australia and south America because of naturally huges number of animals were there.

After 1950, Europe, Australia, South America and North America are the Pioneer for the Modern Zoo. In Asia, Only the Singapore National Zoological Garden and Jurong Bird Park of Singapore is famous for the modern Zoological Garden of its well management and keeping. Modern Zoo follows these parameters:

- Bio-diversity conservation and animal welfare
- Education
- Research
- Recreation

2.5 Types of Zoo

Modern trends of zoos includes breeding of endangered animals in captivity (some have been re-introduced into the wilds), exhibiting animals in enclosures, simulating their natural habitat rather than in cages (open range zones or safari parks) and educating the public.

The Zoological Society of London (after 1950) surveyed and reviewed Zoo's of the world and Classified the following types of Zoo —

1. Menagerie
2. Systemic Zoo
3. Habitat Zoo
4. Behavioral Zoo
5. Bioclimatic Zoo
6. Zoo-geographical Zoo

Menagerie

French menage means to manage. In 1752, Menagerie was established at Shanbrun Hall in Viena. The words Keeper and Curator were introduced in 1752.

Keeper- Keep and observe
Curator- Care for.

In Menagerie, animals were kept in enclosure like a prison. There was no scientific management and knowledge to keep the animals or care for the zoo animals. But animals were shown to the people. Before 1752 wild animals were collected on behalf of Royal kingdom for showing a sign of great wealth but not exhibited to the people. The Menagerie and Aviaries of China, Egypt and Rome were famous in ancient times. From the late Medieval period many ruler have Menagerie.

Systematic Zoo

Systematic zoo is one of the modern Zoo based on systematics of animal kingdom. Arrangement and displaying the zoo animals should be based on Class-Order-Family-Genus-Species wise according to the modern classification to know the systematics of animal kingdom. This type of zoo is good for research and education but bore feeling to the general people or visitors.

Habitat Zoo

Displaying the collected zoo animals as a cluster from same habitat. e.g. Tundra, Northern coniferous forest, Mountains, Desert, Tropical rainforest, Tropical grassland, Temperate rainforest, Temperate grassland, Coasts, Ocean, Fresh, Mangrove, Coral reef, Urban, Scrub forest, Tropical dry forest, Temperate forest etc.





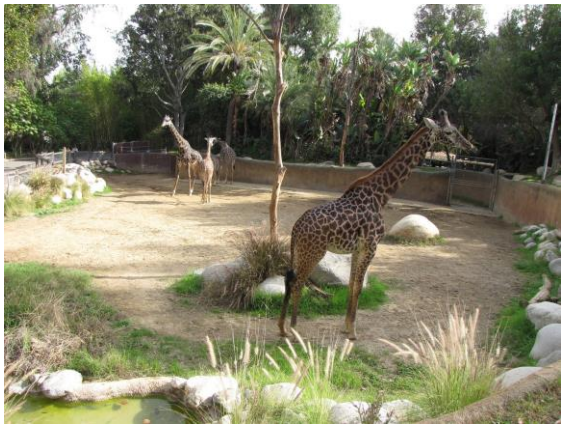



Plate 2.1: Animals kept in Habitat Zoo

Behavioral Zoo

Behavioral enrichment, also called environmental enrichment, is an animal husbandry principle that seeks to enhance the quality of captive animal care by identifying and providing the environmental stimuli necessary for optimal psychological and physiological well-being. (Shepherdson, 1998) The goal of environmental enrichment is to improve or maintain an animal's physical and psychological health by increasing the range or number of species-specific behaviors, increasing positive utilization of the captive environment, preventing or reducing the frequency of abnormal behaviors such as stereotypies, and increasing the individual's ability to cope with the challenges of captivity. Environmental enrichment can be beneficial to a wide range of vertebrates and invertebrates such as land mammals, (Young, 2003) marine mammals, (Sheperdson, *et. al.*, 1998) birds, (Nicol, 2007) amphibians, (Hurme *et.al.*, 2003) reptiles, (Hawkins, 2004) octopi and spiders. (Carduccia, 2000).

Any stimulus which evokes an animal's interest in a positive way can be considered enriching, including natural and artificial objects, scents, novel foods, and different methods of preparing foods (for example, frozen in ice). Most enrichment stimuli can be divided into six groups:

- **Sensory**; stimulating animals' senses: visual, olfactory, auditory, tactile, and taste.
- **Feeding**; making feeding more challenging. Different methods of food presentation encourage animals to investigate, manipulate and work for their food as they would in non-captive environments.

Plate 2.2: Behavioral enrichment - Sensory

- **Manipulation**; providing items that can be manipulated by the paws, feet, tail, horns, head, mouth, etc. This promotes investigatory behaviour and exploratory play.

Plate 2.3: An Asian elephant in a zoo manipulating a suspended ball provided as environmental enrichment

- **Environmental**; enhancing the animals' captive habitat with opportunities that change or add complexity to the environment.
- **Social**; providing the opportunity to interact with other animals, either conspecifics or interspecifics.
- **Training**; training animals with positive reinforcement or habituation.
- **Puzzle**s; requiring an animal to solve simple problems to access food or other rewards.

Elaborate systems of food presentation have been developed (e.g. presenting dead rats for wildcats in a Swedish zoo) and computer programmed devices which allow the animals in the enclosure to search for prey as they would in their natural environment.

It can be argued that a stimulus may be considered enriching even if the animal's reaction to it is negative, such as with unpleasant scents, although stimuli that evoke extreme stress or fear should be avoided, as well as stimuli that can be harmful to the animal. A contrary point of view is that for environmental enrichment to be considered successful, it should promote only positive behaviours.

Enclosures in modern zoos are often designed to facilitate environmental enrichment. For example, the Denver Zoo's exhibit Predator Ridge allows different African carnivores to be rotated among several enclosures, providing the animals with a different sized environment and exposing them to each other's scents.

The success of environmental enrichment can be assessed quantitatvely by a range of behavioral and physiological indicators of animal welfare. In addition to those listed above, behavioral indicators include the occurrence of abnormal behaviours (e.g. stereotypies, (Mason, 1991 and Claes, *et. al.*, 2010) cognitive bias studies, (Mendl, *et al.*, 2009) and the effects of frustration. (Duncan, 1971 and Zimmerman, *et. al.*, 2003) Physiological indicators include heart rate, (Kemppinen, *et. al.*, 2010) corticosteroids, Laws, *et al*., 2007) immune function, (Martin *et al.*, 2011) neuorobiology, (Lewis, *et al.*, 2006) eggshell quality (Hughes, *et al.*, 1986) and thermography (Wilcox, *et. al.*, 2009).

Bioclimatic Zoo

There are two major components of diversity: within-habitat (diversity may vary greatly between two forest types, for example) and between-habitat (this covers diversity for an entire area, thus also dependent on the diversity of habitats present). Within-habitat diversity is highest in forests of the equatorial lowlands, and lower with increased latitude, altitude, seasonal variation in climate, simplicity of vegetation, and any environmental extreme, to very low near poles and on high mountains. There are similar latitudinal gradients in fresh and salt water, also decreased aquatic diversity with depth and chemical extremes. There is also lowered diversity on peninsulas and islands because of problems of historical access.

Animal basic needs include homeostasis, space, refuge, food, predator avoidance, and reproduction. Homeostasis needs lead to occurrence only in a restricted range of temperature, humidity, salinity, oxygen level, and other features that affect the animal's internal environment. There is great variation in tolerance to environmental extremes, maximal in endothermal birds and mammals. Land and water are two basic environments, and many animals move between them or secondarily into the air for relatively brief periods. Locomotion is significant in animals (lacking in plants for most part) to allow these movements, also movement about home range and long-distance movements that may be for dispersal or may involve seasonal back-and-forth migration. Some major groups of animals are sessile (fixed in place) and like plants move only in certain life-history stages. Space needs lead to fixed or dynamic home ranges, which are defended in some sessile or territorial motile animals. The size of the home range or territory may change seasonally or be different in different age/sex classes. Refuges are needed for hiding from predators, sleeping, storing food, and having and rearing young.

Food sources are plants (herbivores) or other animals (carnivores), and diets vary from very generalized to very specialized. Many animals are omnivores (plant **and** animal diets). Herbivores specialize on leaves, seeds, fruits or nectar, with different arrays of adaptations for each type. Leaves are easy to capture but difficult to digest, so leaf-eaters have special adaptations to process cellulose and antiherbivore compounds. Seeds are locally and seasonally abundant, and are often stored by caching for leaner periods. Special adaptations (rodent teeth, finch bill) are needed to crack seed coats. Color vision is an important adaptation to locate flowers and fruits for both nectar- and fruit-eating, with much coevolutionary fine tuning for these pollinating and seed-dispersing interactions. There are just as many specialized sets of adaptations for carnivory, including those for finding and capturing plankton, mollusks, worms, termites, butterflies, fish, snakes, birds, and other morphologically distinctive taxonomic groups, even carrion. Memory and intelligence are characteristic components of some of these predator adaptations, but there are many other special attributes, such as the use of tools or venom.

There are many predator-avoidance adaptations, including hiding out of sight or in sight (camouflage); escaping by speed or stealth or immersion in a group; fighting or threat with weapons (teeth, horns); physical protection such as spines or shells; chemical protection such as unpalatability or poisonous bite or sting; and mimicry of unpalatable/dangerous animals. There is a wide variation in reproductive strategies: clutch size, size of offspring at birth, eggs vs. live birth, and degree of parental care.

Most types of adaptations are clearly attributable to one of these basic needs. For example, coloration may be an adaptation for species recognition (need for conspecific territory defenders to recognize each other involves space; need for mates to recognize one another involves reproduction), to look like the environment (camouflage for predator avoidance or prey capture) or like some other animal (mimicry for predator avoidance) or to warn of its dangerousness (aposematic coloration for predator avoidance) or to increase or decrease heat load by absorbing or reflecting sunlight (homeostasis).

Zoogeographical Zoo

The branch of the science of biogeography (q.v.) that is concerned with the geographic distribution of animal species. In addition to mapping the present distribution of species, zoogeographers formulate theories to explain the distribution, based on information about

geography, physiography, climate, and geologic history, as well as knowledge of the evolutionary history and relationships of the animals involved. This advanced type of zoo has establised-

a. To develop interrelationship among the zones or animals.
b. To present separately based on the zoo-geographic region. Flightless birds, Insular Fauna to be presented separately as their zoo-geographical regions.

2.6 Safari Park

A safari Park is a Zoo-like commercial tourist attraction where visitors can drive in their own vehicles and observe wildlife, rather then viewing animals in eages or small enclosure. The main attractions are large animals from sub Shaharan Africa eg. Giraffes, Lions, Elephant, Zebra etc.

A safari park, sometimes known as a wildlife park, is a zoo-like commercial tourist attraction where visitors can drive in their own vehicles or ride in vehicles provided by the facility to observe freely roaming animals. The main attractions are frequently large animals from Sub-Saharan Africa such as giraffes, lions, rhinoceros, elephants, zebras, and antelope.

A safari park is larger than a zoo and smaller than game reserves. For example, African Lion Safari near Cambridge, Ontario, Canada is 750 acres (3.0 km^2). For comparison, Lake Nakuru in the Great Rift Valley, Kenya, is 168 square kilometres (65 sq mi), and a typical large game reserve is Tsavo East, also in Kenya, which encompasses 11,747 square kilometres (4,536 sq mi).

Safari parks often have other associated tourist attractions: golf courses, carnival rides, cafes/restaurants, miniature trains, and gift shops.

The first lion drive-through opened in 1963 in Tama Zoological Park in Tokyo. In double-glazed buses, visitors made a tour through a one-hectare enclosure with twelve lions.

The first drive-through safari park outside of Africa opened in 1966 at Longleat in Wiltshire, England. Longleat, Windsor, Woburn and arguably the whole concept of safari parks were the brainchild of Jimmy Chipperfield (1912–1990). Former co-director of Chipperfield's Circus, although a similar concept is explored as a plot device in Angus Wilson's "Old Men at the Zoo" which was published five years before Chipperfield set up

Longleat. Longleat's Marquess of Bath agreed Chipperfield's proposition to fence off 40 hectares (99 acres) of his vast Wiltshire estate to house 50 lions. Knowsley, the Earl of Derby's estate outside Liverpool, and the Duke of Bedford's Woburn estate in Bedfordshire both established their own safari parks with Chiperfield's partnership. Another circus family, the Smart Brothers, joined the safari park business by opening a park at Windsor for visitors from London. The former Windsor Safari Park was in Berkshire, England, but closed in 1992 and has since been made into a Legoland. There is also Chipperfield's "Scotland Safari Park" established on Baronet Sir John Muir's estate at Blair Drummond near Stirling, and the American-run "West Midland Safari and Leisure Park" near Birmingham. One park along with Jimmy Chipperfield at Lambton Castle in the North East England has closed.

Between 1967 and 1974, Lion Country Safari, Inc. opened 6 animal parks, one near each of the following American cities: West Palm Beach, Florida; Los Angeles, California; Grand Prairie, Texas; Atlanta, Georgia; Cincinnati, Ohio; and Richmond, Virginia. The first park, in South Florida, is the only Lion Country Safari still in operation.

Burgers' Zoo at Arnhem, Netherlands, opened a "safari park" in 1968 within a traditional zoo. In 1995, Burgers' Safari modified this to a walking safari with a 250-metre (820 ft) board walk. Another safari park in the Netherlands is Safaripark Beekse Bergen.

Most safari parks were established in a short period of ten years, between 1966 and 1975.

2.7 Bio Park

A Bio Park is a living interaction of the seen and unseen worlds that constitute our reality, a dynamic interaction Place where life evolves. A features on Bio park in Rome are as follows:

The zoo was conceived in 1908 to hold exotic animal species for exhibition. Unlike other zoos at the time which mainly worked for scientific criteria, this zoo was designed for the entertainment and amusement of the people. The zoo covered 12 hectares (30 acres) and was erected in the northern part of the Villa Borghese estate; it was opened on 5 January 1911.

The zoo was designed by Carl Hagenbeck, who had already opened a zoo in Hamburg Stellingen. The park was built in the style of that in Hamburg: ditches and pits instead of bars, and generous green spaces.

This initial success did not hold. Attempts were made to stock the zoo with especially rare and exotic animals. Various park expansions were undertaken and in 1926 a further expansion was planned into the neighboring red deer park. In 1933, the architect Raffaele De Vico began his work in the new areas, which were to hold two main attractions: the large aviary and the reptile house which opened in 1935.

The zoo began to deteriorate, although many areas were renovated and others fully rebuilt. In 1970, the reptile house had to be closed due to its ailing condition; its improvements took about nine years and it was finally reopened in 1983.

The idea to transform the zoo into a biopark was first suggested in 1994. In 1997 a master plan was produced based on the principles of the Gilman Foundation. In April 1998, the organization Bioparco S.p.A. was established to be financed through the city of Rome with 51%, from Costa Edutainment with 39% and from Cecchi Gori with 10%.

2.8 Open Zoo

As same as safari Park but some artificial arrangements are needed. A feature on open zoo in Africa and Melbourne are as follows:

Werribee Open Range Zoo is an African themed zoo in Werribee, about 32 kilometres (20 mi) south-west of Melbourne, Victoria, Australia. It is part of the Zoological Parks and Gardens Board or 'Zoos Victoria' which also includes Melbourne Zoo and Healesville Sanctuary. It is situated on approximately 225 hectares (560 acres) and is located on the Werribee River in Werribee Park, adjacent to the Werribee Mansion. It was originally agistment land to the Melbourne Zoo.

Visitors to the zoo can take a bus tour which normally lasts 45 minutes and takes up to 70 people. The tour includes animals such as the hippo, animals of the grassland, like zebra, waterbuck, giraffe, ostrich, and rhinoceros, as well as the camel and the oryx. Adults are kept "open range" although young are often not released until they have bonded with their mother.

The zoo has a simulated African village, with educational and entertaining features, including a mock scenario of an African ranger and his adventures tracking lions, and an interactive soundscape walk with simulated lion sounds surrounding the walker. There are two independent trails that visitors may follow: the Pula Reserve Walking Trail which

focuses on African animals, including lions, Vervet Monkeys, Cheetahs and meerkats, and the Volcanic Plains Walk which focuses on Australian animals, like the wallaby and kangaroo. There is a Learning Centre which teaches more about the history and geography of animals in their environments. Visitors can also book various 'specialty' tours, including the open vehicle adventure or a close encounters with lions, rhinos or giraffe. Werribee Open Range Zoo also has an animal/adoption sponsorship program which is used for gifts and other altruistic purposes.

In April 2008 it was announced that a theme park known as African Safari World was proposed, by Warner Village Theme Parks to be built within the grounds of the zoo. On July 1, 2008 the proposed theme park plans were indefinitely postponed, the Government citing the potential $100 million cost to the taxpayer as the reason they were postponed.

The zoo is planning on getting the three retired breeding gorillas at Melbourne Zoo, as these are not shown to the public and are located in the old Gorilla exhibit. The new public display gorilla habitat will be a huge 10,000 m^2 (2.5 acres) sanctuary that features wide-open spaces, climbing structures and indoor facilities. Once operational, this new facility will enable Zoos Victoria to provide best-practice care for the bachelor gorillas and confirm the organisation's reputation as a world leader in gorilla management. The Victorian Government recently gave $1.5 million to support the construction of this $2.2 million facility. Zoos Victoria Foundation is seeking public support to help raise the remaining $700,000 through the Gorillas in the West campaign.

Chimpanzees also will be coming to Werribee. Melbourne Zoo moved their chimpanzees to Taronga Zoo 10 years ago. In 2010, the Zoo made national headlines over the gorilla enclosure when comedy duo Hamish and Andy dressed in gorilla suits and played with radio controlled cars and golf clubs as part of a television special. Some viewers believed the Zoo to be attempting to con them and complained.

2.9 Specialist Zoo

Bird Park, Snake park Crocodile Park, ape garden, primate zoo etc. Some examples of specialized Zoos are:

Caves of Sea Lions

Oregon's Sea Lion Caves are the only known mainland rookery and wintering home of the Stellar Sea Lion. The system of sea-level caves also provide sanctuary for the California Sea Lion and serve as a resting place for a variety of birds, from Tufted Puffins to Bald Eagles. There's even a whale watching deck from which visitors can see Gray Whales and migrating orcas.

The caves were discovered by Captain William Cox in 1880, but have only been open to the public since 1932, as the cliffs and lack of roads made it difficult to access the caves by land. Today, visitors can access the caves via their gift shop off of U.S. 101

The High-Altitude Zoo

The only specialized zoo in India and the largest high-altitude zoo in India, Padmaja Naidu Himalayan Zoological Park (a.k.a. Darjeeling Zoo), specializes in breeding animals for alpine conditions, including Snow Leopards, Tibetan Wolves, Red Pandas, and Himalayan Newts. The zoo is also home to Blue Sheep, Blood Pheasants and Bhutan Grey Peacock Pheasants, Satyr Tragopans, and Himalayan Monals.

The zoo was established in 1958 as the Himalayan Zoological Park. It was renamed in 1975 when then-Prime Minister Indira Gandhi dedicated the zoo to the memory of Padmaja Naidu, the former governor of West Bengal.

The Biblical Zoo

The Tisch Family Zoological Gardens in Jerusalem, also known as Jerusalem Biblical Zoo, highlights a collection of animals featured in the Hebrew Bible. The narrow focus has been difficult for the zoo to maintain, since many of the Bible's animals are now extinct in Israel. The terms used in the Bible to name animals are also somewhat ambiguous, leading to some uncertainty over which animals are actually discussed. The zoo now includes a variety of endangered species in addition to the biblical animals, and it has become known for its breeding programs, which have enabled it to reintroduce at least 11 species to Israel's nature reserves.

Since its inception in 1940, the zoo has moved several times, but today it resides in the Malha valley. The two-level park includes trees and shrubs mentioned in the Bible, an

artificial wall called Moses' Rock, and a "two-story, boat-shaped wooden visitor's center meant to resemble Noah's Ark."

Old MacDonald's Farm

In 1966, a public park and petting zoo called Old MacDonald's Farm opened in Hampton, Virginia. Designed like a working farm, the park showcases farm animals and fowl as well as Virginia-native wild animals. Now known as Bluebird Gap Farm, the park intends to expose kids to animals in a farm setting, to which they would otherwise have very little exposure.

In addition to the animals, the park showcases both modern and antique farm equipment, the original Hampton train station, a family cemetery, a demonstration garden, and an Azalea Trail featuring rare azaleas.

The Butterfly Zoo

The U.S. is home to at least 35 butterfly gardens, homes, and exhibits, but the oldest is Florida's Butterfly World, which opened in 1988. (Butterfly World also holds the distinction of being the world's largest butterfly park.) Butterfly World serves as a public attraction, research facility, and butterfly farm.

In addition to approximately 5,000 live butterflies, the park also houses the U.S.'s largest free flight hummingbird aviary, an enclosure in which visitors can feed Lorikeets, tropical birds, botanical gardens, a Bug Zoo with live bugs, and an Insectarium of mounted bugs and butterflies.

The Sanctuary for Rescued Animals

New Jersey is home to Popcorn Park Zoo, a sanctuary for abandoned, injured, ill, exploited, abused and elderly animals. The small zoo—housing just 200 animals on 7 acres—has been nurturing rescued animals since 1977. The animals range from foxes, geese, and deer to lions, tigers and bears. They also have rescued dogs and cats that are available for adoption.

When I was a child visiting the park with my grandparents, my favorite animal was an elephant with an injured trunk, who was followed around the park by a little troop of ducklings. The elephant would use its trunk to pet and herd the ducklings.

The Zoo in a Rainforest

Pana'ewa Rainforest Zoo and Gardens in Hilo, Hawai, is the only U.S. zoo located in a rainforest. At just 12 acres, Pana'ewa is a small zoo, but it boasts a popular white Bengal Tiger named Namaste, who was given to the zoo by the Las Vegas magician Dirk Arthur.

The free zoo is home to more than 80 different animal species, a petting zoo, and a butterfly house.

The Koala Sanctuary

Australia, naturally, is home to the world's oldest and largest koala sanctuary, Lone Pine Koala Sanctuary. In addition to the koalas, the sanctuary is also home to other Australian animals, including kangaroos, Tasmanian devils, wombats, echidnas, parrots and cockatoos, reptiles, and a platypus.

Visitors have the rare privilege of being able to hold koalas for a fee. They can also feed and pet free-roaming kangaroos and feed nectar to lorikeets.

The Home for Birds of Prey

The International Centre for Birds of Prey is located in Gloucestershire, England, and houses some 60 species of owls and other birds of prey. At any given time, the Centre has about 20 to 40 trained birds residing in its Hawk Walk, an assortment of birds that rotates throughout the year to give the birds a break from the spotlight. The trained birds are used in flying demonstrations at the ICBP.

The Centre was originally established in 1967 as the Falconry Centre by the Glasier family, aiming to educate people about birds of prey and teach falconry. (Phillip Glasier was the leading expert on hawking and falconry in the UK; his daughter, Jemima Parry-Jones, is the current director of the ICBP.)

The Amusement Park Resort Zoo

Long before Disney built Animal Kingdom in Florida, England had an amusement park that offered a zoo, rides, and a resort all in one. Flamingo Land, which opened in 1959, is named for its popular colony of pink flamingos, some of the first animals housed at the park, but today the zoo is home to more than 120 species of animals.

The animals are only one facet of this amusement park and resort, which includes more than 50 rides and attractions, three shows, a 9-hole golf course, a fly fishing stream, a 1000-seat entertainment venue, a swimming pool, and log cabins. Flamingo Land was the subject of a "docusoap," *Theme Park*, on ITV and has also been featured in *Zoo Vet at Large* on ITV1.

The World's Most Northern Zoo

Norway's Polar Zoo is the world's most northern zoo and the zoo with the biggest area per animal ratio. Spread over 114 acres, the zoo focuses on creating a "Scandinavian wilderness experience," showcasing animals in their natural habitats. The cold-weather animals include wolves and bears as well as red deer, reindeer, moose, and musk ox.

The Polar Zoo offers some unique experiences, including a wolf camp and fox camp in which you can get up close and personal with socialized wolves and foxes, respectively. You can also go "photoguiding," during which a keeper will take you inside enclosures to take "the perfect picture," or join the wolves for a "howl night," in which you not only meet the wolves inside their enclosure but also howl with them.

The Harem's Zoo

Egypt's Giza Zoo, an 80 acre zoological garden encompassing Giza's largest park, first opened in 1891 on land that was once part of the harem gardens. The original collection of animals was taken from the private menagerie of Imsa'il Pasha, the Khedive of Egypt from 1863 to 1879. The harem building itself served as a natural history museum from 1890 through 1902.

Today, the zoo houses a wide variety of animals, but the architectural and botanical features are just as fascinating. The garden roads are paved with black stone flags from Trieste, and footpaths are done in mosaic designs. The zoo includes a suspension bridge designed by Gustave Eiffel (of Eiffel Tower fame) that allows visitors to view the animals from above; it is thought to be the world's first elevated viewing area in a zoo. There are also five grottos and a Japanese building.

2.10 Sea World

Sea aquarium, marine aquarium, Marine Park etc. Sea World is a marine mammal park, oceanarium, and theme park located on the Gold Coast, Queensland, Australia. It includes rides, animal exhibits and other attractions, and promotes conservation through education

and through the rescue and rehabilitation of sick, injured or orphaned wildlife. The park is commercially linked to Warner Bros. Movie World and Wet'n'Wild Gold Coast as part of the theme park division of Village Roadshow.

Sea World was founded by Keith Williams in 1958. It was originally known as the Surfers Paradise Ski Gardens, which presented “water ski shows that combined comedy, aqua ballet and action”. In 1971, the Surfers Paradise Ski Gardens moved to land on the Spit. Major dredging works were required to build the new ski lake. A year later, the Surfers Paradise Ski Gardens became known as Sea World with the introduction of dolphins, marine displays, a replica of the Endeavour, a swimming pool, licensed restaurant and gift shop. Extra additions over the next decade included the purchasing of competitor marine park, Marineland, and the transfer of animals and exhibits to Sea World as well as the addition of more shops and food outlets.

- In 1975, the Sea World train opened. "The train is a two-third scale replica of Queensland's famous number 6A10, which is now on display at the Queensland Railway Museum. The ride was designed and built by Sea World.
- In 1978, the first major ride was added to Sea World. The Viking's Revenge Flume Ride opened. This ride was custom-built at a cost of $350,000.
- In 1981, the park's first roller-coaster opened. Originally known as the Wild Wave Rollercoaster, it was accompanied by the Pirate Ship and Carousel. The Wild Wave Rollercoaster changed its name to the Thrillseeker and closed in 2002.
- In 1982, the Corkscrew rollercoaster opened. The ride is an Arrow Dynamics Sitdown Looper and features three inversions.
- In 1986, Australia's first monorail opened, the Sea World Monorail System. This ride features three stations throughout the park.
- In 1987, Sea World welcomed the Water Park and Lassiter’s Lost Mine ride. Lassiter's Lost Mine ride was the second water ride for the park and was made in house.
- In 1989, the Sky High Skyway opened. It features a unique bird's eye view of the park.
- In 1994, Bermuda Triangle opened and replaced Lassiter's Lost Mine ride. It used the same ride system but featured updated ride theming. Sea World opened the 3D theatre Sea Dream.

- In 1998, Pirates 3D Adventure debuted at the 3D theatre. The film uses "a series of special effects that enables the audience to feel part of the adventure".
- In 1999, Cartoon Network Cartoon Beach opened featuring five children's rides and an interactive water fountain.
- In 2003, Pirates in 3D was replaced with Planet SOS in 4-D. This film features an environmental message presenting the issues of global warming, ocean habitat destruction, and deforestation.
- In 2004, the park opened "Shark Bay". This system of artificial lagoons allows sharks to be viewed from both above water and underwater. Sharks exhibited include large and potentially dangerous tiger sharks and bull sharks.
- In 2005, the ski show received a makeover and became Waterski Wipeout. Also the water park got a makeover with the relocation of The Plunge from Wet'n'Wild Water World.
- In 2006, the Sea World Eye was introduced for a limited time. Swiss manufacturer CWA Constructions built the 60-metre high wheel which featured 42 air-conditioned gondolas.
- In 2007, Sea World introduced Sesame Street Beach. Sesame Street Beach replaced Cartoon Network Cartoon Beach with the addition of a new stage show and a new ride.
- In 2008, Jet Rescue opened. Jet Rescue is a motorbike launch coaster made by Intamin which features jet-ski cars. It is themed to a sea-lion rescue. Also 'Ray Reef' opened featuring over 100 rays 'flying and gliding' under the water. It is Sea World's first new wildlife exhibit since 2004.
- In 2009, Sea World updated and renewed several things. In early 2009, the Pirate Ship attraction closed and removed from the park. Waterski Wipeout performed its last show on 20 July 2009. Pirates Unleashed opened on Boxing Day as a replacement. In September, Sea World announced the opening of Ocean Rescue, a new film for their theatre replacing Planet SOS in 4-D. A new educational exhibit also opened in 2009 titled Shark Attack which replaced Dugong Discovery. The Corkscrew rollercoaster was rethemed and renamed to become the Sea Viper.

- In 2010, the park closed Shark Attack, the Sea World Aquarium, Ocean Rescue, Bermuda Triangle and part of the Water Park to construct new attractions. In September, Castaway Bay opened in former location of the water park. It is a children's area featuring Sky Fortress (a climbing structure), Sky Climb (a set of high ropes) and Battle Sails (a water battle). Also in September, Ocean Rescue was replaced by Happy Feet 3D Experience. In October, Sea World closed the Bermuda Triangle for routine maintenance before closing the ride permanently. Its replacement is expected to be open by late 2011. Sea World also opened Penguin Encounter, an Antarctic penguin exhibit where Shark Attack And Sea World Aquarium once stood on 26 December 2010. During the summer school holidays Sea World ran Jet Stunt Extreme as a temporary jet-ski-based stunt show located on the Sea World lake. It operated for a limited season until 23 January 2011. Sea World has noted that it could become a permanent addition depending on the overall success of the show.
- In 2011, Pirates Unleashed had its final performance on 20 July. Jet Stunt Extreme returned on 17 September 2011. On 16 August 2011, Sea World announced a partnership with Nickelodeon which would see characters like SpongeBob SquarePants and Dora the Explorer appear in park shows from Christmas 2011. SpongeBob ParadePants and Dora's Best Friends Adventure began on 17 December 2011. Towards the end of the year, Happy Feet 3-D Experience was replaced with SpongeBob SquarePants 3-D. Sesame Street Beach was replaced with Beach Break Bay.
- In 2012, Sea World announced that they would be launching Dinosaur Island, an interactive dinosaur exhibit. The exhibit opened to the public on 16 June 2012.
- In 2013, the park officially opened Seal Harbour, a seal and sea lion exhibit, originally scheduled to open in December 2012. A water powered jet pack was also added to Jet Stunt Extreme. In December, Sea World opened Storm Coaster, a Mack Rides Water Coaster, replacing the former Bermuda Triangle ride.
- In 2015, the park will unveil a multi-million dollar African jungle exhibit. The exhibit will include gorillas, hippos, and crocodiles. Construction for the exhibit began in 2012 on the site of the former Pirate Ship ride slowly spreading out to reclaimed portions of the Sea World Lake. The attraction was originally intended to have a 2014 opening.

Rides and Attractions

- **Beach Break Bay** is a themed zone featuring several rides specifically designed for children. The area was originally themed to Cartoon Network when it opened in 1999 before being rethemed to Sesame Street in 2007. In late 2011, it was rethemed to have the generic theme of Beach Break Bay. The area features 6 attractions including the Carousel and Beach Ball Bounce.
- **Castaway Bay** opened in September 2010. It is contains a new children's area featuring Sky Fortress (a climbing structure), Sky Climb (a set of high ropes) and Battle Boats (formerly Battle Sails, an interactive water battle). It is located at the northern half of the Water Park.
- **Dinosaur Island** is an interactive dinosaur exhibit. It features animatronic dinosaurs outdoors as well as an indoor exhibit.
- **Jet Rescue** is Sea World's latest roller coaster. The ride is themed around the journey of a Sea World Rescue Team on a mission to save marine life. Riders board a jet ski and race at speeds of up to 70 kilometres per hour (43 mph) around a highly twisted and banked track.
- **Sea Viper** (originally named the Corkscrew) is the only looping roller coaster at the park and features three inversions. The ride is an Arrow Dynamics sit down looper which opened in 1982. In 2009, the ride had the train replaced and became the Sea Viper.
- **Sea World Monorail System** was the first mono rail system in Australia. It allows guests to travel between three stations throughout the park.
- **Sky High Skyway** offers a unique bird's eye view of the park. The ride takes guests from the top of the park, near the entrance, to the castle which houses the Sea World Theatre.
- **Storm Coaster** is a Mack Rides Water Coaster. The ride is soft opened on 2 December 2013 as a replacement for the Bermuda Triangle which closed in 2010.
- **Viking's Revenge Flume Ride** is a water flume ride. Opening in 1979, this ride was built by Sea World and was Australia's first theme park ride.

Shows

- **Dora's Best Friends Adventure** is a live stage show featuring Dora and Diego adjacent to Beach Break Bay. It began on 17 December 2011.
- **Fish Detectives** is the latest incarnation of Sea World's seal show. The show features similar tricks to previous shows with only the storyline and music changing. The show is based around the fish store Alota Baloney, where Big Al is making big profits by catching too many fish. The detective team, made up of humans and sea lions, are on the case to catch Big Al and solve this environmental crime.
- **Imagine** is the latest incarnation of Sea World's dolphin show. The show features similar tricks to previous shows with only the storyline and music changing. The show is set in Dolphin Cove which is the largest sandy bottom lagoon ever built for dolphins containing five different pools and more than 17 million litres of water. Each show caters for 2,500 guests with additional grass seating available.
- **Jet Stunt Extreme** is a live jet-ski-based stunt show located on the Sea World lake. It previously operated for a limited season over the summer of 2010–2011. Due to the success of the show it replaced Pirates Unleashed and became a permanent addition from September 2011 onwards.
- **SpongeBob ParadePants** is a multi-million dollar parade on the Sea World Lake featuring a cast of characters from SpongeBob SquarePants including SpongeBob, Patrick, Squidward, Mr. Krabs, Sandy and Plankton. It began on 17 December 2011.
- **SpongeBob SquarePants 3-D** is a 3D film currently showing in the Sea World Theatre.

Marine Attractions

- **Dolphin Nursery Pool** is part of Sea World's highly successful dolphin breeding program which has resulted in dolphin births. The exhibit allows guests to see young dolphins develop under the protective watch of their mothers.
- **Penguin Encounter** is a 96-square-metre (1,030 sq ft) Antarctic penguin exhibit featuring a 220 cubic metres (7,800 cu ft) pool with under and above water viewing.
- **Penguin Point** is an exhibit featuring Little Penguins. Unlike Penguins on Parade, the previous penguin exhibit at Sea World, Penguin Point has a larger, more open style. It contains a variety of substrates including gravel, rock and grass as well as a large pool. The exhibit can house up to 60 penguins.

- **Polar Bear Shores** is Australia's only Polar Bear exhibit. It was one of the most technologically advanced exhibits for Polar Bears when it opened in 2000. Guests can view the polar bears from three viewing platforms: ground level, underwater and above ground. As of 2013 there are four polar bears in Polar Bear Shores: Lia, Hudson, Nelson and an unnamed offspring.
- **Ray Reef** allows guests to meet, feed and learn about one of the ocean's most misunderstood inhabitants. The exhibit features over 100 rays.
- **Rescue Point Lighthouse** showcases the achievements of Sea World's Research and Rescue Foundation.
- **Seabird Rehabilitation Aviary** is designed to house birds under care and rehabilitation. According to the official website, "many of the sea birds housed in this area will never return to the wild due to severe disabilities which have been caused mostly by mans' ignorance and careless ways. For example, we have received pelicans that have had a broken wing from being caught in fishing line. Their wings have since been amputated. Those that recover from their injuries are free to leave at any time.
- **Seal Harbour** is a seal and sea lion exhibit which opened in January 2013. The exhibit has the capacity to feature up to 20 animals including Australian sea lions, California sea lions, New Zealand fur seals, and subantarctic fur seals.
- **Shark Bay** is the world's largest man-made lagoon system for sharks. The exhibit consists of four zones allowing for viewing and interaction. The zones include a touch pool, an inter-tidal zone, a reef lagoon and a shark lagoon. Four 10 x 3-metre windows allows all guests to see the sea life featured in these pools.

Chapter Three
Materials and Methods

During the research work, the procedures were followed stated below:

1. Selection of Zoos and Safari park:

There are about seven mostly recognized zoos and two Safari Parks present in Bangladesh. These are Dhaka Zoo, Rajshahi Zoo, Rangpur Zoo, Chittagong Zoo, Khulna Zoo, Comilla Zoo, Savar Cantonment Zoo, Gazipur Bangabandhu Safari Park and Dulahazra Safari Park.

Among them Dhaka Zoo, Rajshahi Zoo, Rangpur Zoo and Dulahazra Safari Park were considered for the research work.

2. Survey Methods:

All the selected zoos and safari park in Bangladesh surveyed by visiting and collecting data.

3. Data Collection Procedure:

i. Primary source- During the collection of Primary data, two methods were followed as-

a. A questionnaire for collecting different information about number of exhibited zoo animals and there health, hygiene, food, disease, treatment, management and breeding condition of zoo animals.

b. Observation of infrastructure, enclosures and different sections of zoos and safari park.

ii. Secondary source- Secondary data were collected from register and record books of zoos and safari park, different Journals, books related to zoo management and wild life conservation, newspapers and through internet.

4. Data analysis:

Data were analyzed by sophisticated statistical tools and presented.

5. Photography:

Photographs were taken from all the zoos and safari park about their infrastructure, cages, enclosure and the habitat of the captive zoo animals.

Map: Showing the Studied Zoos and Safari Park

Chapter Four
Results and Observation

Zoos in Bangladesh

The Zoos are operated by the different authority. There are 4 Goverment Zoos in Bangladesh. Among them Dhaka Zoo and Rangpur Zoo are operated by the Ministry of Livestock and Fisheries. Chittagong Zoo and Comilla are operated by the District Collctorate office. There is only one Shahid A.H.M Kamaruzzaman Central Park and Zoo, Rajshahi, operated and maintained by Rajshahi City Corporation. Bangabandhu Safari Park, Gazipur and Dulahazra Safari Park, Cox's Bazar operated by the Ministry of Forestry and Envrionment. Bangladesh Army established some zoos which are present in cantonment areas are Khulna Zoo, Savar Cantonment Zoo and Rajshahi Cantonment Zoo. A mini private zoo present in Sylhet and it is maintained by Mr. Sitesh Ranjan. Most resently, Ministry of Livestock and Fisheries has taken an initiative to establish a new National Zoo in Sylhet.

4.1 Dhaka Zoo

4.1.1 History of Dhaka Zoo

The necessity for establishment of Zoological garden and Botanical Gardens in the province of East Pakistan was felt at the very inception of Pakistan in the year 1947 as there was no such garden in the province. This was receiving attention of the Government science 1947. In 1947, necessity of establishing a state owned zoological garden was felt. A zoo park was being started at High court premises of Dhaka with a limited number of spotted deer, monkeys and few other species of animals. A master plan was approved with a view to establish a zoological garden at Mirpur in 1960. An advisory board was constituted for establishment and proper management of zoo next year. The zoo was opened on June 23, 1974 after necessary construction and procurement of animals from home and abroad. Till then it has been gradually grown into a beautiful and attractive zoological garden exhibiting animals in natural settings using modern method of keeping. Main objectives of Dhaka Zoo are wildlife conservation through collection and breeding

of rare and endangered species of wild animals, research and education and recreation. Conservation of wild animal's diversity, education and research on wild animals and promotion of public awareness about these species of animals. All the exhibits are correctly named and described. Endangered and extinct species are illustrated with elaborate description along with.

About 4 million visitors visit Dhaka zoo every year. It is a center for healthy recreation of peoples of all ages and corners. Calm environment of the zoo attracts people to get relief from the bustle and monotony of urban life.

4.1.2 General Information

A master plan was accepted in 1960 for establishing central zoo. An advisory board was constituted for establishment and proper management of zoo in 1961. The master plan has received appreciations of experts from various countries. According to that master plan present zoo is developed.

Total Land of the Zoo

Acquired land for the zoo is 86.37 hectors, but handed over to Central Poultry Farm is 8.15 hectors, handed over for Flood Control Embankment is 2.7 hectors, Presently 75.53 hectors of land are remained for the Dhaka Zoo.

Lakes of the Zoo

Two lakes are present in the Dhaka Zoo. One is South lake (7.29 hector) and another is North lake (5.67 hector). Total area of the lakes are 12.69 hector.

Enclosure and Infrastructure

There are 33 enclosure and 237 room (cages) in the Dhaka Zoo. About 3655 meter pacca road, 3137 meter brick soling road and few road are kacha, power substation, Islands (Utsab, Niribily) as picnic spot, Anser camp for security, museum, resting shed, Mosque (with separate arrangement for women), Public toilets are available inside the zoo.

Warning notice for the visitors

Do not Feed Zoo Animals

There are some animals in the zoo which the visitors must NEVER feed, the warning notices are on the enclosures of the animals. They must not give any animal remains of feed staff, dirty and unwholesome food, source and things which are not good for the health of the animals. The offering of food to zoo animals can sometimes cause injury to visitors or their property. Please don't try to feed the Zoo animals.

Dogs and other Pets

Entry of dogs or any other pets in the Zoo is strictly prohibited because they may cause any accident or they may carry any diseases in the Zoo.

Fire arms and other Weapons

The visitors will not be allowed to carry guns, air guns, other fire-arms, sharp weapons and sticks with sharp ends inside the Zoo. No children are allowed to carry sticks, rods, wires, nails, etc., in the Zoo.

Portable Radios and Mikes

The visitors are requested not to play radio sets or mikes within the Zoo, as it causes great annoyance to other visitors and also to the Zoo animals.

Photography

The use of cameras in the Zoo without prior permission from the Zoo authority is prohibited. Professional photographers should apply to Zoo authority for special permission.

Visitor facilities:

Restaurant and Souvenir Shop

Two restaurants (Mainly first food) and two souvenir shop in the Zoo are opened for convenience of the visitors. Price of all food items are fixed and price list are displayed in front of restaurant.

Recycling facilities

It is observed that the permanent recycling banks are not located in the zoo, but unwanted clothes/goods can be left at the zoo's reception desk

Emergency Telephone Numbers of Dhaka Zoo

Curator Office (PA) +088-02-9002020, Curator Office (Direct) +088-02-80035035, Deputy Curator (Admin) +088-02-9002738, Fax +088-02-80035035, Zoo Hospital-+088-02-90032052

First Aid

Contact Veterinary Surgeon or Information Centre near the entrance gate for First Aid.

Lost Children

If child is lost inside the zoo, contact to the information centre near the entrance gate or take lost children to the Information centre for announcement.

Lost Property

Please deposit any lost articles you find in the Zoo to the Information Centre. Anybody may apply to the Information Centre in case loose anything in the Zoo.

Rules for the Visitors

- ❖ Comply with Danger notice (animals which look harmless may turn dangerous at any moment).
- ❖ Comply with Don't Feed notice.
- ❖ Don't carry fire-arms, air guns, fire-crackers, etc., in the zoo.
- ❖ Children must not carry sticks, etc.
- ❖ Don't go inside barriers or climb on them (these are for protection of visitors).
- ❖ Don't stay in zoo after dusk and watch your children.
- ❖ Don't blow whistles in the zoo (this is a signal between zoo employees).
- ❖ Don't throw litter about.
- ❖ Don't throw rubbish into the animal enclosures.
- ❖ Don't put hand on animal cages (zoo management authority will in no account be responsible for responsible injury or loss sustained due to negligence).

Elephant and Horse Riding Time Table and Rates

Season	Morning/Govt. Holiday	Evening	Rates	
April- September	11.00 AM-01.00 PM	3.00 PM-5.00 PM	Elephant	Horse
October – March	10.00 AM-12.00 PM	2.00 PM-4.00 PM	Tk.5.00	Tk.3.00

Shooting in the Zoo premises

The natural beauty of Dhaka Zoo is unique. The Commonwealth Magazine had all praise for it and described it as an unique beauty spot in the world. The undulating contour of the site, two big lakes with islands and peninsula entering into the clear water of the lakes, bushes clearings, the river side, the visible scene of vast haor beyond the other bank of the river. Thus the zoo site provides all type of natural scene required for making any film.

Present Approved Rates of Film Shooting in the Zoo are as Following

Serial	Subject	Rate
Ka	Film shooting	@Tk. 200.00 per hour or fraction of hour but at a time not less than Tk. 1500.00
kha	Shooting wih the animals (elephant, horse, camel, ass) and that type of four footed pet animals.	@ Tk. 100.00 per hour or fraction of hour per animal but at a time not less than Tk. 1000.00
Ga	Shooting with the ferocious animals (Lion, Tiger, Bear) and that type of ferocious animals.	@ Tk. 100.00 per hour or fraction of hour per animal but at a time not less than Tk. 1000.00
Gha	Shooting with birds/Cage bird	@ Tk. 100.00 per hour or fraction of hour per cage but at a time not less Tk. 1000.00
Uma	Shooting with Snake an other poisonous animals.	@ Tk. 100.00 per hour or fraction of hour per snake but at a time not less than 1000.00
Cha	Fishing	One person with helping hand can fishing using three wheels at a time, from 6.00AM to 7.00PM at the cost of Tk.1000.00.

Hire for the Picnic Spot Inside the Zoo

Two picnic spots (Utsab and Niribily) are availabile inside the zoo for picnic or other social gathering. The rate of hiring spot- Utsab 2000.00/day, Niribily 1000.00/day.

Regulation for Film Shooting and Hire of Animals

Arms will not be allowed to be carried in the zoo premises without special and prior permission of the zoo authority. Entrance of any animals from outside the zoo is strictly prohibited. Maximum number of hours for which Zoo animals can be lent on hire will be decided by Zoo authority and animal so lent out will be under the custody of Zoo staff.

Animals may be lent out at the discretion of Zoo authority so that attraction of the zoo and other functioning of the zoo are not affected. Prospective lentee will furnish a guarantee at the time of hiring and the lentee will also furnish a certificate to the effect that such animals/pictures will not be utilized in connection with any political affairs. Lentee will also provide feed free of cost as per direction of Zoo authority during the period of that animal is away from the Zoo.

Auction of zoo animals and others

Only spotted deer are sold on cost of Tk. 15,000 per animals after getting permission from CCF (Chief Conservator of Forest). Jackfruits and other seasonal fruits are also sold in auction.

Visitors time

Summer season (April to October) 9.00AM- 6.00 PM,
Winter season (November to March) 8.00AM-5.00 PM
Zoo is closed every Sunday except government holidays.

Entrance Fees

Main gate entrance fee above two years Tk.10.00 BDT, Zoo museum entrance fee Tk.02.00 BDT. Children ages of 0 to two years are free and students from school, college and University are free (condition apply).

4.1.3 Brief Description of Dhaka Zoo

List		Information
Description of land	Acquired land	213.41 Acres
	Handed over to Central poultry farm	20.13 Acres
	Handed over for flood control embankment	6.65 Acres
	Total land at present	186.63 Acres
Two lakes of the Zoo		32 Acres
Animal/ Bird Shed Room		119 268
Pucca road		3655 meter
Brick soling		3137 meter
Power sub station		1
Island(Utsav, Niribili)		2

Police camp	1
Ansar camp	1
Zoo museum	1
Resting shed	13
Mosque	1
Sections a) Administration b) Accounts c) Animal health d) Research e) Animal nutrition f) Carnivores g) Avian/birds h) Small mammals/Reptiles i) Herbivores and large animal j) Security k) Electrical and Engineering l) Arboriculture m) Museum n) Fisheries o) Information Centre	
Public toilet	3
Card phone booth	1

Visitors Facilities in Dhaka Zoo	
Information center	Located at the entrance. Contact for any necessary information. Zoo guide and folders are available on payment.
For lost or found properties	Information center can be contacted.
Telephone service	Card Phone service is available at the information center.
Drinking water	Drinking water is available in some definite locations.
Children's Park	For children's amusement.
Riding facilities	Elephant and Horse riding is allowed on payment in definite time.
Mosque	Separate mosque for male and female for prayer.

Security	Ansar and Guards are always ready for rendering security.
Toilet	Public toilets are available on payment.
Fishing	Fishing in the lake is allowed on payment.
Shooting	Film shooting is allowed on payment.
Animal sale/ Collection	Deer, Rhesus monkey are sold at fixed rates with approval from competent authority. Any donation of animals and birds are accepted.
First aid	First aid service is provided to visitors.
Photography	Personal photography is allowed on permission but commercial photography is prohibited.
Wheel chair	Wheel chair are available for old and disabled persons.

Mission of the Dhaka Zoo

A direction for today and promise for tomorrow. Secure a better world for animals through human understanding.

Dhaka Zoo Core Values

Protect - passionately committed their expertise and resources to saving animals and ensuring their long-term survival.

Honor - strive for excellence in everything we do. They treated their public, animals, volunteers and staff with respect. They conduct their selves with integrity.

Innovate - strive to discover creative solutions through progressive thinking, practices and partnerships.

Engage - connect people with animals and create defining moments to inspire everyone to respect, value and care for the natural world.

Empower - equip their guests, communities, volunteers and staff with the knowledge and tools to take positive action for all species.

Serve - deliver exceptional service to our customers, our animals and one another. They are a trusted resource for our community and provide programs and services that make meaningful contributions to one's daily life.

4.1.4 Organogramme of Dhaka Zoo

It was observed that there is no offical organogram of the zoo but the allotted posts and designation of the zoo are as follows:

1. Curator
2. Deputy Curator (Administration)
3. Deputy Curator (Survey)
4. Animal Nutrition Officer
5. Veterinary Surgeon
6. Publicity Officer
7. Zoo Research and Education Officer
8. Officer in Charge for Museum
9. Zoo Officers
   a. Zoo Officer (Large Mammals and Herbivores)
   b. Zoo Officer (Birds)
   c. Zoo Officer (Small Mammals and Reptiles)
   d. Zoo Officer (Carnivores)
10. Fisheries Section
11. Zoo Estate and Law department
12. Engineering Section
13. Office of Arboriculture
14. Zoo Security Section
15. Accounts Department

Manpower of Dhaka Zoo

Category	Allotted post	Filled post	Blank post
Class-1	11	11	-
Class-2	3	-	3
Class-3	28	20	8
Class-4	170	140	30
TOTAL	212	171	41
Master roll	15	15	-
Ranger	20	20	-

Instructions to the Visitors as Do's and Don'ts

- Do be kind to animals in captivity.
- Do be co-operative with zoo employees.
- Do abide by the zoo rules.
- Do leave the zoo before dusk.
- Do guard your children so that they are not lost.
- Do keep yourself and children at a safe distance from the zoo animals.
- Do not tease the helpless animals.
- Do not feed zoo animals.
- Do not get close to the zoo animals.
- Do not get on enclosure.
- Do not put your hand or cloth on animal house.
- Do not bring pet, firearms, other weapons, rods, firecrackers etc. inside the zoo.

Animals of Dhaka Zoo

In Dhaka Zoo, there are 54 species of mammals, 57 species of birds and 10 species of reptiles are present. The total numbers of mammals are 368, birds are 1190 and reptiles are 64. In total 121 species are present with total number of 1622 animals.

4.1.5 List of exhibited mammals in Dhaka Zoo

Table 4.1: Mammals of Dhaka Zoo

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange CChange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	Indian Elephant		2		2						2		2						2		2
2	Goyal	1	3		4					1	3		4					1	3		4
3	Giraffe	1	1		2					1	1		2					1	1		2
4	Greater Kudu		2		2						2		2						2		2
5	Butani Caffe		2		2						2		2						2		2
6	Common Eland	2	3		5					2	3		5					2	3		5
7	Garul Sheep		1		1						1		1						1		1
8	Water Duck	5	6		11					5	6		11					5	6		11
9	Nilgai	0	1		1					0	1		1					0	1		1
10	Hippopotamus	4	4		8					4	4		8					4	4		8
11	Barking Deer	6	6		12					6	6		12					6	6		12
12	Spotted Deer	43	22	6	71					43	22	6	71				3	41	21	6	68
13	Samber	1	7		8	1				1	7	1	9					1	7	1	9
14	Horse	1	2		3					1	2		3					1	2		3
15	Ass	5	2		7					5	2		7					5	2		7
16	Common Zebra	1	0		1					1	0		1					1	0		1

Continued

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange CChange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
17	Indian Rhinoceros		1		1						1		1						1		1
18	Chimpanzee	1			1					1	0		1					1	0		1
19	Impala	1	1	1	3					1	1	1	3					1	1	1	3
20	Wildebeest (Black)	1			1					1			1					1			1
21	Wildebeest	1	2		3					1	2		3					1	2		3
22	Beisa Oryx	1			1					1			1					1			1
23	Royal Bengal Tiger	7	3		10					7	3		10					7	3		10
24	Indian Lion	7	9		16					7	9		16					7	9		16
25	Leopard	1	1		2					1	1		2					1	1		2
26	Fishing Cat	1	1	1	3					1	1	1	3					1	1	1	3
27	Ratel	1	-	-	1					1	-	-	1					1	-	-	1
28	Spotted hyeana	1			1					1	1		2					1	1		2
29	Striped hyeana	2		-	2					2		-	2					2		-	2
30	Indian fox	1	2		3					1	2		3					1	2		3
31	Dingo	1		-	1					1		-	1					1		-	1
32	Asiatic black bear	1	5	-	6					1	5	-	6					1	5	-	6
33	Rabbit	3	2	3	8					3	2	3	8					3	2	3	8

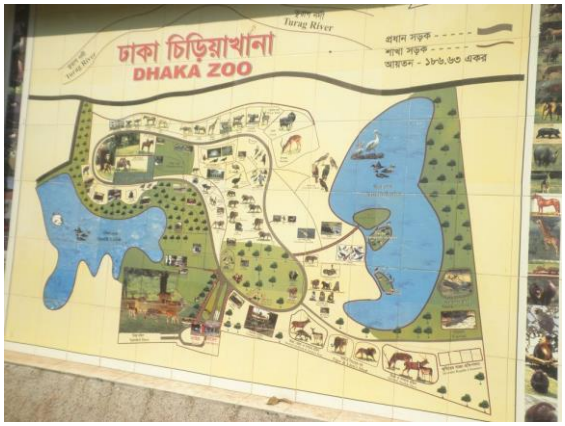
Continued

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange CChange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
34	Pig tailed Macaque	2	1	-	3					2	1	-	3					2	1	-	3
35	Golden Mangabey	1		-	1					1		-	1					1		-	1
36	Olive Baoon	4	1		5					4	1		5					4	1		5
37	Common Langur	1	2		3					1	2		3					1	2		3
38	Capped Langur		1		1						1		1						1		1
39	Hollock Bibbon	1	2		3					1	2		3					1	2		3
40	Rhesus Macaque	28	34	3	65					28	34	3	65					28	34	3	65
41	Mandril		1	-	1						1	-	1						1	-	1
42	Velvet Monkey	2	2	3	7					2	2	3	7					2	2	3	7
43	Hamadrayas Baboon	2	2	2	6					2	2	2	6					2	2	2	6
44	Indian Porcupine	9	13	2	24					9	13	2	24					9	13	2	24
45	Binturong		2	-	2						2	-	2						2	-	2

Continued

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange CChange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
46	Large Indian civet		1		1						1		1						1		1
47	Common Otter	2		-	2					2		-	2						2	-	2
48	Common palm civet	0	2	-	2					0	2	-	2					0	2	-	2
49	Common palm civet	0	2	-	2					2	2	-	4					2	2	-	4
50	Domestic Guinea pig	8	15		23					8	15		23					8	15		23
51	Indian Fruit Bat	1	1	-	2					1	1	-	2					1	1	-	2
52	Grey Squirrel	1	-	-	1					1	-	-	1					1	-	-	1
53	Stripped Squirrel	-	-	4	4					-	-	4	4					-	-	4	4
54	Kangaroo	1	1		2					1	1		2					1	1		2
Total no. of mammals					**370**	**01**							**371**				**03**				**368**

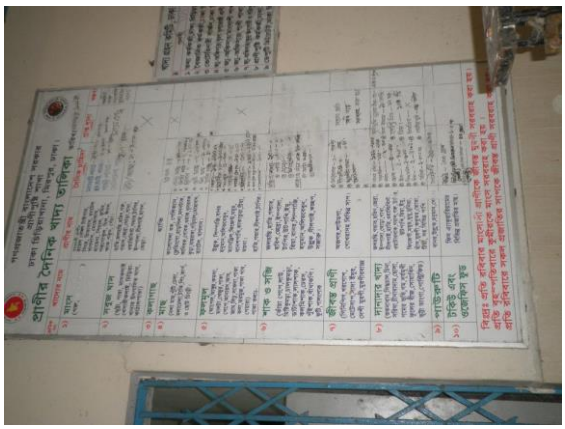
Entrance (Main gate)



Information Map

Information Center

Nutrition Section



List of Food Chart

Veterinary Hospital

Plate 4.1: Some important features of Dhaka Zoo

Royal Bengal Tiger

Goyal

Wilde beast

Rhinoceros

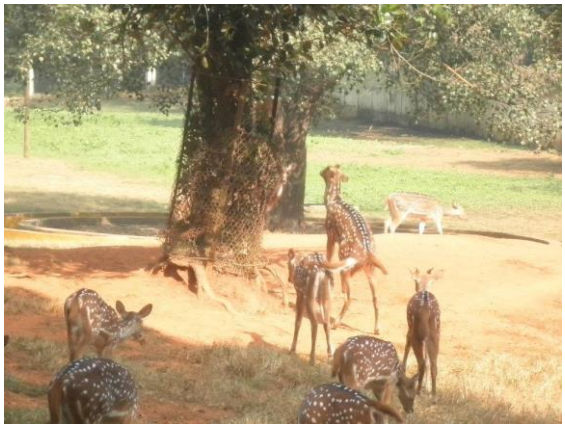
Elephent Enclosure

Zebra Enclosure

Plate 4.2: Some important mammals of Dhaka Zoo and their enclosure

Water buck

Guineapig



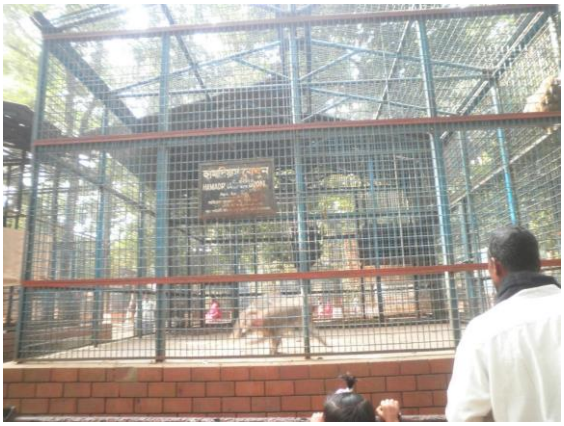
Spotted deer

Hippopotamus

Monkey

Ziraffe

Plate 4.3: Some important mammals of Dhaka Zoo



visitors infront of animals cage

visitors infront of animals cage

Samples preserved in the musum

visitors infront of animals cage

Elephant riding

Public toilet facilities

Plate 4.4: Visitor facilities of Dhaka Zoo

4.1.6 List of Exhidited birds in Dhaka Zoo

Table 4.2: Birds of Dhaka Zoo

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	Ostrich	1			1					1			1					1			1
2	Emu	1	1	1	3					1	1	1	3					1	1	1	3
3	Cassowary	1	1		2					1	1		2					1	1		2
4	Demoiselle Crane	1	1		2					1	1		2					1	1		2
5	Lifford Crane	2			2					2			2					2			2
6	Indian Sarus crane	1	1	-	2					1	1	-	2					1	1	-	2
7	Greater Flamingo	3	2		5					3	2		5					3	2		5
8	Lesser Adjutant	4	1		5					4	1		5					4	1		5
9	Black necked Crane	2	1		3					2	1		3					2	1		3
10	Purple heron		1		1						1		1						1		1
11	Indian Purple	-	1	1	2					-	1	1	2					-	1	1	2
12	Night heron	70	56	6	132					70	56	6	132					70	56	6	132
13	Pond heron	45	45		90					45	45		90					45	45		90
14	Cattle egret	1	2		3						1	2	3					1	2		3
15	Little Egret	1	1		2					1	1		2					1	1		2
16	Grater Cormorant	2	2	3	7					2	2	3	7					2	2	3	7
17	Little cormorant	2	2	3	7					2	2	3	7					2	2	3	7

Continued

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
18	Brown headed Cull	1			1					1			1					1			1
19	Grey Pelican	1	-		1					1	-		1					1	-		1
20	Large White Pelican	1	1		2					1	1		2					1	1		2
21	Turkey	1			1					1			1					1			1
22	Common peafowl	22	11		35					22	11	2	35					22	11	2	35
23	White Peafowl	3	3	2	6					3	3		6					3	3		6
24	Silver Pheasant	2	2		4					2	2		4					2	1		3
25	Indian Spotted Dove	45	58		103					45	58		103					45	58		103
26	Green Dove	5	3		8					5	3		8					5	3		8
27	Easterm Turtle Dove	2	3		5					2	3		5					2	3		5
28	Ring Dove	1	3		4					1	3		4					1	3		4
29	Jalali Pigeon	45	53		98	3				45	53	3	101					45	53	3	101
30	Giribaz Pigeon	14	13		27					14	13		27					14	13		27
31	Indian B R Pigeon	40	50		90					40	50		90					40	50		90
32	Northem R R Parakeet	3	2		5					3	2		5					3	2		5
33	Rose Ringed parakeet	5	5	5	15					5	5	5	15					5	5	5	15
34	Parakeet			100	100							100	100	2						98	98
35	crested Cockatoo	1			1					1	1		1					1			1
36	Crested serpent Eagle	1	1		2					1	2		2					1	1		2
37	Brahminy Kite	1	2		3					1	3		3					1	2		3
38	Pariah Kite	3	3		6					3	1		6					3	3		6

Continued

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
39	Palla's Fishing Eagle	1	1		2					1	3		2					1	1		2
40	Bengal Vulture	3	3		6					3	1		6					3	3		6
41	Canorous Vulture	2			3					2			3					2	1		3
42	White crow (Crossed)	1			1					1			1					1			1
43	Indian Pied Hormbill	0		1	1					0		1	1					0		1	1
44	Hill Mynah	1	1		2					1	1		2					1	1		2
45	Jungle Babbler	7	4		11					7	4		11					7	4		11
46	Pied Mynah	2	1		3					2	1		3					2	1		3
47	Common Mynah	3	2		5					3	2		5					3	2		5
48	Bank Myna	5	3		8					5	3		8					5	3		8
49	Magpie Robin	1			1					1			1					1			1
50	Red vented Bulbul	8	4		12					8	4		12					8	4		12
51	Indian Cuckoo	7			7					7			7					7			7
52	Black headed Munia	3	3		6					3	3		6					3	3		6
53	Red headed Munia	2	3		5					2	3		5					2	3		5
54	White headed Munia	3	2		5					3	2		5					3	2		5
55	Tila Munia	3	2		5					3	2		5					3	2		5
56	Munia			320	320							320	320							320	320
Total no. of birds					**1190**	**3**							**1193**	**3**							**1190**

Flamingo

Birds inside the aviary

Birds inside the cage

Birds taking food

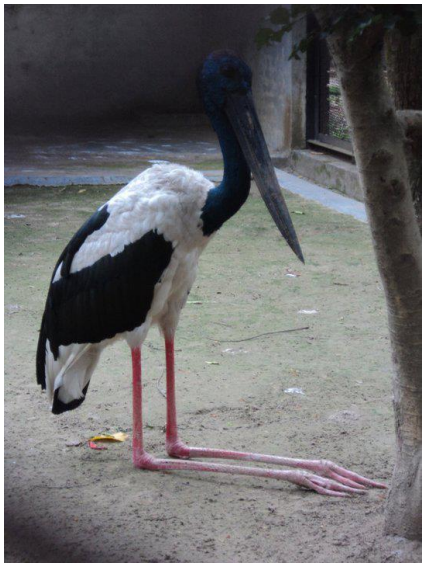
Heron

Vulture

Plate 4.5: Some important Birds of Dhaka Zoo

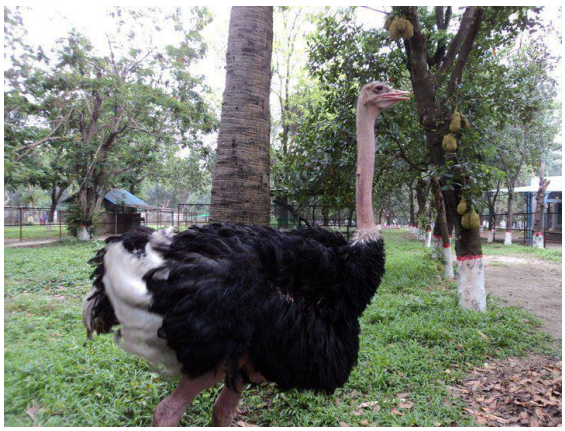
Birds inside the cage

Peacock inside the cage

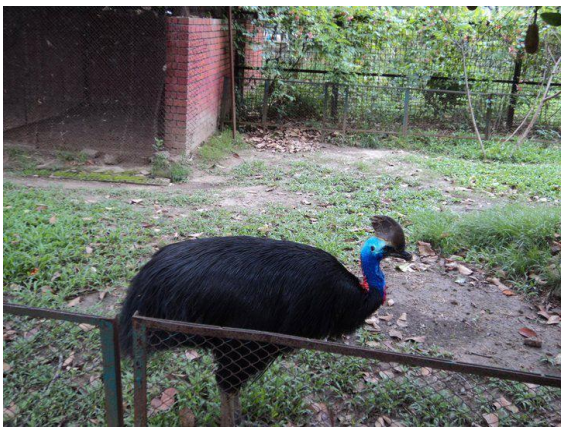


Birds inside the cage

Birds inside the cage



Ostrich



Cassowary

Plate 4.6: Some important Birds of Dhaka Zoo

4.1.7 List of the reptiles in Dhaka Zoo

Table 4.3: Reptiles of Dhaka Zoo

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Ex change	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Marsh Crocodile	1	2	29	32					1	2	29	32					1	2	29	32
2	Esturian Crocodile	2	1		3					2	1		3					2	1		3
3	Gharial	3	1		4					3	1		4					3	1		4
4	Land Tortoise		1		1						1		1						1		1
5	Tortoise			2	2							2	2							2	2
6	Indian Python	10	5		15					10	5		15					10	5		15
7	Cobra	2	0		2					2	0		2					2	0		2
8	Vine Snake	1			1					1			1					1			1
9	Banded Krait	1	1		2					1	1		2					1	1		2
10	King Snake	1	1		2					1	1		2					1	1		2
					64								84								64

Crocodile

Crocodile enclosure

Crocodile inside the cage

Visitors infront of python cage

Plate 4.7: Some important Reptiles of Dhaka Zoo

Crocodile taking rest

Offspring within enclosure

Tortoise

Python inside the cage

Plate 4.8: Some important Reptiles of Dhaka Zoo

4.1.8 List of Aquarium Fish in Dhaka Zoo

Table 4.4: Aquarium Fish of Dhaka Zoo

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	Guppy			141	141							141	141							141	141
2	Tiger Shark			3	3							3	3							3	3
3	Blue Gourami			4	4							4	4							4	4
4	Sucking Cat Fish			28	28							28	28							28	28
5	Gold Fish			8	8							8	8	1						7	7
6	Widow Tetra			1	1							1	1							1	1
7	Kai			2	2							2	2							2	2
8	Comet Fish			5	5							5	5							5	5
9	Angel Fish			2	2							2	2	1						1	1
10	Albino Shark			33	33							33	33							33	33
11	Rainbow shark			29	29							29	29							29	29
12	black Moor			2	2							2	2							2	2
13	Tiger Kai Camp			3	3							3	3							3	3

Continued

SLNO	Name of Animal	Initial Status				Animal Addition				Total No of Animal				Subtraction				Final Status			
		Male	Female	Unidentified	Total	Born	Buy	Donation	Exchange	Male	Female	Unidentified	Total	Died	Remove	Donation	Sale	Male	Female	Unidentified	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
14	Kai Carp			4	4							4	4							4	4
15	Sing Fish			2	2							2	2							2	2
16	Night Fish			8	8							8	8							8	8
17	Tiger Barb			3	3							3	3							3	3
18	Kissing Gourami			10	10							10	10							10	10
19	Telicho			8	8							8	8							8	8
20	Cat Fish			4	4							4	4							4	4
21	Oskar			8	8							8	8							8	8
22	Piranha			8	4							4	4							4	4
23	Rosy Barb			4	5							5	5							5	5
24	Jewel Fish			5	8							8	8							8	8
25	Silver Dollar			12	12							12	12							12	12
26	Blue Akara			2	2							2	2							2	2
Total No. of Fishes				**339**	**339**							**339**	**339**	**2**						**337**	**337**

Live Animal Health and Extension

Lonely Animal

There are a few lonely animal or single animals (38) present in Dhaka Zoo. It may not be possible to procure the pair for the entire lone animal complying all the international rules and regulations for animals. So the steps should be taken for procurement of ½ pair(s) of such animals.

Over Aged Animals

There are at present 48 over aged animals of different species at Dhaka Zoo. They become ineligible for exhibition and within them 11 animals are kept in isolation shed.

Table 4.5: Some Important Statistics of Dhaka Zoo

Serial no.	Topic	Number	Remarks
01	Animal born at Dhaka Zoo	673	From 2000 to 2009
02	Donation/Exchange between different Zoo's of Bangladesh	111	From 2000 to 2009
03	Animal Purchase from Home and Abroad	94	From 2000 to 2009
04	Aged animals of Dhaka Zoo	48	Total 25 Species
05	Single Animals	38	Total 16 Species
06	Education and Research Coordinate research programme for Internee students-1980 and MS/ M-Phil-07 or PhD students - 01 from different institutions.	3316	From 2004 to Till to date

Master Plan of the Dhaka Zoo

The National Zoo is undergoing a comprehensive master planning process. As described last year, Master Plan will guide the Zoo's facilities renewal, which will help the Zoo achieve its mission for providing leadership in animal care, science, education, and sustainability. This long process, which is far from over, considers a variety of alternatives and benefits from feedback from the public.

The current phase involves an Environmental Assessment, which will be followed by such steps as comparing business plans.

4.1.9 Future Plan of Dhaka Zoo

Dhaka Zoo has 118 sheds for large animals and birds. It can provide space of about 2200 large animals and birds. There were about 2100 large animals and birds present in the Zoo in 2007. But now the total number of animal is about 1800 and 25% of sheds are free in the Zoo.

Ministry of Fisheries and Livestock has already taken an initiative to change the Dhaka Zoo as a category of world class Zoo. For this a digital survey and feasibility study has already been completed. It will take 295 Crore of taka for total expenditure.

With the help of Architecture Department of BUET, Zoo Outreach Organization of India, Brunei Zoo Network and Malaysia Nilson Network survey, already a project started with 114 crore of taka. In this project the following matters will be considered :

- ► Zone wise division making for animal keeping
- ► Establishment of Digital gate, Foot over bridge, Underpass, Night safari, Lake safari, Land train, Open aviary, Butter fly Zone, Snake Zone, Frog Zone, Semi-natural enclosure, Under water aquarium, Garden pavilion, Modern children park, Waste management plant, Water purification plant, Development of Hospital and Research facilities, Education and Research center
- ► Addition of Website and Close Circuit (CC) Camera
- ► About 400 animals and birds of 40 species (National-International) will be bought with an expenditure of 10 crore taka
- ► 04 nos. of Spotted Hyena, 04 nos. of Stripped Hyena, 03 nos. of Giraffe, 03 nos. of Zebra, 03 nos. of Chimpanzee, 04 nos. of Hanuman, 03 nos. of Hollock, 04 nos. of Ostrich, 06 nos. of Pelican, 12 nos. of Grey Parrot and some other species of animals and birds will be bought from South Africa
- ► 03 nos. of White Tiger, 04 nos. of Red Kangaroo, 04 nos. of Macau, 04 nos. of Mandrill, 03 nos. of Beer, 06 nos. of White Crow and 06 nos. of Flamingo will be bought from Australia
- ► 03 nos. of Rhino and 03 nos. of Elephant will be bought from Nepal
- ► 03 nos. of Arabian Horse and 03 nos. of Camel will be bought from Saudi Arabia
- ► 04 nos. of Bazzer, 06 nos. of Coca tail grey, 20 nos. of fishing birds, 20 nos. of pink love birds, 200 nos. of Munia birds, 30 nos. of Reptile like (Snake and Tortoise) animals of 18 Species will be bought from through out the country.

4.2 Shahid A.H.M. Kamaruzzaman Central Park and Zoo, Rajshahi

Rajshahi Zoological Garden and Central Park is situated on the bank of the Padma river. In wide sense, Rajshahi Zoological Garden and Central Park has made up off as main entertaining center in whole Northern Area of Bangladesh. There are only 32.76 acre areas of this zoo. It is surrounded in the South by the river Padma. Rajpara thana and Anticorruption office is on the North of it. Parjatan motel, Christian church, Mission hospital are on the East. Horticulture, Village Development board, Primary Education office, Primary teachers training institute, Rajshahi district Judge Court are on the West.

A central park 'Shahid Qumruzzaman central park' and zoo is one of the main attractions of Rajshahi city. A wide area with lush green trees and grasses also houses different animal species. It is located by the bank of river Padma. There are other parks in the city such as Bhubon Mohon park, Captain Monsur Ali park etc. There is a park specially designed for the children's amusement called 'Shahid Zia children's park'. Bank of the Padma river along the city is also very popular destination for recreation too. The bank is planned zone in many parts of the city to accommodate city dwellers for recreation purposes. As example Munsguard park near magnificent old Dutch borokuthi building and Lalonshah park near shahmukhdum eidgah are recently build to give city people a nice place to enjoy the magnificent views of padma river.

4.2.1 Historical Background of Rajshahi Central Park and Zoo

The race course is introduced in our country by the English at the period of British regime. After the freedom of Bangladesh the race was forbidden. There was a race curse ground on the bank of Padma at Rajshahi. Now this race course is replaced by Rajshahi Central Park and Zoo. After forbidden race this race course ground was abandoned for a long time.

1972 : Former Home Minister A.H.M Kamaruzzaman took attempt to established park at this ground in 1972. Ex Deputy Commissioner of Rajshahi Ahmed Abdur Rouf and Ex Deputy Commissiner of Rajshahi Md. Nazrul Islam was co-operate with this attempt. This park was established by the moral and financial support of Ex President H.M. Ershad, Ex Secretary Kazi Jalal Uddin Ahmed, Ministry of Education and Cultural Department, Ex Director, Department of Animal Husbandry Mirza Abdul Jalil and Principal of Dhaka Zoo Mr. Azizul Haque.

1975 **:** At first a couple of Deer was brought in this park.

1977 **:** Later a couple of Ghorials was bought in this park.

1983 **:** This park was accepted also the name of Zoo.

1985 **:** In 1985 Deputy Commissioner Syedur Rahman and Engineer of Distrist Council Abdur Rahim was took attempt to establish a complete Zoo. Now it is called the name of Rajshahi Central Park and Zoo. In 1985 Deputy Commissioner Syedur Rahman collected 242 animals in 45 species. Some animals were also bought from Dhaka Zoo and some were collected from different areas. This Park was under the management of District Council from 1972 to 1995.

But in 1996 Rajshahi City Corporation has got the project from District Council for development and the Project was transferred to Mayor of Rajshahi City Corporation from the ministry of LGRD on 25th November in 1996.

4.2.2 Animals of Rajshahi Zoo

In Rajshahi Zoo, there are 13 species of mammals, 18 species of birds and 3 species of reptiles are present. The total numbers of mammals are 155, birds are 249 and reptiles are 5. In total 34 species are present with total number of 409 animals.

Table 4.6: Mammals of Rajshahi Zoo

Sl. no	English name	Scientific name	Place of collection	Present no.	sex	Total
01	Lion	Panthera leo	Dhaka Zoo and Chittagong Zoo	2	Male- 1 Female-1	2
02	Monkey	*Macaca mulatta*	Donation	36	Male-20 Female-16	36
03	Black beer	*Melursus ursinus*	Dhaka	01	Male	01
04	Rabbit	*Lampus timidus*	Donation	14	Male- 8 Female-6	14
05	Ass	*Equas hemionus*	Bought	07	Male- 4 Female-3	07
06	Maya deer	*Muntiacus muntjak*	Jaypurhat and Dhaka Zoo	02	Male- 1 Female-1	02
07	Spotted deer	*Axis axis*	Dhaka Zoo	81	Male- 36 Female-45	81
08	Baboon	*Baboon spp.*	Dhaka Zoo	03	Male- 03	03
09	Striped Hyena	*Hyena hyena*	Dhaka Zoo	01	Male- 1	01
10	Otter	*Lutra spp.*	Bought	01	Male-1	01
11.	Palm Civet	*Paradoxurus hermathroditus*	Donation from Natore	02	Male-2	02
12	Crested Procupine	*Hystris indica*	Donation	02	Male-2	02
13	Horse	*Equas fersus*	Mission hospital, Rajshahi	01	Female-1	01

Table 4.7: Aves of Rajshahi Zoo

Sl. no	English name	Scientific name	Place of collection	Present no.	sex	Total
01	Black Vulture	*Agypius monachus*	Godagari, Rajshahi	01	Male-1	01
02	Parrot	*Psittacula krameri*	Mohisbathan, Rajshahi	26	Unidentified	26
03	White peacock	*Pavo cristatus*	Bought	01	Male-1	01
04	Pigeon	*Columba livia*	Bought	74	Unidentified	74
05	Owl	*Bubo bubo*	Bought	02	Unidentified	02
06	Pelican	*Pelecanus onucrotulus*	Naoga, Rajshahi	01	Male-1	01
07	Cockatoo	*Cacatua sulphurea*	Bought	02	Male-2	02
08	Night heron	*Nycticorux spp.*	Donation	01	Unidentified	01
09	Cotton teal	*Nattapus wromandelianas*	Bought	10	Unidentified	10
10	Duck	*Anas poecilorhyncha*	Donation	2	Male	02
11.	Brahmiry kite	*Haliastur indus*	Donation	10	Unidentified	10
12	Mach mural	*Ichthyophga ichthyaetus*	Rajshahi university	02	Unidentified	02
13	Hargilla	*Leptoptilos dubius*	Donation	01	Male-1	01
14	Golden pheasant	*Chrysolophus pictus*	Dhaka zoo	01	Male-1	01
15	Dove	*Stceptopelia decaoctu*	-	17	Unidentified	17
16	Nol-kak	*Corvus splendens*	Mohonpur, Rajshahi	02	Unidentified	02
17	Swan	*Cygnus olor*	Bought	52	Male-22 Female-30	52
18	Different spp. of pigeon	-	Donation	119	Unidentified	119

Table 4.8: Reptile of Rajshahi Zoo

Sl. no	English name	Scientific name	Place of collection	Present no.	sex	otal
01	Python	*Python molurus*	Uttora, Dhaka	01	Male-1	01
02	Turtle	*Chelone mydas*	Donation	03	Unidentified	03
03	Ghorial	*Gavialis gangeticus*	Padma river	02	Female-2	02

Entry gate

Side view of entrance

Inside view

Walkway

Infront of entrance

Natural view of lake

Plate 4.9: Some important features and natural views of Rajshahi Zoo

Natural view of pond

Flower garden with fountain

Foot over bridge on lake

Venus island

Guest room

Picnic corner

Plate 4.10: Some important features and natural views of Rajshahi Zoo

Royal Bengal Tiger

Spotted deer

Fishing cat

Common otter

Baby mankey is playing

Maya deer

Plate 4.11: Some important animals of Rajshahi Zoo

Animals enclosure

Heron inside the cage

Hargilla bird inside the cage

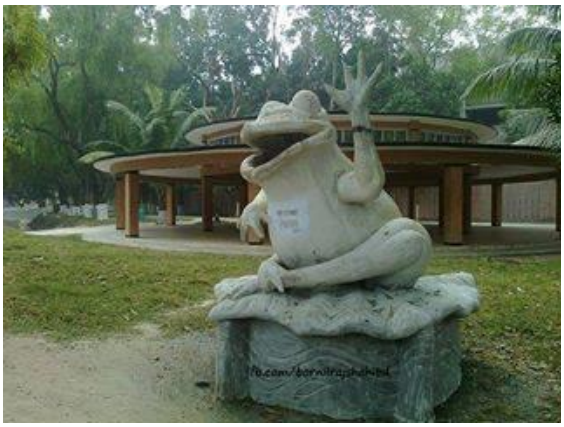
Aviary

Baby Ghorial

Mature Ghorial

Plate 4.12: Animal cage and enclosure of Rajshahi Zoo

Visitors infront of enclosure



Picnic spot with dustbin

Children corner

Mosque

Canteen

Encouraging of visitors to cleanliness

Plate 4.13: Visitors facilities of Rajshahi Zoo

4.2.3 Organogram of the Zoo

It was observed that there is no offical organogram of the zoo but the allotted posts and designation of the zoo are as follows:

1.	Officer in charge (Administration)	-	01
2.	Officer in charge (Technical)	-	01
3.	Pharmacist	-	01
4.	Supervisor	-	03
5.	Animal caretaker	-	08
6.	Garden caretaker	-	12
7.	Cleaner	-	05
8.	Guard	-	09
9.	Ticket Counter	-	02
	Total	-	42

4.2.4 Visitors Facilities

1. The Zoo open for the visitors all the year round.
2. Canteen and foods are available in the middle part of the Zoo.
3. A very nice mosque for praying.
4. Boat riding facilities in the lake with pay.
5. A children park and different rides present for the recreation.
6. Picnic facilities in different picnic corner with pay.
7. Photography and Shooting facilities with the permission of Authority.
8. Disable person may visit by the rickshaw or other vehicle with the permission of Authority.

4.2.5 Brief Description of the Zoo

Serial	Feature	Number
1.	Zoo office Building	01
2.	Rest room	01
3.	Mosque	01
4.	Animal cage	59
5.	Flower garden	06
6.	Picnic spot	14
7.	Burner for cooking (in picnic spot)	10
8.	Pond	01
9.	Lake	01
10.	Foot over bridge	01
11.	Public toilet	05

Fees

1. Entry fee- 10 taka/ adult person
2. Free entry of child 0 to two years.
3. Picnic corner fees- Taka 300, 500 and 700 varies with the type of spot.
4. Campaigning with packing food 200 taka.

4.2.6 Some Negative Features of the Zoo

1. Exception of Deer, Monkey, Dove, Owl, Civet cat, Pigeon, Cockatoo, Porcupine most of the animals present here with a single number.
2. Lion, Beer, Hyena, Hargilla are over aged animals and bird.
3. Most of the cages has no security boundary. So the visitors can go easily close to the animals and birds.
4. As it has a small land area, most of the cages are made very nearer to each other. It's a great cause of hampering biosecurity system.
5. All the cage are small in size for the animals and birds.
6. The height of birds cages are very short to fly easily.
7. Absence of Veterinary Clinic, Separate Drug preservation store room, isolation shed.
8. Animals and birds are kept here without any systematic way because of cages made in a very unplanned way.

4.2.7 Some Strengthen Features of the Zoo

1. All the cages will be made in a very systematic way with a master plan. Already construction is going on.
2. A new budget is already casted for buying new animals and birds.
3. Any donation or injured animals and birds caught by the people are received here as their own home.
4. Breeding performance rate is exclusively high incase of Spotted deer, monkey, Ass and pigeon.
5. All the employees of the Zoo are committed to serve the people. Employees doesn't get any benefit or over time allowance for their duty on holiday.
6. The Zoo contributing a great role for the purpose of education and research for the students of different Department of Universities and organization.

4.2.8 Future Plan

A sustainable developmental work with a master plan has already been started in the year 2010 with an expenditure of 14 crore of taka. The following structures are included in the master plan:

i. New entry gate with ticket counter
ii. Boundary wall
iii. Zoo office building
iv. Animal cage
v. Brick soling path way
vi. Children's park
vii. Foot over bridge
viii. Veterinary clinic
ix. Public toilet
x. Canteen
xi. Mosque

4.3 Rangpur Zoo

Rangpur Central Zoo is one of the main amusement and recreation spot of Rangpur city with an area of 20.27 acre of lush green trees and grasses. The Rangpur zoo is located east side of Hanuman-tola road beside police-line, not far from Rangpur district Administration office. The Zoo has 181 individual animals of 22 species. Many wild animals are available to attract visitors. A few of them are The Royal Bengal Tiger, African lion, Black panther, Rhinoceros, Leopard, Hippopotamus, Peacocks, Alligators, Turtles, Spotted deer, different kinds of Birds, Snakes and so on.

The Rangpur zoo was built in the 1880s. Bangladesh University of Engineering and Technology (BUET) completed a digital survey and feasibility study of "Dhaka And Rangpur Zoo Modernization Project" to upgrade the facilities to international standard. It is operated by the Ministry of Livestock and Fisheries.

4.3.1 Historical Background Rangpur and Rangpur Zoo

Rangpur was conquered by the army of Raja Man Singh, a commander of the Mughal emperor, Akbar, in 1575, but it was only until 1686 that it was fully integrated into the Mughal Empire. Names of places like *Mughalbasa* (literal meaning being a locality of the Mughals), and *Mughalhat* (literal meaning a "local market" organized by the Mughals) bear testimony to the Mughal Association and past of Rangpur and its hinterland. Later on, Rangpur passed under the control of "Sarker" of Ghoraghat. During the period of the British East India Company, the Sannyasi Rebellion took place. Rangapur Ghoraghat has been mentioned in the Riyaz-us-Salatin. During the early period of the company rule fakir-sannyasi resistance and peasant rebellion were held in Rangpur.

The construction/ infrastructure of the Zoo started in the year 1990. After then year by year different developmental work has been completed with the fund allocation by the Ministry of Livestock and Fisheries.

4.3.2 Animals of Rangpur Zoo

In Rangpur Zoo, there are 13 species of mammals, 7 species of birds and 2 species of reptiles are present. The total numbers of mammals are 90, birds are 85 and reptiles are 6. In total 22 species are present with total number of 181 animals. The number of exhibited animals of the Rangpur Zoo is not satisfactory but some of the common animals are keeped by the authority.

Table 4.9: Mammals of Rangpur Zoo

Sl. no	English name	Scientific name	Place of collection	Present no.	sex	Total
01	Lion	*Panthera leo*	Self	2	Male- 2	2
02	Monkey	*Macaca mulatta*	Donation	6	Male-4 Female-2	6
03	Black beer	*Melursus ursinus*	Dhaka	02	Female	02
04	Rabbit	*Lampus timidus*	Donation	25	Male- 11 Female-24	25
05	Tiger	*Panthera tigris*	Dhaka zoo	02	Male-1 Female-1	02
06	Jackal	*Canis aureus*	Donation	04	Unidentified	04
07	Spotted deer	*Axis axis*	Dhaka Zoo	40	Male- 18 Female-22	40
08	Baboon	*Baboon spp.*	Dhaka Zoo	02	Male- 02	02
09	Striped Hyena	*Hyena Hyena*	Self	01	Male- 1	01
10	Sumber deer	*Rusa unicolor*	Dhaka zoo	01	Male-1	01
11	Water buck	*Kobus ellipsiprymnus*	Dhaka zoo	01	Male-01	01
12	Crested Procupine	*Hystris indica*	Donation	03	Male-2 Female-1	03
13	Hippopotamus	*Hippopotamus amphibius*	Dhaka Zoo	01	Male-1	01

Table 4.10: Aves of Rangpur Zoo

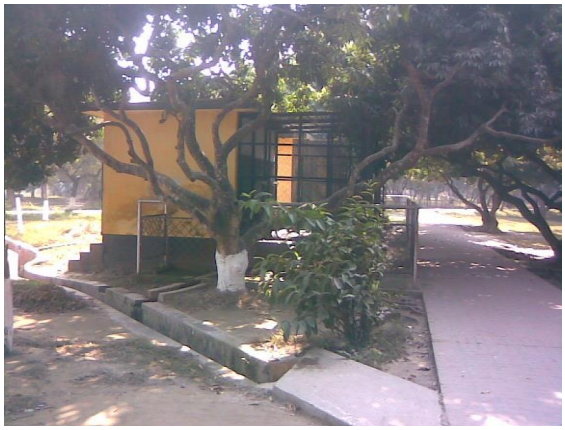
Sl. no	English name	Scientific name	Place of collection	Present no.	sex	Total
01	Black Vulture	*Agypius monachus*	Dhaka zoo	10	Male-6 Female-4	10
02	Parrot	*Psittacula krameri*	Donation	04	Unidentified	04
03	White peacock	*Pavo Cristatus*	Bought	01	Male-1	01
04	Night heron	*Nycticorux spp.*	Donation, Dhaka zoo	50	Unidentified	50
05	Brahmiry kite	*Haliastur indus*	Donation	14	Unidentified	14
06	Hargilla	*Leptoptilos dubius*	Dhaka zoo	05	Unidentified	05
07	Cassowary	*Casuarius casuarius*	Dhaka zoo	01	Male-1	01

Table 4.11: Reptile of Rangpur Zoo

Sl. no	English name	Scientific name	Place of collection	Present no.	sex	Total
01	Python	*Python molurus*	Dhaka zoo	02	Male-2	02
02	Ghorial	*Gavialis gangeticus*	Dhaka zoo	04	Male-4	04

Entry gate

Walkway



Animal cage with front and backyard road

Garden of medicinal plants

Fruit trees

Resting tools for visitors

Plate 4.14: Some important features and natural views of Rangpur Zoo

Cage of tiger

Handling of tiger

Spotted deer

Hyena taking food

Hippopotamus

Asiatic black beer

Plate 4.15: Some important animals of Rangpur Zoo

Offspring of Jackal

Monkey

Front side of animal cages

Samber deer

Animal taking food

Cage of python

Plate 4.16: Some important animals and cages of Rangpur Zoo

Aviary

Side view of aviary

Front side of cassowary cage

Cassowary

Cage of parrot

Black vulture

Plate 4.17: Bird cages of Rangpur Zoo

Children park

Food shop

Canteen

Visiting zoo animals

Visiting zoo animals

Visiting zoo animals

Plate 4.18: Visitors facilities of Rangpur Zoo

4.3.3 Organogram of the Zoo

It was observed that there is no offical organogram of the zoo but the allotted posts and designation of the zoo are as follows:

1.	Deputy Curator	-	01
2.	Zoo officer	-	01
3.	Office Assistant cum Accountant	-	01
3.	Animal caretaker	-	02
4.	Carpenter	-	01
5.	Gardener	-	05
6.	Guard	-	05
7.	MLSS	-	02
8.	Master roll staff	-	05
	Total	-	23

4.3.4 Facilities for the Visitors

Rangpur zoo provided some facilities for the visitors are as follows:

1. The Zoo open for the visitors all the year round but Sunday is closed for the visitors.
2. Canteen and foods are available in the middle part of the Zoo.
3. Boat riding facilities in the lake with pay.
4. A children park and different rides present for the recreation.
5. Picnic facilities in different picnic corner with pay.
6. Photography and Shooting facilities with the permission of Authority.
7. Disable person may visit by the rickshaw or other vehicle with the permission of Authority.

4.3.5 Brief Description of the Zoo

Serial	Features	Number
1.	Zoo office Building	01
2.	Canteen	01
3.	Restaurant	01
4.	Animal cage	20
5.	Garden	05
6.	Pond	01
7.	Godown	01
8.	Public toilet	02

Fees

1. Entry fee- 05 taka/ adult person
2. Free entry of child 0 to two years.
3. Picnic corner fees- Taka 300, 500 and 700 varies with the type of spot.
4. Campaigning with packing food 200 taka.

4.3.6 Some Negative Features of the Zoo

1. Some animals present here in a pair of same sex as Lion, Python, Olive baboon, Ghorial etc.
2. Some single animals present here are Hyena, Sumber deer, Water buck, Cassowary, Hippopotamus etc.
3. There is no isolation shed and Veterinary Clinic present for the sick animal.
4. Lacking of proper manpower.
5. An aviary present but with a little space and varieties of bird are kept here.
6. Most of the cages are small in size.
7. Crime occurs often at the canteen side.

4.3.7 Some Strengthen Features of the Zoo

1. Reproduction rate of Spotted Deer is high in the Zoo.
2. Some successful captive breeding of Tiger and lion are present here. The Zoo donate about 16 nos. of newborn Tiger and 04 nos. of newborn Lion in Dhaka Zoo.
3. A new budget is already casted for buying new animals and birds with the Dhaka Zoo.
4. Any donation or injured animals and birds caught by the people are received here as their own home.
5. Breeding performance rate is exclusively high incase of Spotted deer, Tiger, Lion, Rabbit etc.
6. All the employees of the Zoo are committed to serve the people.
7. The Zoo contributing a great role for the purpose of education and research for the students of different Department of Universities and organization.

4.3.8 Future Plan

- A new project work and budget already proposed with the Dhaka Zoo for the new cages and buying new animals and birds.
- About 10 crore of taka sanction for the new developmental work. (Appendix-III)

4.4 Dulahazra Safari Park

4.4.1 Historical Background

Cox's Bazar is an extra-ordinary tourism place of Bangladesh. The Safari Park is an exceptional step of the forest division for the conservation of biodiversity of plants and animals. This park is situated in Dulahazra Union under Chakaria Thana (Police station) of the Cox's Bazar district. This park is constructed 110 kilometers South, towards the Chittagong Cox's Bazar highway. From that place the distance of Cox's bazar is only 47 km. Once upon a time Dulahazra was a virgin forest. There are some trees like Garjan, Boilam, Telsur, Sivet, Chapalish etc are valuable resources and animals like Elephant, Tiger, Deer, Bear, Monkey and birds of different species were seen. Due to the increasing population and illegal hunting innumerable wild animals and plants were killed. So, it made a great effect in their biodiversity. As a result many wild animals had disappeared. Wild animals are import for maintaining the biodiversity of food cycle and environment. That is why for the existence of mankind the role of wild animals is immense. For the opportunity to study research, Eco-tourism and sight seeing alongside the territory of wild animals and biodiversity of forest the progress of this park was started in the economical year 1998-1999. The Safari Park was constructed following the South Asian Model. This is a government approved fenced territory, where domestic and foreign animals can maintain their livelihood. There is a opportunity of tracts where a visitor can travel by bus and can study, do research and sightseeing by walking. The concept of Safari Park is different from Zoo. In a Zoo, the animals are watched in a cage by visitors. But in Safari Park the animals move freely and the sightseeing is done carefully or inside a bus.

4.4.2 Land scaping of Safari Park

Dulahazra of Cox's bazar district, taking 900 hector areas from the forest department for establishing the Safari Park. For the development of Dulahazra Safari Park following steps are taken by the authority.

- Guard post, Ticket counter and different residential buildings
- Parking area
- Student Dormitory
- Entrance of Safari Park and different model and mural of wild animals
- A model map of Park at the right side of main gate

- Construction of Orcid house
- Information and study centre
- Construction of sightseeing centre
- Construction of Natural History Museum
- Construction of three "Rest House" for tourists
- A Safari bus for the visitors of Safari Park
- Construction of animal Hospital, Small and small large cage sitting place, car parking and garage etc.
- Animal food and various kinds of artificial garden
- Development of animal land
- Construction of spot of animal feeding
- Construction of large bird house
- Development of supply of electricity and water
- Collection of main nearly lost Asian and African animal
- Construction of Observation tour
- Broad walkway of 500 meter
- Construction of 11 km Metal road, bridge, culvert etc.
- An area of 60 hectors for the living place of tiger
- An area about 40 hectors for the living place of lion
- An area of 50 hectors consisting of different wild animals like sambar, Maya Deer, Chitra Deer, Goyal and different omnivorous animals
- Eight lakes or ponds for wild animals around 50 hector of land
- Two living house for Bears around 20 hectors of land
- Living place of different wild animals around 10 hectors of land
- Living place of Hippopotamus around 5 hectors of land
- Living place of Elephants around 150 hectors land

4.4.3 Animals of Dulahazra Safari Park

Dulahazra Safari Park started its journey with a main goal of conservation of animals. This park is known as samber deer breeding center. In Safari Park, there are 28 species of mammals, 42 species of birds and 14 species of reptiles are present. The total numbers of mammals are 1482, birds are 331 and reptiles are 118. In total 84 species are present with total number of 1931 animals.

Table 4.12: Mammals of Safari Park

Sl. No.	Animal	Total	Present No
1	*Panthera tigris*	03	03
2	*Panthera leo*	07	07
3	*Munticus muntjak*	04	04
4	*Elephus maximus*	04	04
5	*Axis porcinus*	05	05
6	*Seminopithcus entellus*	01	01
7	*Artictis binturong*	04	04
8	*Sus scrofa*	07	07
9	*Lepus nigricolis*	20	00
10	*Bos gaurus*	03	15
11	*Vivera zibetha*	05	00
12	*Felis chaus*	02	04
13	*Felis mormata*	02	04
14	*Felish bengalensis*	04	02
15	*Manis crassicaudata*	225	225
16	*Hystrix indica*	04	01
17	*Pteropus giganteus*	03	00
18	*Nyctice coucang*	24	24
19	*Macaca assamensis*	20	20
20	*Hylobates hillock*	02	02
21	*Selenorctos thibetanus*	14	14
22	*Cervous unicolor*	20	20
23	*Canis aureus*	60	60
24	*Felish viverrina*	02	02
25	*Petuaurista magnificus*	1000	1000 above
26	*Cannochaepes taurnis*	04	04
27	*Hippopotamus amphibious*	04	04
28	*Axis axis*	46	46
	Total=	**1499**	**1482**

Table 4.13: Birds of Safari Park

Sl. No.	Birds	Total	Present No
1	*Phalacrocoras niger*	07	12
2	*Loophura leucomelana*	15	12
3	*Bubo Zeylonesis*	02	01
4	*Dromaius novaehollandiae*	08	03
5	*Tyto alba*	06	04
6	*Podiceps rufficollis*	08	05
7	*Alcedo atthis*	50	47
8	*Halcyon pileata*	23	15
9	*Sturnus contra*	25	34
10	*Polypectron bicalcaratum*	04	04
11	*Sturns pagodarum*	05	05
12	*Streptopelia chinensis*	01	01
13	*Corvus macrorhynchas*	15	20
14	*Ardeaola grayii*	10	10
15	*Chrysolophus pictus*	02	01
16	*Pssitacula krameri*	20	20
17	*Ardea cinerea*	01	03
18	*Bubulcus ibis*	02	01
19	*Nycticora nycticoray*	01	01
20	*Eudynamys scolopaca*	05	04
21	*Pycnonotus jocosus*	05	02
22	*Chrysolophius pictus*	03	03
23	*Lophura nycthemera*	03	01
24	*Orthotomus sutorius*	07	12
25	*Dedrocygna javanica*	03	03
26	*Haliastur indicus*	04	04
27	*Copsychus saularis*	05	05
28	*Ichthyophaga ichthyophaga*	04	04
29	*Gallus gallus*	02	03
30	*Passer domesticus*	25	25
31	*Amaurornis phoenicunes*	02	02
32	*Lonchura punctulata*	07	00
33	*Leptoptilos javanicus*	06	02
34	*Micropternus branchyurus*	07	07
35	*Porphyrio porphyrio*	04	04
36	*Dinopium benghalense*	35	35
37	*Cacatua galerita*	04	04
38	*Aquila rapax*	04	04
39	*Anthra malabaricus*	01	01
40	*Bucros bicornus*	01	01
41	*Grus grus*	02	05
42	*Lbis oleucoaphalus*	01	01
	Total=	**345**	**331**

Table 4.14: Reptiles of Safari Park

Sl. No.	Reptiles	Total	Present No
1	*Hadrella thurji*	08	08
2	*Calotes Versicolor*	07	07
3	*Kachuga tecta*	09	09
4	*Varanus bengalensis*	02	01
5	*Chitra indica*	05	05
6	*Enhydris enhydris*	0	0
7	*Aspideretes nigricans*	01	01
8	*Star tortoise*	53	53
9	*Lessemys punctata*	28	28
10	*Artetium schistosum*	0	0
11	*Naja naja*	0	0
12	*Xenichrophis picsator*	0	0
13	*Python morulus*	04	04
14	*Indotestudo elongate*	02	02
	Total=	**119**	**118**

Table 4.15: Amphibians of Safari Park

Sl. No.	Amphibians	Total	Present No
1	*Hoplobartracus tigrina*		
2	*Rhacophorus maximus*		
3	*Bufo melanostictus*		

Entry gate

Veterinary clinic

Model Map of Safari Park

Guide line map

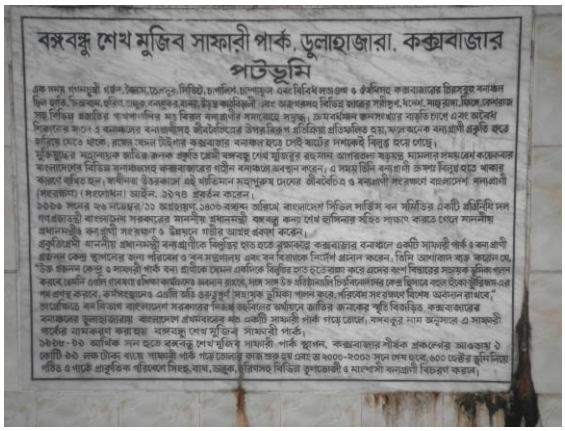
Nature interpetation center

Orchids house

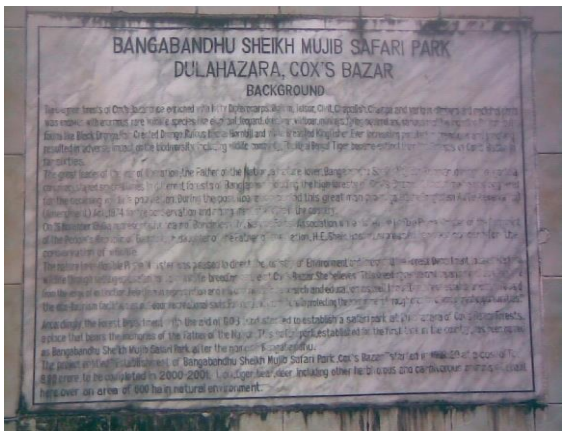
Plate 4.19: Some important features and natural views of Safari Park

Information of some projected enclosure

Isolation shed



Background inforamtion in Benglai



Background inforamtion in English

Captive breeding point of tortoise

Walkway beside animal enclosure

Plate 4.20: Some important features and natural views of Safari Park

Animals cages

Aviary

Cage of peacock

Monkey

Viewing of animals

Walkway inside Safari Park

Plate 4.21: Animals and cages of Safari Park with viewing facilities

Cage of bird

Cage of bird beside the bond

]

Pelican cage

Bird cage on the pond

Hargila bird

Enclosure of lion

Plate 4.22: Animals and cages of Safari Park with viewing facilities

Lion within enclosure

Walkway

Viewing of animal

Viewing of bird

Name plate of Samber Deer Breeding Center

Tourist bus inside the Safari park

Plate 4.23: Visitors facilities of Safari Park

4.4.4 Brief Information of the Safari Park

Lake

Eight ponds and two lakes are constructed for the supply of water for wild animals in a land of 50 hectors. Every year thousands of migratory birds stay here and gives pleasure to the visitors.

Elephant Riding

In the north-eastern side of park a living place of Elephants are created around a land of 150 hectors. Any visitor can be delighted by riding the elephants.

Visit to Tiger and Lion Enclosure

The living place of Lion and tiger is constructed on a land of 100 hectors. There is a road of 2 kilometers, where any visitor car travel by a bus and enjoy the natural scenery of lions and tigers.

Nature Interpretation Centre

In Safari park the first interpretation centre of Bangladesh has been constructed. In this centre model and mural of different forest areas and wild animals has been created by providing light and sound the concept about different wild animals and enclosing area are given. About 100 model and mural of wild animals and plants are constructed in the interpretation center for the visitors and visitor can also enjoy a audio-visual for 12 minutes.

Natural History Museum

In the forest area of Dulahazra Safari Park wild animals like Elephant, Maya Deer, Monkey, Porcupine, Wild pig, wild cat, Mayna, wild tiger, Parrot, Shalik, King fisher are even seen now. About 2000 wild animal's body parts, specimen and staffing are collected and kept in this museum. About 300 wild plants herbarium are collected and preserved here. For the conservation of wild animals, consciousness is created among the people. Education and research facility is provided in the Natural History Museum and it is a systematic step. By this step, tourists and visitor, students and researchers can get due concept of animals in danger and animals that are nearly lost. Except these from database student and researchers can get information relation to plant and animal kingdoms.

Orcid House

On the right side of the main door of safari park there is a orcid house. There are 50 orcids of different countries and of different species.

Broad Walkway

In the middle of deep forest a board walk way of 500 metre in length and 10-15 metre high has been created. Visitors can Match different types of wild animals while moving in a board walk.

Sight Seeing of Safari Park

A visitor can visit the park by paying fee. Government approved entry fee has been shown below :

1. Adult (Above 15 years) 10 taka
2. Students of school (below 15 years) 5 taka
3. Student group from study tour of educational institution (30-100) 100 taka
4. Students from educational institution (above 100) 200 taka
5. Tourists: 5 US Dollars or same amount in Bangladeshi Taka
6. Car Parking Fee : a) Bus- 25 taka, b) Car/Microbus- 15 taka

Things which Visitors can Enjoy

- ❒ By information and education centre video Briefing visitors can get the idea about Safari Park
- ❒ Visitors, Students, researchers can know about the wild animals and plants of different species of the museum
- ❒ Visitors can enjoy sightseeing of animals like Tiger, lion, Elephant, Sambar and other animals by bus
- ❒ Different migrating birds can be seen near the lakes
- ❒ One can observe a beautiful natural scenery of birds, animals from observation tower
- ❒ In bird house different domestic and foreign birds can be seen
- ❒ Rest house and Dormitory for staying at night
- ❒ Students and researchers can absorb knowledge before the payment
- ❒ There are umbrella, shed, round house and public toilet for the people

Instructions for Visitors of Safari Park

- ❒ Polythene and intercomparable elements should be kept at dustbin
- ❒ Packet of cigarette, left over paper, dead batteries lighter, biscuit etc packet should not be kept here and there
- ❒ Not to enter the park with personal vehicles
- ❒ Not to enter unprotected area
- ❒ Not to jump in the living place of lion or tiger
- ❒ Not to throw mineral water bottle in the forest
- ❒ To buy ticket from the ticket counter before entering the zoo
- ❒ Not to use mike and fire crackers
- ❒ Not to make noise in a group
- ❒ To use rest house pre booking should be done
- ❒ Not to feed the animals with any kind of food
- ❒ Not to tease the animals
- ❒ Not to enter the living place of animals
- ❒ To park the vehicle properly in the parking area
- ❒ Visiting hours of the Safari park from 9.00 am to 5.00 pm.

Bus Service

People can drop at Dulahazra while traveling from Dhaka to Cox's bazar. It is 350 gauge to the East from the main road.

Train Service

There is no direct train service from Dhaka to Cox's bazar. That's why we can travel by train from Dhaka to Chittagong then from there we can go to Cox's bazar by bus and can visit the Safari Park by dropping in Dulahazra. The distance between Dulahazra and Cox's bazar is only 47.0 kilometers. After visitign park anyone can reach the coast of Cox's bazar only in 45 minutes. There is a chance for everyone to stay over at night in any hotel.

4.5 Total List of Species and Animals in Dhaka, Rajshahi, Rangpur Zoo and Safari park

Table 4.16: A Comparative study of Animals and Birds Species and Number in Dhaka, Rajshahi, Rangpur Zoo and Dulahazra safari park

DHAKA ZOO			
SL.NO.	**CLASS**	**SPP.**	**TOTAL NO. OF ANIMALS**
1.	MAMMALS	54	368
3.	BIRDS	57	1190
2.	REPTILES	10	64
	TOTAL	**121**	**1622**
RAJSHAHI ZOO			
SL.NO.	**CLASS**	**SPP.**	**TOTAL NO. OF ANIMALS**
1.	MAMMALS	13	155
3.	BIRDS	18	249
2.	REPTILES	3	5
	TOTAL	**34**	**409**
RANGPUR ZOO			
SL.NO.	**CLASS**	**SPP.**	**TOTAL NO. OF ANIMALS**
1.	MAMMALS	13	90
3.	BIRDS	7	85
2.	REPTILES	02	06
	TOTAL	**22**	**181**
DULAHAZRA SAFARI PARK			
SL.NO.	**CLASS**	**SPP.**	**TOTAL NO. OF ANIMALS**
1.	MAMMALS	28	1482
3.	BIRDS	42	331
2.	REPTILES	14	118
	TOTAL	**84**	**1931**

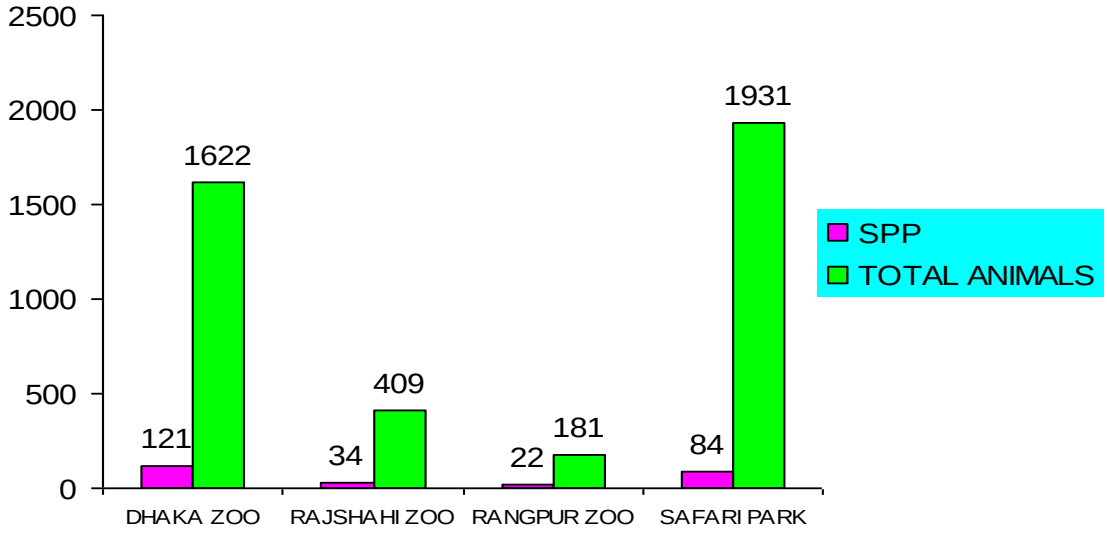


Figure 4.1: Comparative statement of species and total animals in different zoo

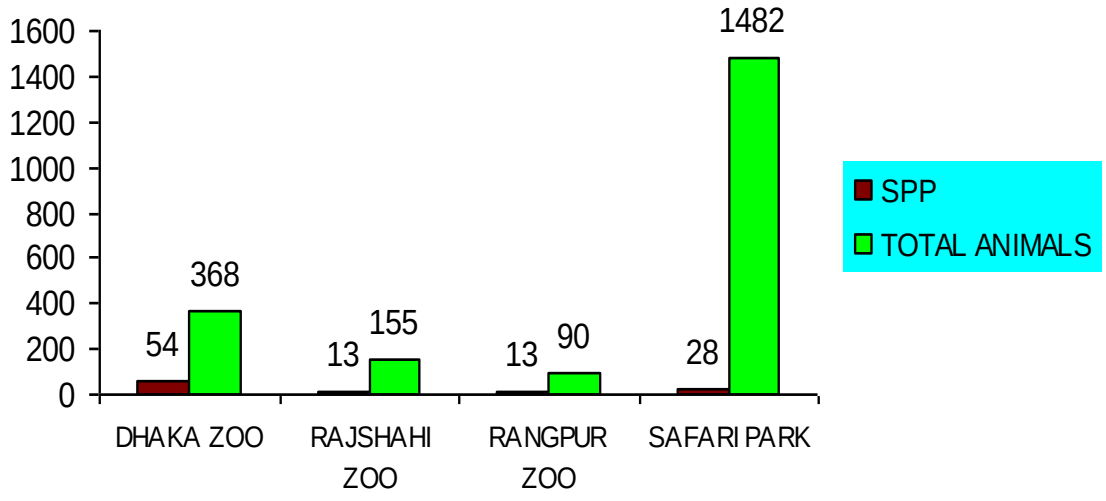


Figure 4.2: Comparative statement of species and total mammals in different zoo

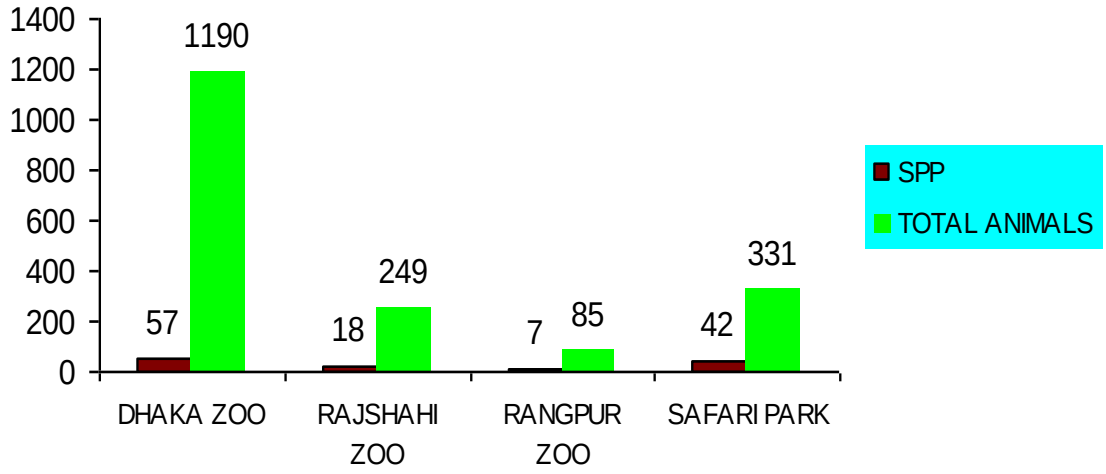


Figure 4.3: Comparative statement of species and total birds in different zoo

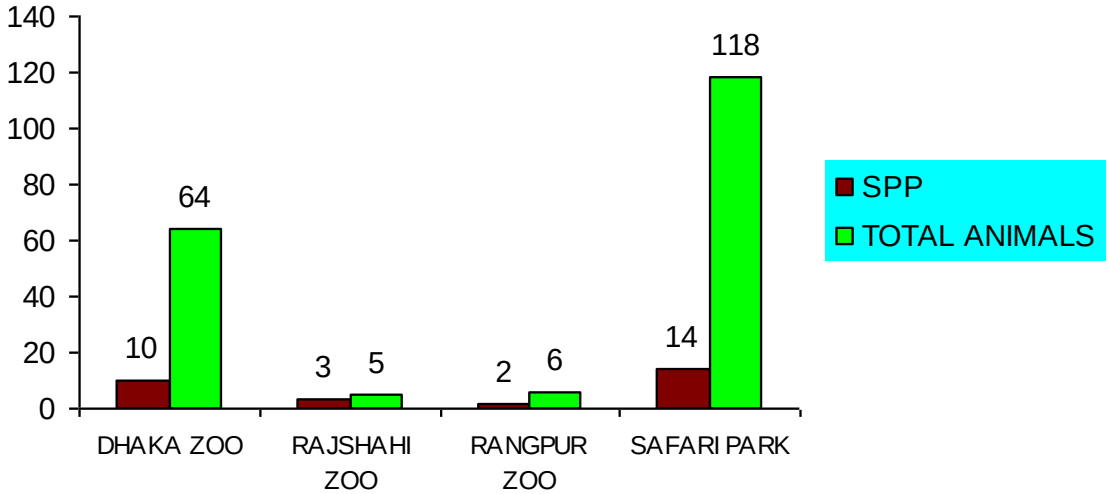


Figure 4.4: Comparative statement of species and total reptiles in different zoo

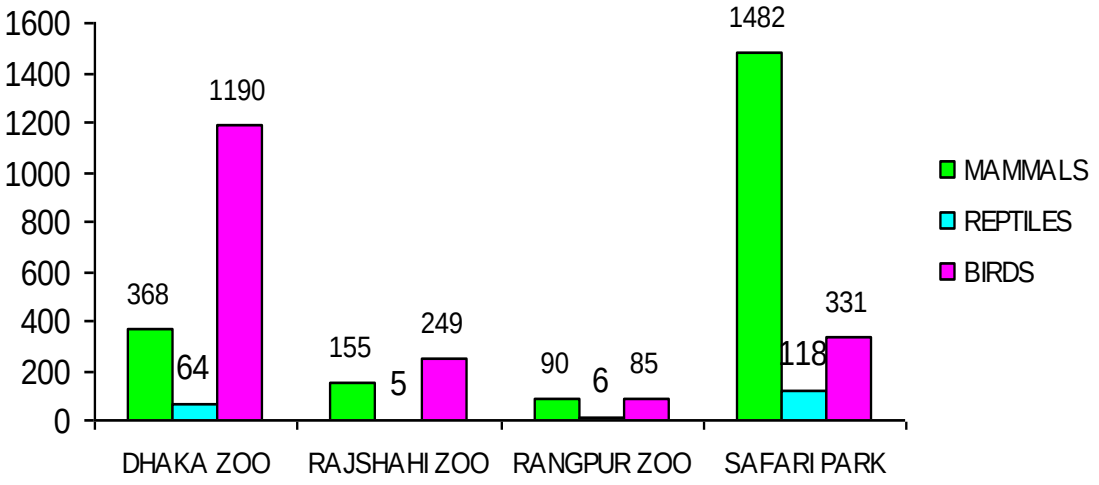


Figure 4.5: Comparative statement of Mammals, birds and reptiles in different zoo

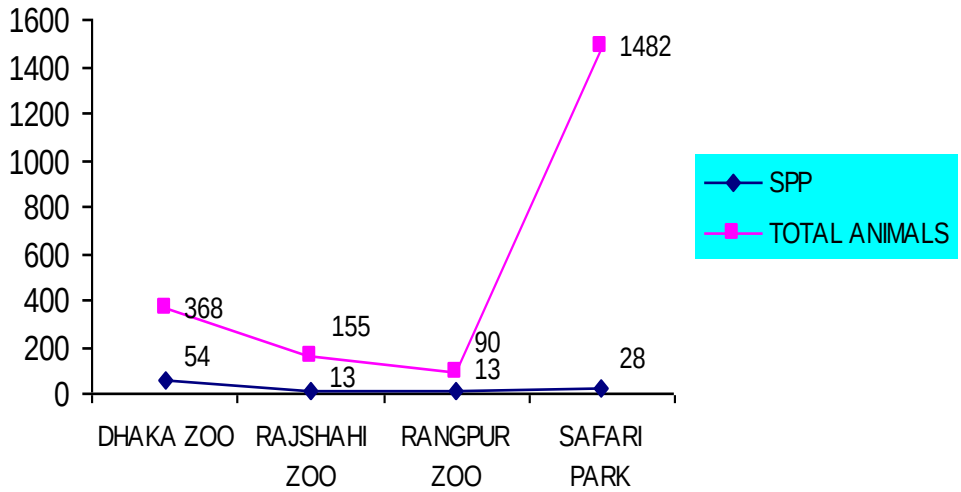


Figure 4.6: Comparative statement of species and total mammals in different zoo

\

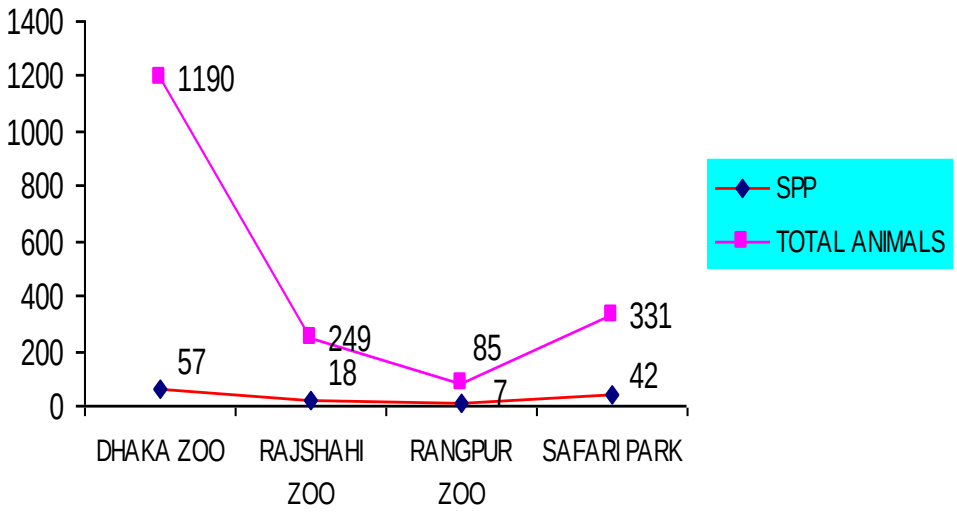


Figure 4.7: Comparative statement of species and total birds in different zoo

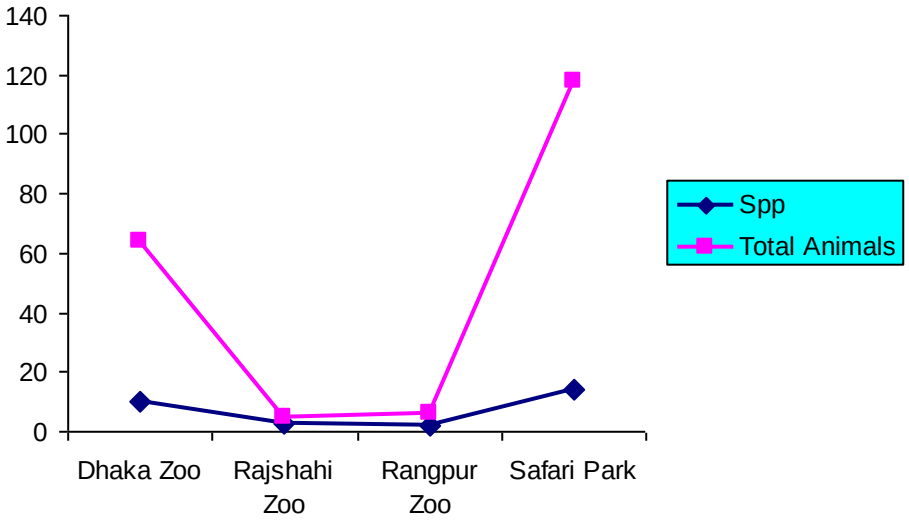


Figure 4.8: Comparative statement of species and total reptiles in different zoo

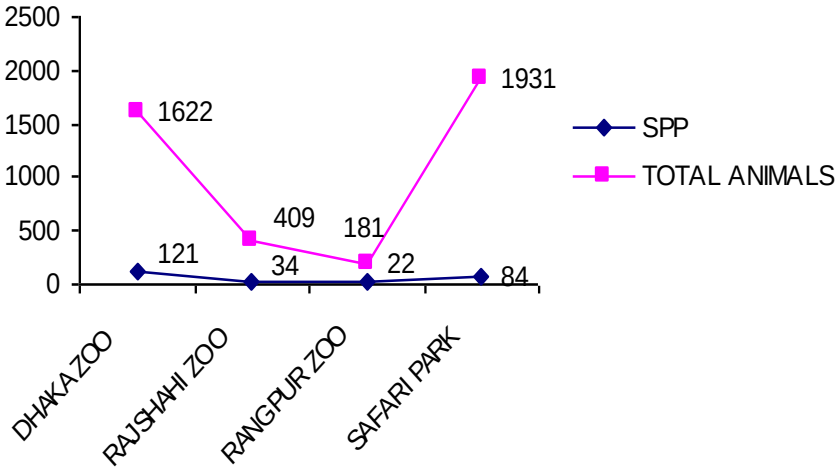


Figure 4.9: Comparative statement of species and total animals in different zoo

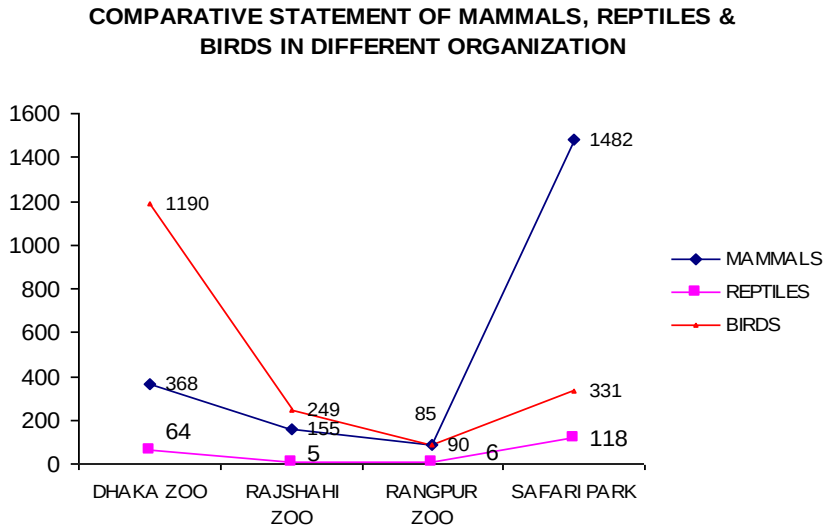


Figure 4.10: Comparative statement of mammals, birds and reptiles in different zoo

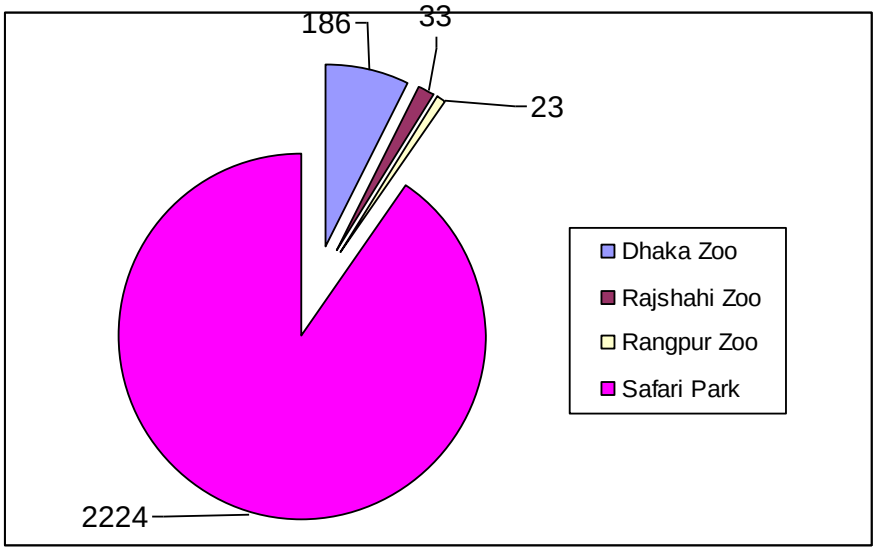


Figure 4.11: Comparative area in different zoo (Acre)

4.6 Some Features of Captive Breeding and Rehabilitation in Bangladesh

In Bangladesh Captive Breeding and Rehabilitation by Ex-situ is not more but progress slowly.

Mammals

1. Royal Bengal tiger (*Panthera tigris*)
   – Dhaka and Rangpur zoo.
2. Leopard (*Panthera pardus*)
   – Dhaka zoo.
3. Rabbit
   – All zoos in our country.
4. Hog deer (*Axis porcinus*)
   – Dhaka zoo.
5. Axis- impure breed of cervus.
   – Dhaka zoo.
6. Sambar deer (*Cervus unicolor*)

– Dulahazra forest near Cox's Bazar, A protected safari Park known as Sambar Deer Breeding Centre.

Total Area 42.5 hactor, Started from 1995 with only one pair of Sambar Deer.

It has a good natural condition and vegetation for deer culture. Management system provides a good model for rearing sambar. It could be a successful example of our country for conservation and breeding of some essential faunal diversity.

7. Fishing cat

– Dulahazra forest near Cox's Bazar.

8. Wild cat

– Dulahazra forest near Cox's Bazar.

9. Civet cat

– Dulahazra forest near Cox's Bazar.

10. Jackale

– Dulahazra forest near Cox's Bazar.

11. Resus monkey

– Dulahazra forest near Cox's Bazar.

12. Spotted deer

– Dulahazra forest near Cox's Bazar.

13. Maya deer

– Dulahazra forest near Cox's Bazar.

14. Wild boar

– Dulahazra forest near Cox's Bazar.

Birds

Stork (kani bok)

– Dhaka zoo.

Zalali Kobutor at the Mazar of Hazrat Shahzalal in Sylhet.

Threatened species- Valture, Hawks, Falcon, Leptoptilos, Soem storks, Cairina, Ciconia etc.

Reptiles

a. Crocodiles (*Crocodylus porosus*): In the pond of Khan Zahan Ali Mazar of Bagerhat.

b. Turtles: In St. Martins Islands Centre for Natural Resource Studies (CNRS- for sea turtles) produced huge number of turtles in captivity and released in the Bay of Bengal.

– Olive ridley (48-176) eggs in a year

– Green turtle (115×3-5) times in a year

– Hawks bill (160×2-4) times in a year

– Logger head (125×4-7) times in a year

– Leather back (110×6-9) times in a year

CNRS have a Hatchery for turtle rearing in Saint Martins.

c. Bon rui

– Dulahazra forest near Cox's Bazar.

d. Dragon

– Dulahazra forest near Cox's Bazar.

e. Python

– Dulahazra forest near Cox's Bazar.

f. Sundi tortoise

– Dulahazra forest near Cox's Bazar.

g. Bostami tortoise

– Dulahazra forest near Cox's Bazar.

Chapter Five
Discussion

The main objective to established a zoo are conservation of animals, animal welfare, research, education and recreation. Dhaka zoo is the largest zoo among the others zoo. It is opened on 1974 and has 186.63 Acres of land area. Rajshahi Zoo started its journey on 1985 and has 32.76 Acres of land. Rangpur Zoo established on 1990 and has 26 Acres of land, Dulahazra Safari park established on 1998 and has 900 hectre land area.

5.1 Animals Species Status

Zoo animals are categorized as mammals, birds and reptiles species. The number of bird species are highest in Dhaka Zoo, Rajshahi Zoo, Dulahazra Safari Park, except Rangpur Zoo. Mammals are the Second highest species in all Zoos and Safari Park, except Rangpur Zoo.

Table 4.16 shows that there are total 121 number of species has been kept in Dhaka Zoo, 34 number of species has been kept in Rajshahi Zoo, 22 number of species has been kept in Rangpur Zoo and 84 number of species has been kept in Dulahazra Safari Park.

Among them Dhaka zoo Possesses 54, 57 and 10 number of mammals, birds and reptiles species respectively. It has possesses 26 number of aquarium fish species.

Rajshahi Zoo possesses 13, 18 and 3 number of mammals, birds and reptiles species respectively.

Rangpur zoo possesses 13, 7 and 2 number of mammals, birds and reptiles species respectively.

Dulahazra Safari Park possesses 28, 42 and 14 number of mammals, birds and reptiles species respectively. It hs possesses 3 number of amphibian species.

It was reported in 1829 by Edward Turner Bennet that the Tower menagerie had contained 43 mammals, 11 birds and 4 reptiles in 1818 (Edward, 1829). Zoos in Bangladesh still have the characteristics as pre-modern zoos (menagerie) both for the collection, display and management.

In our neighbour country (India), National Zoological Park Delhi possesses 127 number of speices and 1347 number of animals (en.wikipedia.org), Alipore Zoological Garden, Kolkata possesses 108 number of species and 1266 number of animals (en.wikipedia.org) and Nandarkanan Zoological Park, Odisha possesses 120 number of speciess and 1659 number of animals. Although the mentioned 3 Indian Zoos consists more number of speices but the total number of animals are more or less similar to Dhaka Zoo and Dulahazra Safari Park.

5.2 Lonely Animals/Single Sex Species Status

Conservation of animals can be ensured through reproduction and captive breeding, To ensure reproduction and captive breeding, both sexes (male and female) of animals are desired. But unfortunately some species of lonely animal present in some zoos.

Table 4.1 shows that there are about 17 single sex species of mammals present in Dhaka Zoo, Table 4.2 shows that 12 Single sex species of birds and Table 4.3 shows that 2 single sex species of reptiles present in Dhaka Zoo.

Table 4.6 shows that there are 7 single sex species of mammals present in Rajshahi Zoo. Table 4.7 shows that 7 single sex species of birds and Table 4.8 shows that 2 single sex species of reptiles present in Rajshahi Zoo.

Table 4.9 shows that there are 7 single species of mammals present in Rangpur Zoo. Table 4.10 shows that 2 single sex species of birds and Table 4.11 shows that 2 single sex species of reptiles present in Rangpur Zoo.

Like Bangaldeshi Zoos, also the Alipore Zoological Garden, Kolkata, India has attracted a lot of criticism over the years for keeping single and unpaired specimens of rare species like the banteng, great Indian one-horned rhinoceros, crowned crane and the lion-tailed macaque (Somdatta, 2005). Lack of breeding and exchange programs has led to the elimination of individuals and populations of environmentally vulnerable species like the southern cassowary, wild yak, giant eland, slow loris and echidna.

5.3 Successful Captive Breeding Status

Some captive animals performing continuous reproduction actively, Table 4.5 shows that 673 animals born in Dhaka Zoo during the year 2000 to 2009. Breeding performance rate is exclusively high incase of spotted deer, monkey, ass, rabbit, pigeon, dove in Rajshahi Zoo and spotted deer, tiger, lion, rabbit in Rangpur Zoo. Dulahazra Safari Park is known as Samber Deer Breeding Centre in Bangladesh.

In Inida, National Zoological Park, Delhi is a part of conservation breeding programs of the Central Zoo Authority for the Royal Bengal Tiger, Indian rhinoceros, Swamp deer, Asiatic lion, Brow antlered deer, and Red jungle fowl (nzpnewdelhi.gov.in).

Alipore Zoological Garden, Kolkata, India was among the first zoos in the world to breed white tigers and the common reticulated giraffe. While it has successfully bred some megafauna, its rate of breeding rare species had not been very successful, often due to lack of initiative and funding. One notable exception is the breeding programme of the *Manipur brow-antlered deer*, or thamin which has been brought back from the brink of extinction by the breeding program at the Alipore Zoo (Gautaman, 2011).

Nandankanan Zoological Park, Odisha, India enjoys a good reputation internationally for successfully breeding black panthers, gharials, and white tigers in captivity. Endangered species such as the Asiatic lion, three Indian crocodilians, Sangal lion-tailed macaque, Nilgiri langur, Indian pangolin, mouse deer and countless birds, reptiles and fish have been breeding successfully at Nandankanan (khordha.nic.in).

All zoos in the world are trying to formulate a captive breeding program to conserve the threatend and critically endangered species of wild animals.

5.4 Animal Cages and Safety Boundary

Most of the cages are small in size. Plate 4.11 Shows that cages are small in size in Rajshahi Zoo and height of the safety boundary is too short (Plate 4.12).

Plate 4.15 and Plate 4.16 shows that the cages are small in size in Rangpur Zoo. Height of bird cages are too short. A small aviary present but it is too short in height and has no perfect safety boundary (Plate 4.17).

Plate 4.22 shows that though Safari Park comprises a large area but some small aviary present which are shorten in height and size. Some safety boundary of cages already broken down and are too short in height (Plate 4.21)

5.5 Animals Health Care and Veterinary Faciltieis

Animal health care with veterinary facilities, isolation shed and veterinary clinic inorder to provide medication, treatment, disease control and surgery present in Dhaka Zoo and Dulahazra Safari park, But there is no veterinary clinic present in Rajshahi Zoo and Rangpur Zoo. In that case, medication and treatment providing to the zoo animals directly inside the cages.

It is necessary to establish a veterinary hospital or clinic inside the zoo and safari park. According to the zoo ethics, no sick animal will be exhibited to the public. It has to be treated in veterinary clinic. Before exhibition, a new animal imported from abroad or from other places, it should be kept inisolation shed for some days, Only Dhaka Zoo and Dulahazra Safari Park has veterinary clinic (Plate 4.1 and Plate 4.19). But no veterinary clinic and isolation shed present in Rajshahi and Rangpur Zoo.

In Delhi Zoo, India the Veterinary Section is other most crucial section of the zoo. It is headed by the Veterinary Officer. One Assistant Veterinary Officer is also there to help and support him. Other paramedical staffs work under him to mange the affairs. They are responsible for proper medical care of the animals during sickness. They are also responsible to decide the feed of the animals and to take preventive measures including routine check up of animals. The zoo has a modern well equipped Veterinary Hospital in the campus with all diagnostic facilities and required personnel (nzpnewdelhi.gov.in).

Nandankanan Zoo, Odisha, India got a new veterinary hospital and an interpretation centre on its premises. Forest and environment minister BijoyshreeRoutray inaugurated the facilities on Saturday. The modern veterinary hospital was constructed at a cost of Rs 29.14 lakh. It has facilities such as instrument rooms, dispensary, isolation ward, X-ray room, quarantine and operation theatre. Three doctors, two specialists and a veterinary surgeon will be present at the hospital apart from a live stock inspector. (timesofindia.indiatimes.com)

All the zoos around the world are trying to ensure good health care and veterinary facilities for the zoo animals.

5.6 Animals Welfare

All the zoos and Safari park are committed to maintain welfare of animals. In order to increase the variety of species, Dhaka Zoo purchase 94 animals during the year 2000-2009 from home and abroad (Table 4.5). Dulahazra Safari Park is very rich in animal collection and providing large area to the animals and birds due to consisting huge land. Any donation or injured animals and birds caught and rescued by the local people received in Rajshahi and Rangpur Zoo. Dhaka Zoo donate and exchange about 111 animals during the year 200-2009 between different Zoo's of Bangladesh. (Table 4.5)

The Alipore Zoo, Kolkata, India is also home for wintering migratory birds such as ducks, and sports a sizable wetland inside the zoo grounds. Since the zoo is enveloped by urban settlements for miles, the zoo wetlands are the only resting spot for some of the birds and are a focus of conservationists in Kolkata. However, the number of migratory bird visiting the zoo dropped from documented highs by over 40% in the winter of 2004–2005. Experts attribute the causes of the decline to increased pollution, new construction of highrises in the area, increasing threats in the summer grounds of the birds (Staff reporter, 2005) and declining quality of the water bodies at the zoo (Suchetana, 2006).

Captive breeding units of all the three crocodilian species have been established at Nandankanan Zoo (Captive Breeding centres of Crocodiles in Nandankanan zoo). In 1980, the gharial (*Gavialis gangeticus*) was bred in captivity for the first time at the Nandankanan Biological Park in Odisha. This successful effort involved the collaboration and coordination between international and national zoological parks. The zoo was the first in India to successfully breed pangolin. In a programme started before the Central Zoo Authority (CZA) pangolin breeding programme, the zoo authorities started the programme in the nocturnal centre of the animal park. There are 10 pangolins in Nandankanan Zoo, including six females. To help involve the general public in animal conservation and raise money, the zoo started the Adopt-an-Animal programme in 2008 for all of its animals (orissadiary.com and The Hindu 2011).

Now a days, every zoo around the world are trying to provide animals friendly envrionment to the zoo animals.

5.7 Future Plan

Every zoo and safair park has future plan to collect new animals from home and abroad, establishement of new cages and infrastructures, beautification, providing more scientific, seminatural environment, ecofriendly and animal friendly envrionment to the animals and modernization of the organizations. New Construction is going inside the Rajshahi Zoo (Plate 4.9, 4.10 and 4.13). Inorder to increase the variety and number of animals collection from home and abroad, process is alredy going on incase of Dhaka Zoo (4.1.9 Future Plan of Dhaka Zoo). A new budget already custed to Dhaka and Rangpur Zoo Modernization Project (Appendix-III).

Chapter Six
General Management of Zoo

The physical health as well as the social and behavioral well-being of zoo animals depends on enclosure design, nutrition, husbandry, management, group social structure, behavioral enrichment, and good medical and surgical care. Naturalistic enclosures with soil and vegetation are appealing to the public and more stimulating for the animals, but they present challenges for both sanitation and parasite control programs and may complicate restraint procedures. Mixed species exhibits may increase risk of disease transmission between species and can result in interspecific aggression if appropriate choices are not made.

6.1 Management of Zoo

Husbandry

The animal's exhibit should approximate its natural environment and enhance the visual experience for zoo visitors. Many healthy mammals and birds can tolerate a fairly wide temperature range if given access to shade and water in hot weather and to a dry, draft-free shelter with a warm spot and ample food to meet increased energy requirements in cold weather. It is essential to ensure that each animal has access to the protected environment and that one dominant individual does not exclude others from shelter, food, or water; such exclusion can result in frostbite or even death due to exposure. Feed receptacles should be designed to avoid fecal contamination and be easy to clean.

With large numbers of birds or mammals, and especially in mixed species exhibits, several watering and feeding stations should be established at appropriate heights to reduce injuries or deaths resulting from territorial conflicts. The timing of feedings is important. In many species, it is best to feed small amounts throughout the day to stimulate activity; this is beneficial for the animal and results in a better display. Food can also be used to attract an animal to an area where it is more easily and safely examined or treated.

Reproduction

The biology and social behavior of animals must be understood to promote reproduction. Species should be maintained alone, in pairs, or in groups, depending on their established

social systems. For example, in mixed species groups of Artiodactyla, it is possible to establish species estrous cycles through a variety of techniques, including monitoring hormone levels in the urine and feces. Monitoring reproductive cycles may be used to determine when to introduce and remove breeding males, with males of other species rotated to coincide with the estrous periods of the females of each species. This may also reduce injuries from interaction between breeding males. At parturition, the males of some species should be removed for several weeks to prevent attacks on the postpartum females or their offspring. In colder climates, males should be introduced at a time that will allow births to occur during warm weather.

Artificial reproductive technologies such as artificial insemination, in vitro fertilization, and embryo transfer have been successfully employed in diverse zoo species. These efforts have made a significant difference in some endangered species breeding programs (eg, black-footed ferret). However, success requires substantial financial, personnel, and resource investments to determine basic parameters of reproductive cycles and responses to pharmacologic manipulation.

An emerging management priority in maintenance of zoologic collections is the need for selective reproduction. Indiscriminate reproduction is unethical and carries with it the potential for overproduction that exceeds the capacity of the exhibit, the zoo, or other zoos to appropriately house the progeny. Overly successful breeding programs carry a risk of limiting resources that could compromise other captive propagation programs. Regional cooperative breeding programs such as Species Survival Plans should be followed. Contraceptive efforts in zoos are multifaceted and include permanent techniques (castration, vasectomy, ovariohysterectomy, tubal ligation), as well as reversible ones such as separation of the sexes, administration of birth control pills, hormonal implants, gonadotropin releasing hormone agonists, and oral or injectable progestins. Reversible contraception can also be used to control timing of reproductive cycles. There is ongoing work with immunocontraception through administration of porcine zona pellucida vaccines. The Association of Zoos and Aquaria Wildlife Contraception Center is a good source of up-to-date information on contraception techniques.

Preventive Medicine of Zoo Animal

The foundation of a medical program for zoo animals is preventive medicine. Preventive medical programs should be adaptive and include attention to individual specimens as

well as the herd, troop, or flock. Components of the program include quarantine of new arrivals, periodic fecal examinations and treatments for parasites, booster vaccinations, health screening procedures, nutrition evaluation, necropsy examination of deceased specimens, and a comprehensive pest control program. Animals should be evaluated to ensure their health complies with local, state, and federal health requirements before shipment to other zoos or before release in managed reintroduction programs. Preshipment evaluations can also be used as an opportunity to assess the overall health status of the group in which the animal has been living.

Quarantine

Animals entering a collection must undergo quarantine. Quarantine facilities should be designed to allow handling of animals and proper cleaning and sanitizing of enclosures. Shipping crates should be cleaned and disinfected before they leave the quarantine area, and the crates' contents disposed of appropriately. Quarantine facilities require barriers against ingress of potential vectors and vermin. Separate keepers who are skilled at recognizing signs of stress and disease and who will carefully monitor feed intake and fecal characteristics should care for quarantined animals.

Quarantine entry should be strictly controlled. Only essential personnel should be allowed into the quarantine facility. Individuals leaving the quarantine facility should not return to other animal areas without showering and changing clothing. The duration of quarantine should be appropriate to ensure that infectious diseases are not introduced into the permanent collection when the quarantined animals are released to exhibits. Quarantine facilities should follow the “all-in/all-out” principle, ie, if additional animals are added to an ongoing quarantine, the quarantine period should be restarted.

During quarantine, animals should receive appropriate vaccinations and diagnostic testing (eg, tuberculosis, heartworm). They should be examined and treated for ecto- and endoparasites and screened for enteric bacterial pathogens. Before release, animals should receive physical and laboratory examinations, which may include radiographs, serology, hematology, and clinical chemistries. Serum should be frozen for future reference and possible epidemiologic studies. All procedures and results should be recorded in each individual animal's medical record, which is an essential component of the medical

program. Each animal should also be identified by some permanent method (eg, tattoo, tag, band, eartag, transponder) to ensure future identification.

When new animals are introduced to enclosures, caution and forethought are necessary to prevent self-induced trauma. Visual barriers, eg, suspending canvasses from fences or enclosure walls or obscuring glass with soap to provide a visual cue, are standard management steps to protect newly introduced specimens from accidents during acclimation to a new exhibit.

Parasite Control

Like domestic animals, zoo animals are vulnerable to a wide variety of ecto- and endoparasites, and similar drugs are used for treatment. Care must be exercised in the choice of medications due to species-specific sensitivities to some drugs. Young animals and those stressed by shipment, disease, or injury are the most likely to be adversely affected by parasites. At these times, commensal parasites (especially protozoa) can cause disease. Acute diarrhea can result from massive infections of *Coccidia*, *Trichomonas*, *Giardia*, or *Balantidium spp.* Amebiasis, which is fairly common in primates and reptiles, can be fatal in a compromised animal. Intestinal parasites may be a major, continuous problem in species kept in naturalistic exhibits or on dirt substrate or pasture, especially in young, newly introduced, or stressed individuals. Of most concern are parasites with direct life cycles. Incorporating anthelmintics directly into the feed is helpful. As in domestic species, anthelmintic resistance may develop and necessitate rotating medication. Parasites with indirect life cycles are less frequently a problem if the exhibit area is free of intermediate hosts.

Vaccination

Vaccination programs for carnivores, nonhuman primates, equids, artiodactylids, and birds should be developed. Vaccination of zoo carnivores is essential because of their susceptibility to various diseases such as feline panleukopenia, feline rhinotracheitis, feline calicivirus, rabies, canine distemper, and canine parvovirus. (Also see Vaccination of Exotic Mammals). Previously, only killed virus vaccines were recommended, but recent studies have shown that some modified live vaccines are safe for use in select species. Further studies are required because some modified live vaccines (especially canine distemper) produce fatal disease in certain species. A canarypox-vectored

recombinant canine distemper vaccine has proven safe for use in those species susceptible to modified live virus vaccine-induced disease. Appropriateness of rabies vaccination depends on the circumstances of each collection. If indicated in rabies-endemic areas for the protection of individual animals, only a killed rabies vaccine should be used. The decision to vaccinate zoo animals for less common diseases for which a vaccine is available should be made on an individual basis. Newer recombinant and subunit vaccines are being developed for a variety of infectious diseases for domestic animals and humans. These vaccines should be used with caution until safety and efficacy studies have been completed for zoologic species.

Necropsy

All dead animals should be necropsied. This should include gross and histopathologic evaluation of tissue and viral, bacterial, or fungal cultures when appropriate. Tissues should also be saved for potential future examinations. A thorough pathology examination allows evaluation of medical, management, and nutritional programs. It is also valuable in identifying problems requiring immediate action to safeguard the health of the collection. Variations in anatomy should be recorded because such observations may aid in future diagnostic procedures or therapy in the species.

Pest Control

A successful control program is continuous and requires a concerted effort by zoo staff to minimize harborage and food for pests, in addition to the use of mechanical and chemical control methods. Choice of agent, method of use, and storage may minimize zoo animals' access to pesticides and the risk of secondary poisoning. Common zoo pests may serve as important disease vectors. For example, cockroaches are intermediate hosts for GI parasites of primates and birds; rodents can harbor and spread *Listeria, Salmonella,* and *Leptospira spp* and *Francisella tularensis*. Wild and feral carnivores such as foxes, raccoons, and domestic dogs and cats can devastate animal collections through predatory attacks and may be important vectors for viral diseases such as rabies, parvovirus, and canine distemper. Raccoons may also transmit *Baylisascaris* parasites, which can cause larval migration resulting in fatal neuropathy in some species. Pigeons, geese, ducks, and starlings are potential reservoirs for avian diseases; they consume or contaminate animal food and deposit droppings everywhere. Arthropod vectors can transmit pathogens such as West Nile virus.

Clinical Care Program for Zoo Animal

The mainstay of the zoo medical program is a qualified and dedicated keeper staff. The keepers know the individuals under their care and observe them daily. They are the first to recognize abnormalities such as anorexia, inactivity, abnormal feces, or changes in behavior that may reflect early medical problems. Overzealous reporting of observations is preferable to indifference. Because many zoo animals, especially prey species, instinctively conceal overt signs of illness until the disease process is well advanced, it is necessary to make keepers aware of the significance of what may seem to be trivial changes. Past associations with the veterinarian may arouse some animals' responses to the veterinarian's presence, which will mask subtle changes noticeable to keepers.

Once a diagnosis is made, the treatment of zoo animals is similar to that of domestic species except in the method of drug administration and restraint. A comparative medical approach is generally most successful and productive and utilizes application of medical or surgical information about diseases affecting free-ranging animals, related domestic animals, or humans. Frequently, other veterinary experts or human medical or dental specialists are consulted for advice or assistance with complicated medical or surgical cases. Knowledge of comparative anatomy, physiology, behavior, nutrition, pathology, and taxonomy is useful. Attention must be paid to both individual and population health.

Unless medical conditions dictate otherwise, it is often preferable to leave an animal under treatment at its home exhibit where it can maintain contact with its conspecifics and keepers. This can also prevent disruptions in social hierarchies, which may cause difficulties with reintroductions to an established group.

Behavioral Training

An active behavioral training program enables improved health care. Through positive reinforcement, amphibians, reptiles, birds, and mammals in zoo settings have been trained to perform behaviors on command that facilitate accomplishment of various management or medical procedures. Management behaviors include shifting on and off exhibit, onto scales, and into restraint devices or shipping containers. Medical procedures include urine collection, venipuncture, IM injection, tuberculin testing, ultrasonographic examination, and rectal or vaginal examination. Often these behaviors are incorporated into behavioral and environmental enrichment programs. Enrichment programs are designed to encourage

animals to display more of their normal behavioral repertoire, eg, increasing opportunities for foraging or social interaction, which allows animals to spend their time more as they would in nature.

Protected contact, a management system for elephants, utilizes positive reinforcement to encourage the elephant to present appropriate body parts through openings in a wall. Procedures such as venipuncture from the ear, foot trimming, reproductive evaluation, artificial insemination, and trunk washes are routinely performed using protected contact. This system provides safety for personnel working with the elephants and gives the elephant a degree of choice.

Physical Restraint

Most zoo animals resent being handled and resist manual restraint. Struggling with an animal to administer treatment may do more harm than can be offset by treatment. Physical restraint is indicated in some species for minor manipulation or close observation. Restraint devices (squeeze cages) or chute systems are frequently used for difficult to handle, larger, or dangerous species. Many procedures can be performed on unanesthetized animals so confined, including limited physical examinations, tuberculin testing, administration of injections or anesthetics, collection of blood samples, trimming malformed claws or overgrown hooves, and application of topical medications.

While the dimensions and construction of these devices vary, some operate by movement of one wall to restrain the animal against the other. Openings are provided to allow safe access to the animal. Many restraint devices for hoofstock are designed with a “V” shape; once the animal enters, the floor is lowered and the animal's body is restrained by the “V” with its feet suspended off the ground. Whenever possible, animals should be trained to enter or be enticed, rather than forced, into the restraint device. Ideally, these facilities should be designed as part of the animal's regular quarters and located in an area where the animal is normally shifted as part of the daily routine. Exhibits should contain nest boxes or restraint pens equipped with doors that operate remotely to confine the animal. From these areas, the animal can be transferred to a restraint device, anesthetic chamber, or shipping container. Weighing facilities are essential.

Small mammals and birds may be caught and restrained in long-handled hoop nets. These nets must be deep enough that the animal can be confined in the blind end, with the upper part of the net twisted to prevent escape.

Personnel participating in capture or restraint procedures must understand their role and be aware of the behavioral characteristics and physical abilities of animals. This is essential to ensure safety of both animals and personnel. Heavy gloves protect handlers from teeth and claws when animals are manually held after capture. Care must be used to avoid excessive pressure on animals, because gloves hinder dexterity and the perception of the pressure being exerted. Gloves are also difficult to clean and can be a fomite for transmitting infectious agents.

Diagnostic Techniques

The fundamental diagnostic technique is a good history and thorough visual and physical examination (often requiring anesthesia). Ease of sample collection for laboratory testing (CBC, biochemical profile, serology, cytology); fecal examination for parasites; urine for urinalysis; and aerobic, anaerobic, fungal, and viral culture is dependent on species anatomic differences compared with other more commonly treated species. Radiography and ultrasonography are commonly employed. Endoscopy, laparoscopy, and minimally invasive surgery are utilized when indicated. CT and MRI are less commonly utilized but also have a role in specific cases. Virtually any technique used for other species can be modified for use in zoo species.

Drug Administration

Few drugs are approved for use in zoo species, but extra-label drug use laws allow drugs to be legally used in species for which they are not licensed. Providing quality medical care to zoo animals requires that medications be used without documented therapeutic benefit, dosage, treatment schedule, contraindication, and toxicity data in zoo animals. Whenever possible, drug administration should be based on pharmacokinetic data. If appropriate data are not available, extra-polation from what is known about these parameters in other species using metabolic scaling is necessary. Appropriate dosage is necessary if therapy is to be beneficial, especially with drugs that have the potential for organ toxicity. Antibiotic, antifungal, and analgesic treatments, as well as anesthetic dosages, are becoming less empirical due to increasing species-specific knowledge resulting from pharmacokinetics studies in zoo species. When using a drug on a group of animals for the first time, it is often wise to initially administer it to just 1–2 individuals. If no adverse effects are seen, the rest of the group can then be treated.

Drug administration can be challenging. Oral medication has the advantage of minimal disturbance to the animal, but ensuring adequate individual intake may be a problem, especially when animals are housed in a group. Mixing the medication with favorite foods or treats is helpful. Oral antibiotics in hoofstock and other species can disrupt normal bacterial flora and lead to GI problems. Oral sedative or anesthetic administration can result in variable onset, duration, and depth of effect due to inadequate consumption or delayed absorption. IM injections with a hand syringe can be difficult unless a restraint device or other means of physical restraint is used. Remote IM injections may be made by firing a projectile syringe from a dart gun. However, these injections may be painful and may add the trauma of dart impact and injection, especially when delivering large volumes (eg, 10 mL) over long distances (50 m). Problems can be minimized through careful selection of the most appropriate drug and drug concentration, as well as the type of dart gun for the intended use. In addition, practice with projectile darts is mandatory before their use. Marksmanship and familiarity with the weapon are essential—such weapons in the hands of a novice can be fatal. Other less traumatic methods of IM injection, over shorter distance, include syringe poles or blow guns. Through behavioral training, it is also possible to administer IM injections through voluntary participation of the animal. IV therapy is generally restricted to anesthetized animals or those maintained in restraint devices or small enclosures for the duration of treatment.

Anesthesia

Safe anesthesia of zoo animals is of special concern. Many procedures routinely accomplished on domestic animals with minimal restraint require anesthesia of zoologic species for the welfare and safety of both zoo animals and personnel. Prior to initiation of anesthesia in a zoo animal, the veterinarian should be familiar with the species and choice of anesthetic agent. Anesthesia records for the individual, other specimens of the same species in the collection, or published references for the species should be reviewed. Consultation with someone knowledgeable in the field is advised, as there are great differences in effective drugs and dosages in the diversity of species in a zoologic practice.

Many factors influence an animal's response to anesthetic drugs, including age, sex, stage of reproductive cycle, general nutritional status, and most especially mental state before drug administration. Variations may be marked between species as well as individuals and between different collections of the same species. An excited animal usually requires

more drug and, once anesthetized, has a greater tendency to develop capture myopathy secondary to hyperthermia, respiratory depression, and acidosis. Capture myopathy can also occur in manually restrained animals and is more common in ungulates or long-legged birds (see Myopathies in Horses). Monitoring of anesthetized animals may include heart and respiratory rates, temperature, ECG, oxygenation (measured by blood gas determination or pulse oximetry), ventilation (measured by blood gas determination or end-tidal CO_2), and blood pressure (measured directly or by oscillometric techniques). Attention must be paid at all times to appropriate positioning and padding of anesthetized animals and extremes of environmental conditions to prevent secondary complications.

The nature of an enclosure in which animals are to be anesthetized should be carefully considered before initiation of an anesthetic episode to minimize complications. For example, prey species that are darted may startle and hit fences or other barriers. In herd situations, the herd members may attack and injure or kill the darted animal as anesthetic induction begins (eg, ataxia).

Xylazine, detomidine, or medetomidine (α_2-adrenoreceptor agonists) used alone produce adequate sedation in some ungulates, mainly bovids, to allow some manipulative procedures. The sedative effects can be antagonized by administration of yohimbine, tolazoline, or atipamezole. α_2-Agonists should not be used as the sole anesthetic agent in dangerous carnivores because they may appear sedated but can respond aggressively when stimulated. Peripheral vasoconstriction caused by these agents alone or in combination with other drugs can lead to significant hypertension, so blood pressure should be monitored. Peripheral vasoconstriction may also interfere with monitoring pulse oximetry and can make venipuncture more difficult.

The cyclohexamine ketamine (either alone or in combination with tranquilizers or sedatives such as xylazine or medetomidine) is a common anesthetic for small to medium-sized mammals, especially carnivores, primates, and some ungulates. A concentrated ketamine preparation (200 mg/mL) can be obtained from compounding pharmacies with a resultant decrease in the required injection volume. Combining ketamine with a sedative or tranquilizer speeds induction, minimizes excitement, increases muscle relaxation, and

provides a smoother anesthetic induction and recovery than using ketamine alone. The ability to reverse the sedative effects of xylazine or medetomidine with the antagonists yohimbine, tolazaline, or atipamezole enables the use of a lower ketamine dosage and a more complete and rapid reversal upon completion of the procedure.

Tiletamine-zolazepam, a dissociative anesthetic-tranquilizer combination, is relatively safe in most species, has a rapid induction, and can be concentrated to 200 mg/mL to allow a small delivery volume. A disadvantage of this drug is that no complete antagonist exists; therefore, recoveries can be longer than with other drug combinations that can be completely reversed. It is commonly used for anesthesia of carnivores and primates.

The rapid onset and short duration of anesthesia induced by the sedative-hypnotic propofol renders it particularly attractive for use in zoo species. However, due to the necessity for IV administration, its use is limited to species such as reptiles, birds, and small mammals that can safely be manually restrained for drug administration. It is also useful as an adjunct anesthetic agent in large mammals first immobilized with another drug combination.

The potent opioids etorphine, carfentanil, and thiofentanil, alone or in combination with other agents (eg, azaparone, acepromazine, xylazine, detomidine), have been used extensively for anesthesia of ungulates, elephants, and rhinoceros. The antagonist of choice for these opioids is naltrexone, a pure narcotic antagonist, which induces complete reversal when given at 100 mg of naltrexone per mg of opioid. The reversal dosage of naltrexone can be given IV or IM, and in species prone to renarcotization after reversal, additional naltrexone may be administered SC. It can also be given IM 6–8 hr later by remote delivery to prevent renarcotization when the animal is not being observed. Accidental exposure of people to ultrapotent narcotic analgesics is quite dangerous. Therefore, they should only be used by trained, experienced personnel, and only after development of accidental exposure protocols.

Various drug combinations (utilizing ketamine, telazol, medetomidine, detomidine, butorphanol, midazolam, diazepam, or xylazine) have been developed for specific species and purposes. Administration to novel species should be undertaken with care.

Isoflurane has become the inhalation anesthetic of choice for small mammals, birds, and reptiles. It is also used as a supplement to an injectable anesthetic or as an anesthetic maintenance agent to prolong anesthesia in virtually all species. Isoflurane is safe and potent and has minimal side effects, short induction, and quick recovery periods. Sevoflurane has the advantage of even shorter induction and recovery periods and may be preferred over isoflurane in some species. Small animals can be induced with a face mask or placed in an anesthetic chamber. Inhalation anesthesia can be maintained or supplemented using a face mask, nasal cannulae, or intratracheal intubation depending on the species and anesthetic plane.

Regulatory Issues

Collection, transport, and exhibition of wild animals requires compliance with local, state, and federal laws. Permits may be necessary to maintain these species. Institutions in the USA must comply with appropriate rules and regulations such as those of the USDA, United States Fish and Wildlife Service, National Oceanographic and Atmospheric Administration, and National Marine Fisheries Service. Some specific health requirements in the USA include compliance with the USDA's Animal Welfare Act and Permanent Post-entry Quarantine regulations and CDC regulations governing importation of primates and maintenance of colonies of captive bats. Elephants must have 3 negative trunk wash cultures for tuberculosis during a 12-mo period, collected on separate days, preferably during a 7-day period.

Zoonoses Control

Free-ranging and captive wild animals may harbor zoonotic diseases that pose a potential health risk for those who work with these animals. Reptiles are commonly asymptomatic carriers of *Salmonella spp*. Avian species may be infected with *Chlamydophila spp*. Tuberculosis infections in mammals, especially primates, ungulates, and elephants, can be transmitted from people or harbored and shed by animals to infect zoo staff. Many enteric bacterial or parasitic pathogens of primates can be transmitted to humans. Bats may be a source of *Histoplasma spp* or rabies. Carnivorous species of reptiles, birds, and mammals that consume uncooked meat-based commercial diets or whole prey may develop an

asymptomatic *Salmonella* carrier state. Numerous zoo species, as well as feral domestic or native species on zoo grounds, may harbor *Leptospira spp*. Recognition of these zoonotic diseases and institution of procedures to minimize the disease risk to zoo staff and the visiting public are important components of a zoologic practice. An occupational health program should be developed for personnel coming in contact with collection animals. Personal protective equipment (eg, disposable gowns, gloves, face shields) should be used as required by zoo personnel. Frequent hand washing is also recommended.

6.2 Considered Variables for Proper Management

There are numerous variables must be controlled in captive condition to maintain the animal, for its life is happy and productive. Following variables should be considered for proper management of a zoo :

1. Feeding
2. Breeding
3. Housing
4. Health management
5. Record keeping
6. Transportation
7. Exhibition technique management
8. Visitor management
9. Management for new species
10. Enrichment facilities
11. Other management

1. Feeding

Feeding is essential to all animals. It is the process by which edible materials are ingested, digested, absorbed and utilized. Such materials, food, contain energy necessary to maintain life processes, promote growth and allow reproduction.

Some Scientist classified mammalian diets on the basis-of the proportion of the different items consumed by species The classification recognized that the diets of most species are not restricted to single food types (e.g. fruits) but usually combine different types (e.g. fruits and animal material).

Main dietary categories for mammals

Diet Category	**Relative proportion of different foods**
Herbivore-grazer,	>50% grasses
Herbivore-browser	>50% Leaves and Twinges
Frugivore-herbivore	>50% fruits remain: mostly plant material Mostly fruits and seeds
Frugivore-granivore	>50% fruits, remainder mostly invertebrates and vertebrates
Frugivore-omnivore	>50% invertebrates
Insectivore-omnivore	>75% ants and termites
Mymecophage Cemvore	>50% vertebrates

Formulation and Delivery of Zoo Diets very often the diet of captive "species is based on that given to the species in other institutions, or to a close relative 01 a species apparently filling the same ecological niche, already being kept successfully I captivity. While this is acceptable as a base diet every effort should be made to improve upon it following feeding trials and research. The-nutritional requirements of an animal might have to be estimated for an appropriate diet to be formulated.

A major problem in feeding animals in captivity is that artificial diets are restricted in variety and natural choice Attempts to create the perfect diet for captive animals go back to as early as 1930-1935 when Herbert L. Ratcliffe formulated prepared diets for a number of species at Philadelphia Zoo. But the use of prepared diets alone is now generally regarded unsatisfactory, but when combined with more natural feeds they can contribute to a useful and nutritionally adequate diet.

The diet given to a captive animal should he

i. Palatable
ii. Nutritionally balance
iii. Uncontaminated
iv. Toxin-free
v. Easily and cheaply obtainable

Food Presentation: Food must be recognizable and acceptable to the animal otherwise, and regardless of its nutritional value, it may not be consumed. A recurrent problem with

wild-caught animals maintained on a limited diet for a long time is the need to introduce new food items. Different species have specific food manipulation methods so that the shape and size of food items are important. Food acceptance is another problem for some species (e.g. reptiles). Most of these problems can be overcome by training and perseverance to wean the animals onto simpler diets.

How Much to Feed: The quantitative aspects of feeding are of enormous importance and must be considered carefully. All animals have a basic minimum requirement of maintenance is a resting non-breeding animal, known as the basal metabolic rate, where weight and body composition rem.

Elevated Physical Activity or Living Colder Environments: more food with high energy contents are required in line with high metabolic costs.

Growth or Reproduction: Growth, moulting, egg laying, gestation or lactation require both high energy and high protein content foods.

2. Breeding

Considerable time and energy are invested by a species in the preparation (courtship), execution (mating) and realization (gestation or incubation) of breeding. Any institution maintaining populations of wild species; in captivity mush understand these variables in order to increase their numbers. It is imperative that any captive population be self-sustaining.

Necessary Activities for Breeding of Captive Animals:

- Necessary to provide species with appropriate accommodation.
- Breeding stock must be selected with the use of carefully kept records to avoid inbreeding. Unsuitable specimens should be excluded from breeding programmes or culled from populations.
- Individuals must be selected carefully for pairing or grouping. It is vital to recognize secondary sexual characters, to sex monomorphic species and to understand the importance to pair compatibility
- Seasonality and artificial control of cycles must De considered.
- The best possible diet must be provided for breeding females and young for development and growth to follow me correct patterns.

- The frequency of infertility, the development of abnormalities and any birth or hatching problems must be monitored closely in order to take appropriate action.
- Stress often plays a major part in breeding failure in captivity A compromise must be struck between adequate management, hygiene and levels of disturbance. Species characteristics must be taken into consideration **as** some are far more susceptible than others.

3. Housing

Physical Environment

Lighting: Both quality and quantity are of paramount importance both for psychological (e.g. nocturnal, diumal) and physiological (e.g. UV for vitamin D synthesis, heliothermic) needs. Photoperiod has an important impact on the major hormone-mediated systems of the body. (e.g. seasonal reproduction, reproductive condition)

Humidity: Largely of physiological relevance variation to mimic seasonality (e.g. cue for aestivation).

Temperature: Provision of adequate temperatures for even the larges of species during inclement or extreme seasons. Where possible a temperature gradient should be provided as this will give the animal choice (e.g., provision of shade and shelter).

Spatial Confinement

Boundary type : The minimum flight distance of a species must be considered to ensure that an appropriate distance from the public and other specimens is possible. Suitability of the barrier for an animas safety e.g. glass for birds and water for apes may lead to injury or even death if net property managed.

Dimensions : Other regarded most important however quality is more so. Some species require large are is but to others this type of habitat is alien and inappropriate.

Furnishings : Cage or enclosures must facilitate natural behaviors e.g. climbing, swimming, running etc. and make provision for refuge areas so that animals can evade both each other and the public.

4. Health Management

- In nature animals keep their body clean by their own way. They are also naturally resistance to many diseased but in zoo
- Cleaning of animals bed feeder waterer regularly
- Bedding material should be removed when it get dirty, otherwise parasite will affect the animal
- Disinfecting of floor and wail. After disinfecting, the disinfectant should keep far away from the animal
- After disinfection the floor and wall should be cleaned with fresh water, otherwise the animal will lick the disinfectant and will cause many disorder and diseases
- Dead carcass should be removed immediately
- Regular vaccination and deworming
- Immediate treatment for diseased animal
- For introducing new species before entering the zoo they must be quarantined

5. Record Keeping

Keeping daily animal records should be a priority in any modem zoo Keeping records on the animals in a collection is a means to an end, not an aimless activity undertaken solely to justify the holding of wild animals in captivity. At the end of the day, the information we spend valuable time recording in the diaries, and transcribing into permanent records, should have practical value from the point of view of both day to 'day in house animals management, inter-institutional animal management and future investigation as well.

However some events must be recorded-

1. Births/Hatchings
2. Deaths
3. Imports
4. Exports
5. Transfers within the zoo
6. Animal identification
7. Animal management procedures changes
8. Reproductive details/observations
9. Medical treatments/observations
10. Behavioral observations

6. Transportation

- Successful shipment of live animals requires careful planning and management. The following guidelines are necessary for shipment of animal
- Animals should have priority over merchandise
- Though mainly good health animal is transported, animal should be accompanied by qualified veterinarian
- Pregnant animal or animals that are still dependent on their mother should not be transported
- Violent movement of ship, aircraft, lorry should discouraged because the ' animal become lethargic and get dangerous injury
- Animals of different species should not be housed in same container
- Depending on the species of animals involved and the duration of the journey, - feed and water should arranged
- To avoid cross-infection and for health and hygiene-reasons, human contact! with animals should be avoided
- No animal should be transported with radioactive material or other substances dangerous to health
- Containers should be secured the aircraft, rail wagon lorry or ship

7. Exhibition Technique Management

Zoo should consider what impressions zoo visitors perceive from exhibits, bearing in mind subconscious as well as conscious messages whether we are aware of it or not, we are constantly receiving and sorting messages from the surrounding environment .Is it safe? Is it friend? Is it advantageous? in context of the environment is the necessary questions for managing exhibition technique.

8. Visitor Management

Throughout the world, 605 million people visit zoos each year, this represents 605 millions opportunities to communicate with people. In zoo sometimes simple things like broken benches, overflowing rubbish bins/dirty toilets can communicate not only a couldn't -care- less attitude but perhaps even hostility towards the public.

So for good communication with the public creating clean calm and beautiful environment is another important management work in a zoo.

9. Management for New Species

A variety of criteria" is used to determine which are to kept in zoo often played an important part in guiding curators and directors choice of animals. No. of species and acquisition of rare animals for a collection is restricted by the following:

- ❖ Space availability within the zoo
- ❖ Environmental requirements of the species in relation to prevalent conditions of the zoo
- ❖ Staff numbers and expertise required to keep the species Before introducing new species, a zoo will have to take other considerations into account such as:
- Will the animal attract public interest?
- What education potential does the species offer?

10. Enrichment Facilities

Species require enrichment. However it is important to identify the arm, species in collection which will benefit most from a programme of enrichment, type of enrichment is called environmental enrichment. It is for the animals. Beside this, there are another three types of enrichment facilities should be maintained in zoo. They are:

- Recreational enrichment
- Research enrichment
- Educational enrichment

11. Other Management

- Regular electricity, water supply
- Coordination and collaboration of different types of groups, society like IUCN (International Union for Conservation of Nature and Natural Resources), CITES (Convention for International Trade of Endangered Species), CBSG (Captive Breeding Specialist Group), WCMC (World Conservation Monitoring Center) etc.
- Maintaining animal law
- Distribution of leaflet, folder, for the awareness of people about wildlife and its conservation
- Good administration

Captive Breeding of Zoo Animals

Role of modern Zoo for conservation and increasing population of wild animals by captive breeding, in relation to environmental education.

Captivity

Any wild animal that lives under human care known as captivity. Special arrangement for the wild endangered animals towards the developing of capabilities for their breeding under human care known as captive breeding.

Conservation Policy

1980-IUCN published a document on world conservation strategy
1991-Wes published Global Biodiversity strategy
1992-IUCN convention on Biological Diversity

1993-more emphasized on the In-situ conservation. But Modern Zoo will be the place for the Ex-situ conservation.

Conservation Strategy

a. In-situ con → Insite or on the spot
b. Ex-situ con → out of site, e.g. Zoo; Safari or Bio-park

In 1993, IUCN has declared a "Species Survival Commission (SSC)" and divided as specialist group (e.g. Crocodiles Park, Bird Park etc.).

Re-introduction specialist Group (Re-establishment);
↓
Translocation (Population from another range internal);
↓
Re-enforcement I supplementation (Addition of individuals);
↓
Conservation (Within an appropriate habitat and eco-geographical areas).

They are the authority to breed the endangered species in a zoo or in a safari and re-introducing the animals into the Natural habitat of the wild animals. Successful Captive Breeding and Rehabilitation into the original habitat through Ex-situ conservation in the world:

King Goose	⟶	Hawaii
Pris Walaski's (Horse)	⟶	Mongolia
Devid's deer	⟶	China
Brown antlered-deer	⟶	Asam
Golden Lion	⟶	Brazil
Eagle	⟶	Europe
Bison	⟶	Europe and America
Falcon	⟶	Mauritius.
Bali Myna	⟶	Bali Island
Arbi Oryx	⟶	Oman 1975
		(Oman-Finix zoo and UAE)

6.3 Some Important Rules and Regualtion for the Zoo

Some Important Rules and Regulation Provided by the Indian Central Zoo Authority (ICZA) about Establishment and Management are Followings:

General

1. The primary objective of operating any zoo shall be the conservation of wildlife and no zoo shall fake up any activity that us inconsistent the objectives.
2. No zoo shall acquire any animal in violation of the Act or rules made there under.
3. No zoo shall allow any animal to be subjected to the cruelties as defined under the Prevention of Cruelty to Animals Act, 1950 (59 of 1960) or permit any activity that exposes the animals to unnecessary pain, stress or provocation, including use of animals for performing purposes.
4. No zoo shall use any animals, other that the elephant is plains and yalk in hilly areas for riding purposes or draughting any vehicle.
5. No zoo shall keep any animals chained or teethered unless doing so is essential for its own well being.
6. No zoo shall exhibit any animal that is seriously sick, injured or infirm.
7. Each zoo shall be closed to visitors at least once a week.
8. Each zoo shall be encompassed by a perimeter wall with at least two metres height from the ground level. The existing zoos in the nature of safaries and deer parks will continue to have chain link, fence of appropriate design and dimensions.

9. The zoo operators shall provide a clean and healthy environment in the zoo by planting trees, creating green belts and providing lawns and flower beds.

10. The built up area in any zoo shall not exceed twenty five per cent of the total area of the zoo. The built up area includes administrative buildings, stores, hospitals, restaurants, kiosks and visitors rest sheds etc, animal houses and pucca roads.

11. No zoo shall have the residential complexes for the staff within the main campus of the zoo. Such complex, if any, shall be separated from the main campus of the zoo by a boundary wall with a minimum height of two metres from the ground level.

Administrative and Staffing Pattern

12. Every zoo shall have one full-time officer in-charge of the zoo. The said officer the sole responsibility adequate administrative and financial powers as may be necessary for proper uptake and care of zoo animals.

13. Every large and medium zoo shall have at least one full time curator having the sole responsibility of looking after the upkeep of animals and maintenance of animal enclosures.

14. Each large zoo shall have at least two fulltime veterinarians and medium and small zoo shall have at least one full-time veterinarian. The mini zoo may at least have arrangement with any outside veterinarian for visiting the zoo every day to look after the animals.

Animal Enclosures-Design, Dimensions and other Essential Features

15. All animals enclosures in a zoo shall be so designed as to fully erasure the safety of animals, caretakers and the visitors. Stand or barriers and adequate warning signs shall be provided for keeping the visitors at a safe distance from the animals.

16. All animal enclosures in a zoo shall be so designed as to meet the full biological requirements of the animals housed therein. The enclosures shall be of such size as to ensure that the animals get space for their free movement and exercise and the animals within herds and groups are not unduly dominated by individuals. The zoo operators shall take adequate safeguards to avoid the animals being unnaturally provoked for the benefit of viewing by public and excessive stress being caused by visibility of the animal in the adjoining enclosures.

17. The zoo operators shall endeavour to simulate the conditions of the natural habitat of the animal in the enclosures as closely as possible. Planting of appropriate species of trees for providing shade and constructing shelters which would merge in the overall environment of the enclosures, shall also be provided. Wherever it is technically feasible, only moats shall be provided as enclosure barriers.

18. The enclosures housing the endangered mammalian species, mentioned in Appendix 1 to these rules, shall feeding and retiring cubicles/cell of minimum dimension gives in the said appendix. Each cubicles/cell shall have resting, feeding, drinking water and exercising facilities, according to the biological needs of the species. Separate accommodation shall be provided for pregnant animals. Proper ventilation and lighting for the comfort and well being of animals shall be provided in each cell/cubicle/enclosure.
19. Proper arrangement of drainage of excess of water and arrangements for removal excreta and residual water from each cell/cubicle/enclosure shall be made.
20. Designing of any new enclosure for endangered species shall be finalized in consultation -with the Central Zoo Authority.

Hygiene, Feeding and Upkeep

21. Every zoo shall ensure timely supply of wholesome and unadulterated food in sufficient quantity to each animal according to the requirement of the individual animals, so that no animal remains undernourished.
22. Every zoo shall provided for a proper waste disposal system tor treating both the solid and liquid wastes generated in the zoos.
23. All leftover food items, animals' excreta and rubbish shall be removed from each enclosure regularly and disposed of a manner congenial to the general cleanliness of the zoo.
24. The zoo operators shall make available round the clock supply of potable water for drinking purposes in each cell/enclosure/cubicle.
25. Periodic application of disinfectants in each enclosure shall be made according to the directions of the authorized Veterinary officer of the zoo.

Animal Care, Health and Treatment

26. The animals shall be handled only by the staff having experience and training in handling the individual animals. Every care shall be taken to avoid discomfort, behavioral stress or physical harm to any animals.
27. The condition and health of all animals in the zoo shall be checked every day by the person in-charge of their care. If any animal is found sick, injured or unduly stressed the matter shall be reported to the veterinary officer for providing treatment expeditiously.
28. Routine examination including parasite checks shall be carried out regularly and preventive medicines including vaccination e administrative at such intervals as may be decided by the authorized veterinary officers.

29. The zoo operators shall arrange for medical check-ups of the staff responsible for upkeep of animals at least once in every six months to ensure that they do not have infections of such diseases that can infect the zoo animals.

30. Each zoo shall maintain animal history sheets and treatment card in respect of each animal of endangered species, identified by the Central Zoo Authority.

Veterinary Facilities

31. Every large and medium zoo shall have full-fledged veterinary facilities including a properly equipped veterinary hospitals, basic diagnostic facilities and comprehensive range of drugs. Each veterinary hospital shall have isolation and quarantine wards for newly arriving animals and sick animals. These wards should be so located as to minimize the chances of infection spreading to other animals of the zoo.

32. Each veterinary hospital shall have facilities for restraining and handling sick animals including tranquilizing equipment and syringe projector. The hospital shall also have a reference library on animal health care and upkeep.

33. The small and mini zoos, where full fledge veterinary hospital is not available, shall have at least a treatment room in the premises of the zoo where routine examination of animals can be undertaken and immediate treatment can be provided.

34. Every zoo shall have a post-mortem room. Any animal that dies in a zoo shall be subjected to a detailed post-mortem and the findings recorded and maintained for a period of at least six years.

35. Each zoo shall have graveyard where the carcasses of dead animals can be buried without affecting the hygiene and the cleanliness of the zoo. The large and medium zoos shall have an incinerator for disposal of the carcasses and other refuse materials.

Breeding of Animals

36. Every zoo shall formulate a programme for captive breeding of only such animals as are approved by the Central Zoo Authority for that zoo. They shall abide by the guidelines and directives of the Central Zoo Authority in this regard.

37. Every zoo shall keep the animals in viable, social groups. No animal will be kept without a mate for a period exceeding one year unless there is a legitimate reason for doing so or the animal has already passed its prime and is of no used for breeding purposes. In the event of a zoo failing to find a mate for any single animal within this period, the animal shall be shifted, to some other place according to the directions of the Central Zoo Authority.

38. No zoo shall be allowed to acquire a single animal of any variety except when doing so is essential either for finding a mate for the single animal housed in the said zoo or for exchange of blood in a captive breeding group.

39. Every zoo shall take up regular exchange programmes of animals so as to prevent the traits or ill effects of inbreeding. To achieve this objective each zoo shall maintain a studbook in respect of every endangered species.

40. To safeguard against uncontrolled growth in the population of prolifically breeding animals, every zoo shall implement appropriate population control measures like separation of sexes, sterilization, vasectomy, tubectomy and implanting of pellets etc.

41. No zoo shall permit hybridization either between different species of animals or different races of the same species of animals.

Maintenance of Records and Submission of Inventory to the Central Zoo Authority

42. Every zoo shall keep a record of the birth acquisitions, sales, disposals and deaths of all animals. The inventory of the animals housed in each zoo as on 31st March of every year shall be submitted to the Central Zoo Authority by 30th April of the same year.

43. Every zoo shall also submit a brief summary of the death of animals in the zoo for every financial year, along with the reasons of death identified on the basis of post-mortem reports and other diagnostic tests, by 3oth April of the following year.

44. Every zoo shall publish an annual report of the activities of the zoo in respect of each financial year. The copy of the said annual report shall be made available to the Central Zoo Authority, within two months, after the end of the financial year. The report shall also be made available to the general public at a reasonable cost.

Education and Research

45. Every enclosure in a zoo shall bear a signboard displaying the scientific information regarding the animals exhibited in it.

46. Every zoo shall publish leaflets, brochures and guidebooks and make the same available to the visitors either free of cost or at a reasonable price.

47. Every large and medium zoo shall make arrangements for recording in writing, the detailed observations about the biological behavior, population dynamics and Veterinary care of the animals exhibited as per directions of the Central Zoo Authority so that a detailed database could be developed. The database shall be exchanged with other zoos as well as the Central Zoo Authority.

Visitor Facilities

48. The zoo operators shall provide adequate civic facilities like toilets, visitor sheds, and drinking water points at convenient places in the zoo for visitors.
49. First-aid equipments including anti-venom shall be readily available in the premises of the zoo.
50. Arrangements shall be made to provide access to -the zoo for disabled visitors including those in the wheel chair.

Development and Planning

51. Each zoo shall prepare a long-term master plan for its development. The zoo shall also prepare a management plan, giving details of the proposal and activities of development for next six years. The copies of the said plans shall be sent to the Central Zoo Authority.

As Bangladesh is situated in the Tropical Climate Zone, So every Zoo and Safari Park should follow the rules and regulation provided by the Indian Central Zoo Authority (ICZA).

6.4 Design and Planning for a New Zoo

a. Types – what types of zoo are going to be established
b. Objectives- main goal of the zoo
c. Authority by whom to be directed (professional advisor or an advisory board)

The good look of a zoo, the beauty of a zoo depends upon how near the it is to nature, how quiet and calm environment there is for the animals and finally how suitable the environment is for their breeding. All these things are included under zoo design and planning. The future of a zoo depends upon its proper design and planning. Depending on the place and geo-geotropic environment there are some parameters of zoo design and planning. Primarily the design should have the following points-

1. Providing maximum possible living facilities for the animals and this should be closer to the natural environment
2. Providing maximum viewing facilities to the visitors
3. Proper conservation and utilization of natural beauty of the selected place
4. Provision of breeding and research facilities for the animals

5. Animal exhibition should be design in such way that it fulfills the main objectives of the zoo. The differences among the species, geography and their relations to each other should be clearly exhibited

Besides the above points, it is necessary to emphasize the following points-

1. Fencing the boundary of the zoo
2. Facilities of easy access to the zoo like entrance, internal connecting road, walk way, car parking etc.
3. Animal barrier
4. Office, accommodation and labor room
5. Classroom and guest entertainment room for study visit.
6. Interpretation centre
7. Store room, food preparation room, kitchen.
8. Workshop and machine-tools store
9. Prayer room and rest house
10. Entrance gate, ticket room, sales centre, restaurant etc.
11. Toilet, bathroom sitting arrangement, water sully
12. Road for taxi, tram, car, golf court, open space for roaming etc.
13. Wheel chair, walkway
14. Regular supply of water, electricity, gas etc. and their alternative arrangement
15. Proper sewerage and disposal facility
16. Veterinary hospital
17. Quarantine room
18. First aid treatment facility and security office
19. Specially arranged rest room for pregnant women, old and disabled people
20. Maternity room, animal training centre etc.
21. Grazing field and animal food production facilities
22. Food animal production centre
23. Room for engineers and designers
24. Safari, elephant, horse and ostrich ride
25. Section for ancient animal, dinosaur, fossil etc.

Site Selection

a. Location-very important part of a new zoo

b. Geo-mapping + environment (Geoenvironment, communication, water supply gas electricity etc.)

c. Reintroducing facilities and further extension (for 30 years)

Design and Principles of Animal Exhibition

The alternate objective in the design of an animal exhibit is to give the viewer the illusion' the they have 'encountered' a group of animals in the wild. It is only an illusion and of this the visitors are aware-but the use of illusion, even for 5 seconds makes the experience more enriching.

An animal exhibit has a foreground, middle ground and a rear ground. The barriers in the foreground and rear ground should be invisible. The barriers on the sides of the middle ground should also be invisible.

Foreground: The foreground is where the viewer stands on a path and where the front barrier is located.

Vegetation and natural features like rocks and fallen trees should be the same as the viewers side and in the animal exhibit to create 'landscape immersion, or'visual integration.

The front barrier should be invisible, preferably a moat or sheet of glass. In a moat, careful attention should be given to the sight lines.

Middle Ground: The middle ground is where the animal will be displayed to the viewer. This is where necessary features of its ecological niche both functional and aesthetic are located. There should be pools, rock features, tress, vegetation, grass areas, sand patches, mud wallows, salt licks etc.

Although the animals should be offered security and comfort away from the viewer, the alternate challenge for the designer is to ensure that animals are on display anytime a viewer wishes to see them.

Preferably the side barriers should be invisible, Moats can be used or else heavy planting be considered behind and through fences.

Rear Ground: The rear ground add it rear barrier and the 'feeling' of depth of the exhibit.

An ideal exhibit should have an invisible moat as a rear barrier and planting beyond the moat to give the feeling of depth and space to the scene If a fence, is used, it should be heavily planted in front and behind to conceal it.

Psychological Restraints

Most barriers for non-dangerous species can be narrower than their jumping distance. There are loosely referred to as psychological barriers. For example, water is a deterrent for some species of primates like the gibbons.

In the wild, many species set up a territory. They are confined to this territory and defend it against intrusion from other animals of the same species In captivity, the concept of territory can be used to 'confine' animals. Because the territory is for gathering/hunting - as long as food is provided - the size of the territory can be shrunk considerably.

Confining species such as tamarinds to a tree using ho barriers can be achieved, using this principle of psychological restraint.

Attention should be paid to providing a centrally placed den for security and the appropriate ecological niche, i.e. trees and food, water, mates companionship etc.

The animals are confined to the den for one/two weeks. The least dominant anima' is released first. After a few days, it is confined and the dominant animal released. Eventually, all the animals are released and hopefully, they stay and set up their territory around the den.

Master Plan

To be considered the following –

a. Natural habitat for the animals
b. Maximum viewing facilities
c. Captive breeding and research
d. Exhibition animals be set up in the zoo as many as possible by their rank order (related animal with their proper environment)
e. Selected areas should be used/maintained properly

Construction

a. Boundary or out door enclosure

b. Entrance

c. Parking

d. Internal/inside road

e. Land scaping (lake, pond, stream, hill, forest, garden). 75% = other facilities (25-30)% = only for animal

Animal Enclosure (Not more than 25% of the total area) Make an animal enclosure must be ensured the following terms and condition.

(a) To ensure the comfort and freedom as same as natural habitat of the zoo animals with proper protection.

(b) Make ensure the maximum viewing facilities to the visitors.

(c) Easy maintenance by the authority (eg. Feeding, nurshing, cleaning, medication etc.).

Barrier

With these seven examples of different types of views and thirteen different types of barriers present, even a new director or designer may have a set of tools which would allow the creation of a diverse set of enclosure types. It should be remembered that the enclosure style and design should be appropriate for the behavior and biology of the animals. It should be wsie to taking the advice of field biologists or forest rangers and officers who have spent time observing wild animals can be valuable for planning and checking exhibit designs, such as:

- Glass viewing with structure
- Viewing through mesh
- Bunker viewing
- Boardwalk viewing
- Elevated boardwalk viewing
- Edge viewing
- Underwater viewing

Exhibit Barrier Types

1. Vertical Fence Barrier

Fence is primarily used as a side/rear barrier. It is an efficient method of containment but can be damaged by animals, storms, falling trees. The footing depth should be one-third the fence height. The colour should be matte black to counter disadvantage of visibility-or it should be concealed in other ways. A good anti-corrosion system is essential in the

2. Vertical Fence Barrier with Return

In addition to the comments above, the top return permits use with some climbing animals and animals able to scramble up vertical surfaces. This capability if further improved by using metal sheet, fibreglass or other smooth materials on all or part of part of the fence height and return.

3. Depressed Vertical Fence Barrier

As noted in above, a variation that allows the use of fences where there is little other conc. (e.g. vegetation) available or the scenery beyond is part of the display, enclosures.

4. Ha-ha Barrier

Achieves a similar visual effect (i.e. concealment) as the depressed vertical fence The correct choice between these two barriers depends on the jumping or climbing abilities of the animal. This sunken wall is more restricted in use and will be lower than most fences. The wall, however, takes up less area.

5. Two-aldod Dry Moat

Views into this moat-type should not be permitted. Achieving this entails control of the relative levels of the viewer and exhibit and or where not possible, use of beans or planting outside the exhibit to raise the foreground. The inner vertical wall acts to deter animals from getting into the moat. The depth and width has to be proportioned to suit each species and its abilities.

6. Cattle Grid Barrier

Often used for domestic live stock, this barrier can be adapted for wild animals including deer. Spacing of the bars, the initial depth and overall width need to take into account the temperament and physical abilities of the animals. Works best if it psychologically deters

the animals. The dimensions also need to be considered in relation to the road vehicles that will cross the grid.

7. One-sided Wet Moat

As a rule, wet moats should riot be two sided, unless very shallow. The initial slope is necessary to forearm the animal of the increasing depth when usual valued are not available. Gradient and texture of the slope need to be considered" for each species. Extra height above water and top returns are optional variations. Note the bunked edge for aquatic and heavy animals likely to cause erosion.

8. One-sided Dry Moat

Suitable for more flighty animals or where visibility of the moat is unavoidable or van desired. In this case, further landscape treatment (simulated habitat) of the visible surfaces is required. Alternatively, the slope can be left as earth (with suitable planting). Erosion is then a risk, however.

9. Shallow Wet Moat

Suitable for animals with s positive * deter jumping over the water, and/or strong, territorial animals water depth should be shallow to reduce the risk of accidents' drowning.

10. Reinforced Pipe Barrier

Suitable for rhinoceros or large ungulates such as banteng or Water buffalo. Height may very depending on shoulder height of animal. Reinforcing consists of support strut and dead man at each vertical post, or alternating post to prevent animal from pushing barrier out 01 plumb.

11. Horizontal Fence

This consists of a shallow trench moat with a horizontal covering of welded mesh on a metal frame. It works with animals as diverse as suids (pigs), tapirs and hyaenas, but not with cats. The principal is identical to cattle grids except that it is not for vehicular traffic.

12. Hot Wire

This should only be used as a secondary barrier, i.e. in case it fails, there will be a primary containment invoice beyond (and before animals can contact visitor) Hot wire can reinforce the primary barrier, especially during introductions and initial conditioning of

animals. It is used to protect vegetation and trees and to separate incompatible groups within the same exhibit. The consequences of power failure must always be considered.

13. Mesh Enclosure

Used for extremely dangerous and able animals, such as leopards, or small animals and birds that would not display well in open enclosures. A variety of structural systems (framed, tensile, etc,) viewing methods and, other techniques (visual integration) can be used to reduce the impact of mesh and the impression of being caged.

14. Wall Barrier

Mainly a rear barrier, it should always be treated as a simulated habitat feature, such as an eroded earth bank. This is because of its obvious visual prominence. If used as a front barrier, it will be in place of a one sided dry moat (see 8 above). Care must be taken with the lowered ground plane in respect to the viewer it implies. There will also be potential blind spots at the base of the wall.

15. V-Shaped Dry Moat

For animals with poor agility such as rhinos, a compromise on the two-sided moat can be achieved. The main advantage is ease of construction and non-structural retaining walls. The reclining walls serve to allow a steep earth cutting Without the risks of erosion or collapse. It, however, relies on the natural slope capacity of the soil.

16. Free Range Behavioural Barrier

Extremely territorial animals such as marmosets can be conditioned to stay in one place without straying provided the right conditions are maintained. These are food, shelter, security, the right social groupings and a good arboreal environment (for marmosets). It also helps if the patch of habitat is relatively isolated from similar environments.

a. **Fence:** Bamboo, wooden for deer like animal
b. **Trench:** moated canal (Hegenback) for Lion, Tiger etc. depends upon the animals behaviour
c. **Bars:** roads, metal wire etc. for monkey like animal
d. **Glass/acrylic or fibre glass:** For invertebrates, fish, snake, frog, shark, turtle etc.
e. **Illusion barrier:** Invisible (pheromone) or visible (desert like environment)
f. **Electric wire barrier:** for elephant, apes etc. (12 volts)

Raw Materials used in enclosure

a. Ceramics, bricks, glass for outer enclosure of animal houses
b. Cement, wood, blocks, stones for the floor of the zoo animals
c. Metals or wood for door and windows
d. Ring, log, chain, dolna for furniture of the zoo

Success of a new zoo depends on master planning or root planning or good planning.

Zoo Animals: Importation and Exportation

Procedure

a. Wild animals to be collected for a modern zoo on the basis of priority of zoo types
b. Zoo animals should not be collected from their original habitat, if possible to conserve and breed them in In-situ condition
c. Zoo animals may be collected from their original habitat (not more thana breeding pair) for only the Ex-situ conservation if they are endangered or threatened
d. Main goal of a modern zoo must be research, captive breeding, conservation and exhibition. More over to create mass awareness in these regards to the visitors

Collection of Zoo animals

1. Local collection (Native collection)
2. Foreign collection (overseas collection)

1. Local Collection:

a. Self collection
b. Donation or exchange and ethics.
c. Purchasing:
   - Through agencies
   - Local tender

Parameters to be considered	a. Vehicles/media of transportation
	b. food supply during transportation
	c. Hygienic condition or comfort.

C and F→ Insurance → 30 days after receiving animals

(CFI = Cost, Freight and Insurance)

2. Foreign Collection:

Principles, Procedure and ethics	a. Donation or exchange
	b. International tender purchasing through agencies
Transportation	a. Media of transportation/vehicles
	b. Food supply
	c. Hygienic condition or comfort
Quarantine	a. DF (Disease free)
	b. Certified by the Ministry/veterinary Department. (DNA = Designated National Authority)
	c. Forestry or other relevant dept.
Inducing	a. Ring isolation or shunga Nirod (6-12) months.
	b. Adjustability and pairing
	c. Captivity

Zoo authority must follow the procedure, principles and ethics for collecting the zoo animals under the rules and regulations of modern zoo-keeping system.

Zoo management is not so easy as it was in previous decades. There are new demands by legislation and international regulations, by a few more literate, aware and aggressive public, by the animal welfare lobby and by wildlife agencies themselves. If a country has not experienced these things, it is only a matter of time. Zoos must band together and agree to improve their objectives, standards and ethics. If so doing a community of zoos in this region can create a-public image which can be useful to all zoos of South Asia.

Chapter Seven
Conclusion

Modern zoos have an important role to play in conservation of biodiversity. By displaying animals in simulated natural environment and through public education, visitors have a better appreciation for wildlife and conservation issues. Breeding of endangered animals is an important role of all zoos. While for many reasons, it may not be possible to reintroduce most captive-bred endangered animals into the wild. They have played a vital role in the preservation and protection of wildlife by serving as refuge for threatened species. A number of animals nurtured in zoos have been reintroduced into the wilderness.

Zoos are considered educating the visitors on environmental issues but most important contribution to conservation. A little over half a century ago, zoos had the animals kept in bare cages for public viewing. Today, with the help of scientific research, most zoos try to create an environment that closely resembles the animals' natural surroundings. Many of the zoos today also try to make their visitors more cognizant of the distinctive behavior of each animal and of the importance of their (zoos') conservation efforts. The presence of certain species in zoos guarantees their continued existence or prevents their kind from becoming extinct.

One very important tool in ensuring the conservation of endangered species is 'captive breeding.' Many species have been bred successfully inside zoos and a number of them are now being reintroduced in their respective habitats. A complete cognizance of the species involved is required to achieve a high degree of success in captive breeding. Additionally, zoos afford an opportunity for scientists to make further researches, particularly about the conditions in which diverse species will flourish.

Zoos are founded for the purpose of exhibiting and conserving a diversity of species within the animal and plant kingdoms. Now the zoos arc considered as an Ecological Garden or Eco Garden. Zoological Garden has some prime goals-

1. To convey a broad perspective of their zoogeographic and ecological relationships.
2. To promote the public's awareness and involvement in conservation.
3. To undertake scientific research for the advancement of wildlife management.

4. For the conservation of irreplaceable genetic resources, both animal and plant.
5. Potentiality and efficiency of the captive breeding of endangered wild species in conservation.

Unfortunately, zoos have not always fostered such a progressive program and this history has helped to foster a persistent misunderstanding of the role of modern zoos in society. Zoos have existed for hundreds of years. Until relatively recently, captive animals were held largely in private hands for the purposes of either the gratification of the owner or to make money. Husbandry practices in the past were often deplorable in regard to both the physical and behavioral requirements of the animals. Zoological collections were usually assembled for their entertainment value and animals were regarded more as curiosities rather than as living creatures having much in common with their human custodians. The image of the Victorian menagerie, in which animals lived oul their often brief lives crammed inlo liny iron and concrete cages that did not come close to meeting their biological needs, is both powerful and enduring. While facilities such as these can still be found today, a profound change for the better has occurred in the zoo world. The foundation for the improvement in zoos lies not only in better standards of husbandry, but more profoundly, in a new philosophy that has taken shape largely during the last century. Modern, legitimate zoos have adopted as "their ultimate role the promotion of biological conservation. There is no doubt that this mandate can be fulfilled only if sufficient public understanding and sympathy for conservation efforts exists.

Modern zoos arc therefore striving to transform themselves into conservation centres, primarily by providing public education. In that sense progressive zoos contribute indirectly to conservation through public education and scientific research initiatives. Zoos also make significant direct contributions to conservation through participation in efforts such as field projects and captive breeding programs for select species (i.e. in situ and ex situ efforts, respectively). In the following sections zoo based efforts in education, conservation and research arc examined in further detail.

Research is an often overlooked role of the modem zoo. Despite the fact that animals have been kept in captivity for hundreds of years, we know little about the basic biology of many species. Observations made on captive specimens have often revealed aspects of their biology that were previously unknown. Animal nutrition is an area of zoo-based research of obvious importance. Most species maintained in zoos are not domesticated,

hence their precise dietary requirements are not known. Research is directed at such problems as determining acceptance and digestibility of various food items, optimal energy intake and species-specific nutrient requirements.

Animal behaviour is another fertile area for zoo-based research. Much effort has been expended to learn how conditions can be provided that stimulate the intellects of species ranging from great apes to reptiles. Reproductive physiology is an active area of research in zoos. To date most efforts have been devoted to mammals. Similarly, work to develop protocols for artificial insemination in birds has been done in a zoo setting (Patuxent Wildlife Centre). Using similar methods the first psittacine to be produced by artificial insemination, a cockatiel, was successfully raised in 1982.

As captive animal populations become increasingly important for conservation, the need for research into genetic management of such populations has increased. The hazards of inbreeding have been well known for many years, yet methods for making quantitative estimates of loss of genetic diversity in small populations maintained in captivity over multiple generations were developed only relatively recently. Genetic researchers at the U.S. National Zoo have developed computer methods that are now used for this purpose. Just as inbreeding can lead to reduced fitness of captive populations, out breeding can also cause difficulties. Research sponsored by the Wildlife Conservation Society (Bronx Zoo) is aimed at determining population structure for several endangered birds, notably Asian hornbills. Genome banking is an additional area of zoo-based research. Reproductive biologists are working to define protocols for storage of frozen gametes and embryos. This technology is expected to have a major impact on conservation efforts. Unfortunately, the nature of the avian egg places some limits on the use of these techniques in birds that do not apply to mammals.

In addition to contributing to conservation indirectly through research and efforts to raise public awareness, zoos are also involved in more direct conservation projects. The most obvious efforts are in the area of captive propagation. Breeding endangered animals in captivity as a conservation initiative usually requires participation of several, sometimes many, institutions due to space limitations. Unfortunately the resources available for this purpose do not meet the demand because of the high cost of maintaining captive populations of wild animals. Many birds held in zoos are not endangered and are held in

large numbers. Captive populations of these species are not managed intensively (e.g. blue and gold macaws). Other species are managed more closely with the aid of studbooks. The latter are used to record important information about individual specimens in the captive population including age, sex, identity of parents (if known), location (present and previous), and transfers. This information is used when setting up breeding pairs and for monitoring captive populations. Some species are managed more intensively through Species Survival Plans (SSPs). An SSP is a cooperative population management and conservation programme that North American zoos use for selected species. The objective is to maintain a healthy population that is self sustaining, genetically diverse and demographically stable. Each SSP has a coordinator who looks after day-to-day activities and a management committee that makes decisions regarding such things as pairings for breeding, research, and reintroduction (if appropriate). Management decisions are based on the SSP master plan which details the specific goals for the population. Studbooks arc maintained for each SSP species and husbandry manuals have been prepared for many species. Some SSPs also incorporate reintroduction projects.

The Wildlife Conservation Society (WCS, formerly the Bronx Zoo) has been a leader for many years in field oriented conservation efforts. Many aviculturists are aware of the important field work conducted by WCS biologist and conservationist. Aviculturists are probably less aware of the global impact that WCS has had on conservation. A number of other zoos are involved directly in conservation initiatives in the field. Other notable examples concerning parrots in particular include Paradise Park in the United Kingdom. These institutions work to raise funds to be used for various aspects of conservation of wild parrot populations around the world.

Most of today's non-profit and serious zoological gardens display wild animals, not just for the amusement and the entertainment of their visitors, but primarily for conservation of endangered species, for education and biological research.

The concern of these institutions is to help save the diversity of life on Earth through applied conservation activities such as breeding endangered species.

The breeding of endangered species is coordinated by cooperative breeding programmes containing international studbooks and coordinators, who evaluate the roles of individual animals and institutions from a global or regional perspective

7.1 Biodiversity Action Plan

A Biodiversity Action Plan (BAP) is an internationally recognized program addressing threatened species and habitats, which is designed to protect and restore biological systems.

The original impetus for these plans derives from the 1992 Convention on Biological Diversity (CBD).

As of 2006, 188 countries have ratified the CBD, but only a fraction of these have developed substantive BAP documents.

The principal elements of a BAP typically include: (a) preparing inventories of biological information for selected species or habitats; (b) assessing the conservation status of species within specified ecosystems; (c) creation of targets for conservation and restoration; and (d) establishing budgets, timelines and institutional partnerships for implementing the BAP.

The 1992 United Nations Earth Summit in Rio de Janeiro defined Biodiversity as "the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems." Biodiversity did not develop overnight. The great diversity of plants, animals, fungi, and microorganisms reflects an evolutionary history that spans 3.5 billion years. Over that time, many species died out and new species replaced them, shaping the composition and structure of today's biodiversity. Every species, moulded over time by genetic forces, other species, and the surrounding environment, occupies a specific habitat with a definite range of distribution and plays specific ecological roles in the ecosystem. Together they weave an intricate web of life, in which every species matters.

Biodiversity is often understood in terms of the variety of plants and animals, but in fact, it includes three types of diversity as follows.

Species diversity: Species diversity means the wide variety of animals, plants and microorganisms in specific area. This diversity also covers in two aspects: species richness and species evenness.

Genetic diversity: Biodiversity includes genetic differences within each species, which has caused great benefits to livelihood of people, especially agriculture and production. **Ecosystem diversity:** Ecosystem diversity is divided into 3 aspects; habitation, substitution, and topography. In each ecosystem, living creatures form community, interact with one another and with the air, water and soil around them.

Biodiversity in Bangladesh

The most part of the country's land is formed with river alluvium from the Ganges and the Brahmaputra and their tributaries, which consists mostly of flood plains (80%) with some hilly areas (12%) in a sub-tropical monsoon climate. Geographically, Bangladesh falls near the Indo-Burma region which is one of the ten global hot-spot areas and supposed to have 7000 endemic plant species. Due to its unique geo-physical location Bangladesh is exceptionally characterised by a rich biological diversity. An estimated 5,700 species of angiosperms alone, including 68 woody legumes, 130 fiber yielding plants, 500 medicinal plants, 29 orchids, three species of gymnosperms and 1700 pteridophytes, have been recorded in Bangladesh. Some 2260 species of plants have been reported alone from the hilly regions of Chittagong, which falls between two major floristic regions of Asia. Subsequently, the country possesses rich faunal diversity. Bangladesh has approximately 113 species of mammals and more than 628 species of birds (both passerine and non passerine).

Biodiversity and Human Life

Humans share the planet with millions of different species of plants, animals, fungi, and microorganisms, and this biodiversity provides us with the basic necessities of life. The activities of all organisms together maintain the atmosphere, develop new soils, break down waste, store and filter water, pollinate our crops, provide us with food and protect us from disease. Without these ecological services, we cannot have abundant food, natural fibers for our clothes, lumber for our homes and a clean environment and good health. According to UNDP: "Poverty and biodiversity are intimately linked. The poor, especially in rural areas, depend on biodiversity for food, fuel, shelter, medicines and livelihoods. Biodiversity also provides the critical 'ecosystem services' on which development depends, including air and water purification, soil conservation, disease control, and reduced vulnerability to natural disasters such as floods, droughts and landslides. Biodiversity loss exacerbates poverty, and likewise, poverty is a major threat to biodiversity".

Loss of Biodiversity

According to IUCN, an unacceptable number of species are still being lost forever. The current loss of biodiversity is faster than ever before in human history and there is no sign of this process slowing down. Today at least 1,000 species are lost every year. Studies show that 30% of all natural species will be extinct by 2050.Although Bangladesh is rich in biodiversity (species) but in 2004 12 species of wildlife were identified as extinct. In 1992 and 2001 18 species of wildlife were found as extinct from the country. A lot of country's mammals, birds, reptiles are now under tremendous pressure for several reasons. In 2000 IUCN had listed a total of 40 species of inland mammals, 41 species of birds, 58 species of reptiles and eight species of amphibians under various degrees of risks in the country. It has been assumed that already 10% flora of the country is extinct. According to a recent exercise completed by the Bangladesh National Herbarium, 106 vascular plant species face risks of various degrees of extinction in Bangladesh. Again, in 2006 167 plant species were listed as vulnerable or endangered.

IUCN warns that a third of amphibians, a quarter of mammals and one-in-eight birds are threatened with extinction. Out of the 47,677 species in the IUCN Red List of Threatened Species, 17,291 were seemed to be at serious risk. The latest update lists amphibians as the most seriously affected group of organisms on the planet, with 1,895 of the 6,285 known species listed as threatened. Of these, it lists 39 species as either "extinct" or "extinct in the wild". A further 484 are deemed "critically endangered", 754 "endangered" and 657 "vulnerable".

Causes of Biodiversity Loss

The primary causes of biodiversity loss are demographic, economic, institutional, socio-political, technological, cultural and religious factors. And the root causes of losing biodiversity are climate change, invasive alien species, over exploitation, habitat change, nutrient loading etc.

7.2 Conservation Initiatives

Bangladesh has signed the five major conventions and agreements related to biodiversity conservation (i.e., CBD, CITES, CMS, RAMSAR, WHC). As a signatory party to these conventions the government has undertaken various initiatives to conserve biodiversity at both ecosystem and species levels. Again as a CBD-COP the country is bound to adopt

the ecosystem approach to conserve biodiversity. Bangladesh, in 2004, has developed National Biodiversity Strategy and Action Plans (NBSAP). It has nineteen nationally designated protected areas comprising approximately 2,458 km2, which is 1.66 percent of land area of the country. These include ten national parks, eight wildlife sanctuaries and one game reserve.

Bangladesh has so far declared nine areas significant in biodiversity and Environment Conservation, as Ecologically Critical Areas (ECAs). Government has already undertaken project initiatives towards conserving some of these important areas. Government is going to submit the Fourth National Report to the Convention on Biological Diversity. Bangladesh has finalised the Fourth National Report on implementation of the Convention on Biological Diversity, which came up with Biodiversity Programme of Action (BPA) 2020.

Biodiversity is the *"living foundation"* for sustainable development. Now, to make biodiversity sustainable is one thing; and to practice sustainable use of biodiversity is another. Making biodiversity sustainable is the process; and sustainable use of biodiversity is the technique. To us important is that, we shall have to understand the process of making biodiversity sustainable, and the technique to be adopted for its use at the same time.

Sustainable use of biodiversity is measured under the headings -- 'Direct-use value', 'Indirect-use value' and 'Non-use value'. Direct-use value includes food, medicine, biological control, industrial materials, recreational harvesting and ecotourism. Indirect-use value deals with biodiversity and ecosystem functions for maintenance of soundness of environment as a whole. Non-use value provides options value, bequest value, existence value and intrinsic value. All use-values of biodiversity are possible to be sustainable when conservation of biodiversity is made sustainable.

Truly sustainable development requires entities to redefine their policies on land use, food, water, energy, employment, development, conservation, economics and trade. Protection and sustainable use of biodiversity requires the participation of ministries responsible for such areas as agriculture, forestry, fisheries, energy, tourism, trade and finance.

Conservation of biodiversity and its use in sustainable development have been impeded by many obstacles. The need to mainstream the conservation and sustainable use of biological resources across all sectors of the national economy, the society and the policy-making framework is a complex challenge at the heart of the Convention on Biological Diversity (CBD). This will mean cooperation with many different actors, such as regional bodies and organisations. Integrated management of natural resources, based on the ecosystem approach, is the most effective way to promote this aim of the Convention. Provision by developed country Parties of resources to implement the Convention is critical and essential. The Strategic Plan can promote broad-based action by bringing about a convergence of actions around agreed goals and collective objectives.

Major challenges to implementing the conservation of biodiversity and its use in sustainable development are many. Only some selected ones are discussed below.

Population Growth and Increasing Demand for Biological Resources

As we use biodiversity to meet our demand under the above points, population increase in the world stands as a major problem because it increases consumption creating pressure for using bio-resources more and more. The world is losing its tropical forests at the alarming rate of almost 42 million acres per year. This means that nearly 1.3 acres of tropical forest disappear every second. The largest areas of forest loss occurred in Latin America, followed by Africa. However, when deforestation is measured as a percentage of the remaining forest, the most losses happen to have occurred in Asia. At the current rate tropical forest will be gone within 115 years.

The Bangladesh forest with its exuberant majesty and biodiversity depleted and shrank to 6 per cent from 20 per cent of land area within a time span of 50 years. This happened due to policy weakness, over-exploitation and law and order failures. It is fact that, there is lack of legislation to provide protection to the national forest but poor implementation mechanism of the existing rules perhaps causes a greater damage in this regard.

At the beginning of the British rule, the Indian subcontinent including Bangladesh appeared to hold inexhaustible forest resources. Rennel's map (1886) indicated that the Sundarbans, sal forest of the Bhawal-Madhupur tracts covered an area several times larger than it is at present. The hill forests of Chittagong, Sylhet, Mymensingh and

Comilla were also densely populated by more than 2000 flowering plant species including 300 tree species. Nearly 30 tree species in hill forest, 20 species in plain land forest and 30 species in the littoral forests used to be commercially exploited. In addition, the homesteads were covered with valuable fruit, fodder, timber, fuel wood, bamboo and many multipurpose tree species.

Environmental Biology and Biodiversity Laboratory (EBBL), University of Dhaka has recently made a study on *the traditional and cultural involvement of local people and the causes of deforestation* in some forest areas of Chittagong and Cox's-Bazar districts. In the study the impact of population growth and increase, demographic statement of the local people involved, family affairs and tradition, and their education systems were taken under consideration. The local people (because they are poor and illiterate) are culturally habituated to go inside the forest every morning and have some wood or undergrowth plants cut for selling in the market nearby.

Exotic Species

Introduction of exotic species is another major challenge to biodiversity conservation and its use in development.

In Bangladesh, some plant and animal species have been introduced from different countries. These exotic species have hampered endemic species both in their population dynamics and in the position of their trophic levels. At the same time, in many cases the importation has opted for changing ecosystem. In the aquatic ecosystem, the major introduced species those have changed a lot the ecosystem are African magur (*Clarias garipinus*) and red Piranha (Pygocentrus natteri). In the terrestrial ecosystem the species are *Tectona grandis* (Shegun), Acacia spp. Eucaliptus spp. and Swietenia mahagoni.

The forest areas of our country from Karer Hat to Teknaf in the Chittagong division have been dominated by garzon (Dipterocarpus turbinatus) tree as canopy layer since long time; and it is endemically sustained also for long time. The garzon forests have got some important characters for maintaining the three layers of vegetation. First layer of vegetation is with the soil surface and does not come up to the height of more than one meter. They are mainly the grasses and the members of Zingiberaceae family. They keep the soil surface wet. This layer is the suitable shelter for microbes' growth and sustainability. It supports the second layer of vegetation and also the third canopy layer.

Second layer of vegetation is the vegetation of man height level. This is the vegetation layer comprised of vines, grubs, hedges and shrubs plants. These provide enough shade, protection and make favourable conditions for the plants' and microbes' growth of first layer. The layer is called the "Undergrowth Vegetation" in the forest. Third layer is the canopy layer of typical Garzon population or the population with other related trees. Third layer protects the grubs, vines, shrubs and hedges. During the variation of seasons the leaves fall on the ground and the fallen leaves provide enough organic deposition for the growth of both first and second layer of vegetation. In this way the entire typical forest ecosystem in the endemism sustains and survives in a normal and usual situation. If any unusualness appears because of introduction of any exotic species then the change of the ecosystem happens.

In typical aquatic ecosystem of our country (like pond ecosystem), fishes like shingi (Heteropneustes spp.) feed on the chironomid larvae keeping them in the status of fourth trophic level (3rd consumer). The carnivorous fishes of our endemic nature like Chital (Nostosterus spp.) and Boal (Walago spp.) feed on the fishes of fourth trophic level and attain the status of fifth trophic level (fourth consumer). In our typical aquatic ecosystem (pond ecosystem) the energy-flow and ecological pyramids are arranged in this pattern. On the other hand, when African magur (Clarias garipinus) and Red Piranha (Pygocentrus natteri) are introduced to the ecosystem they drastically consume without maintaining the chronology of the ecological pyramid-pattern in an ecosystem. These introduced species drastically reduce the population of animals of all trophic levels and create ecological hazard for the population of all other aquatic animals and many aquatic plants also. Consequently aquatic ecosystem gets changed or "altered".

Government Policies

At least two conditions must be fulfilled if a country has to achieve or at least make significant progress towards the targets of realising biodiversity use in sustainable development. One relates to the capacity of the country to implement policies and programmes effectively. In most developing countries, governance is poor in terms of human capability on one hand and lack of transparency and accountability on the other. It is, therefore, essential that the developing countries take necessary steps to establish good governance, including rule of law and improvement in the economic and social management capacity. In Bangladesh perspective, main constraints for the development are corruption and inadequacy in administration.

Biodiversity conservation has got a great role in maintenance of species richness and proper functioning of an ecosystem. Conservation of biodiversity means the conservation of biotic and abiotic factors together and their interaction to provide the sustainable situation for living organisms in an ecosystem. If the normal proliferation and reproduction of all living organisms and their interaction with abiotic factors fail in an ecosystem, then ecological imbalance remains in its persistence. Persisted ecological imbalance makes the environment unfavourable for initiating any kind of development plan. And this is why the biodiversity conservation stands at epicentre of the sustainability of the global developmental goals and targets.

Habitat Degradation

The major threats to biodiversity that result from human activity are habitat destruction, habitat fragmentation, habitat degradation, overexploitation of species for human use, introduction of exotic species, and increased spread of diseases. Most threatened species face at least two or more of these threats, speeding their way to extinction and hindering efforts to protect them. Typically, these threats develop so rapidly and on such a large scale that species are not able to adapt genetically to the changes or disperse to a more hospitable location.

Habitat degradation becomes threat to biodiversity in different appearance and dimension. In different countries, the habitat loss is different and causes the loss of biodiversity in different ways. One example could be cited from Cambodia, its habitat loss and its impact on biodiversity depletion. Before the Vietnam War, Cambodia was a quiet, forest-rich country. The war disrupted all aspects of the country's life for 20 years, and the ensuing civil war continued the disruption, with environmental consequences that would be felt for many more years to come. Cambodia has lost approximately three fourths of its wildlife habitat and has put at risk more than half of its wetlands.

7.3 Our Duty to Conserve Biodiversity

A wide variety of measures can be used to conserve our biodiversity, including both in-situ and ex-situ methods. In-situ conservation is on-site conservation or the conservation of genetic resources in natural populations of plant or animal species, such as forest genetic resources in natural populations of tree species. Ex-situ is the process of protecting an endangered species of plant or animal outside its natural habitat; for

example, by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans.

Immediate action is needed to conserve biodiversity. In the movement to conserve biodiversity and save the planet, individuals and the community can play an increasingly proactive role. Such as– conserve existing biodiversity, defend threatened species, increase bio-capacity, reduce sources of harm, develop ecologically resilient landscapes, support national and international conservation initiatives, go for sustainable use of ecosystem services, increase public awareness, plant more trees, reduce consumption, adopt greener technologies, increase use of renewable energy, conduct more research, participate in conference, seminar, training, and exhibition for conserving bio-diversity. To survive, we need to conserve all species on earth; we need action from individuals and governments. It's time to join forces and act. Otherwise, it might be too late.

Most of today's non-profit and serious zoological gardens display wild animals, not just for the amusement and the entertainment of their visitors, but primarily for conservation of endangered species, for education and biological research.

The concern of these institutions is to help save the diversity of life on Earth through applied conservation activities such as breeding endangered species.

The breeding of endangered species is coordinated by cooperative breeding programmes containing international studbooks and coordinators, who evaluate the roles of individual animals and institutions from a global or regional perspective.

Zoos are founded for the purpose of exhibiting and conserving a diversity of species within the animal and plant kingdoms. Now the zoos are considered as an Ecological or Eco Garden. One very important tool in ensuring the conservation of endangered species is "captive breeding". Many species can be bred successfully inside the zoos and a number of them can be reintroduced in their respective habitats. A complete cognizance of the species involved is required to achieve a high degree of success in captive breeding. The concern for wildlife is, however, the concern for man himself. All forms of life- human, animal and plant, are so closely interlinked that disturbance in one gives rise to imbalance in the others. Additionally, zoos afford an opportunity for scientists to make further researches, particularly about the conditions in which diverse species will flourish.

Chapter Eight
Recommendations

Advantages of Captive Animal and their Breeding

1. Increase of Animal Population

Continuous inbreeding gives rise of increase population of zoo animals.

2. Proper Care

Properly care for wild animals is possible only in captive condition. If the proper care and observation are taken the animals might be able to protect from diseases.

3. Development of Pure Breed

Due to inbreeding, the genotypes remain constant. Continuous inbreeding gives rise to developed organism. Proper selections for inbreeding organism having more adaptive power.

4. Proper Treatment

Proper treatment is possible for the wild animals when they are kept in captive condition. Zoo animals are given antibiotics, vitamin, mineral premix anthelmentics, painkiller etc. according to their needs by the specialist doctor.

5. Food Security

In wild condition animals may get food or not. But In captive condition they are more secured for food. Foods are regularly supplied to the wild animals in Rajshahi zoo although they age given fixed amount of food.

6. Proper Environment

Those animals who got proper environment are performing well breeding in captive condition. Such as : Monkey, Rabbit, deer, goose etc. Zoo keeping and management is very important for the zoo animals. Proper management should be taken by the authority with the help of zoo specialist.

Following Obstacles of Captive Breeding in Zoo Should be Overcome

i. Animal Teasing

All the animals of the zoo regularly teased by the viewers.

ii. Environmental Factor

Lacking of natural breeding environment are seen the zoo. The cages are too small for the wild animals. And the boundary line are too nearer towards the cages.

iii. Unwanted Hazards

Various types of unexpected animals are present in the zoo. These are the snakes, squirrel, rats, dogs etc. These animals' always takes food from the supplied feed in the cages. And they always disturbed the cage animals.

iv. Food

Fixed amount of food are supplied in the zoo for the animals. And the feeder supplies only one in a day. So most of the animals are suffering from ill health due to lack of sufficient amount of food.

v. Disease

Sometimes disease are occurred from the unexpected animals, faulty or wrongly design of the cages, and from other animals, Parasitic diseases are occurred from the supplied feed.

vi. Obesity

Some animals are not able to breed because of there massive body condition and excessive fat.

vii. Ratio of Male and Female

Some animals are not able to breed for lacking of their opposite partner.

viii. Lacking of Partner Choice

These conditions are seen incase of large carnivores.

ix. Some animals do not breed in captive condition. For example, kakatua, kite, wild cat, vulture etc.

What We will Have to Do

We had a lot of wild animals once upon a time but they are extinct or going to be extinct, So we need to collect some species and breed them in a captive condition immediately–

- Ghorial – From Madras Crocodile Park
- Balihans – From Asam
- Para horin – From Dubai Zoo/Indian Zoo
- Swamp deer – From India
- Crab eating monkey – From Burma
- Green peacock – From Burma/India

i. Organogram is not suitable to maintain and to operate a zoo. Veterinary doctors and animals caretaker are very few in number. Institutional organogram and trained employee are required

ii. Rather than Dhaka zoo and Safari park, Rangpur zoo and Rajshahi zoo has no veterinary clinic to treat the sick animals in a separate place. Veterinary clinic should be established

iii. No back yard road present behind the enclosure and cages. Incase of planning, designing and development of a zoo, suggestions from veterinarian, zoologist and zoo architect are required

iv. Animals are not kept in a systematic way. It should be kept in a systematic way

v. Size of cages are very small. Most of the cages are not comfortable for the large animals. If we can provide animal friendly environment then the potentialities of zoos for the conservation of biodiversity will be increased

vi. Bring all biodiversity agents, administration and proactive forces under a viable discussion forum

vii. Formulate a national guidelines based on tested scientific protocols

viii. Transform zoological gardens in their ability to communicate effective conservation message

ix. Set some basic standards of care for captive wild animals and evolve toward scientific breeding

x. All zoo exhibits should be modified keeping in mind first the welfare of animals, i.e. their behavioural and biological needs

xi. Zoo design should mimic to the extent possible the natural habitat of the animals, while keeping in mind behavioural and biological needs

xii. Permanent identification of animals and adoption of ZIMS (Zoological Information Management Software) among the zoos

xiii. Confirmation of animal welfare and zoo legislation with individual species standards for animal management

xiv. Establish human resource management, waste management, public health safety management program in zoos are needed

xv. Set some standards for attractive, accurate, engaging signage with focus on conservation of wildlife information

xvi. Establish field based conservation education and awareness development

xvii. Training of Zoo personnel is necessary. Employee of all categories incluidng zoo keepers required training from home and abroad inorder to maintain a better zoo mangement and to increase their professional experiences

xviii. Internal contact and linkage between zoos and safari park is very necessary. So that they can share their experiences with one another and can exchange zoo animals when it is requried

xix. Authorities of zoos and safari park should take all the necessary action inorder to maintain biosecurity management. So that spreading of contagious diseases and zoonoses control can be possible

xx. Zoo authority should ensure and must take all the necessary steps mentioned in the Rules and Regulations about establishment and management of a modern zoo.

Chapter Nine
References

"About Us - Learn More About The Nature Conservancy". Nature.org. 2011-02-23. Retrieved 2011-05-01.

"Adoption of animals begins in Nandankanan zoo". *The Hindu* (Chennai, India). 22 October 2008. Retrieved 17 April 2011.

Ahasan, S.A. and Azam, S.U. "Contribution of Zoological Gardens Towards Conservation of Wildlife and Biodiversity : Bangladesh Perspective" Zoos' Print, Volume XXII, Number 8, August 2007 (RNI 8:11), Pp. 13-16.

Ainsworth, Elizabeth A.; Long, Stephen P. (18 November 2004). "What have we learned from 15 years of free-air CO2 enrichment (FACE)? A meta-analytic review of the responses of photosynthesis, canopy properties and plant production to rising CO2". *New Phytologist* **165** (2): 351–372. doi:10.1111/j.1469-8137.2004.01224.x. PMID 15720649.

Algeo, T. J.; Scheckler, S. E. (29 January 1998). "Terrestrial-marine teleconnections in the Devonian: links between the evolution of land plants, weathering processes, and marine anoxic events". *Philosophical Transactions of the Royal Society B: Biological Sciences* **353** (1365): 113–130. doi:10.1098/rstb.1998.0195.

AZA Accreditation Introduction (http://www.aza.org/Accreditation/ AccreditationIntro/)

"Barcode of Life". Barcoding.si.edu. 2010-05-26. Retrieved 2011-09-24.

"Beantwoording vragen over fokken en doden van gezonde dieren in dierentuinen" (in Dutch). Ministry of Economic Affairs (Netherlands). 25 March 2014. Retrieved 9 June 2014.

"Belgium creating 45 "seed gardens"; gene banks with intent to reintroduction". Hbvl.be. 2011-09-08. Retrieved 2011-09-24.

"Big cats prowled London's tower", BBC News, October 24, 2005.

Blunt, 1976; Reichenbach 2002, pp. 151–163.

Blunt, Wilfred. *The Ark in the Park: The Zoo in the Nineteenth Century*. Hamish Hamilton, 1976, pp. 15-17.

Bond, David P.G.; Wignall, Paul B. (1 June 2008). "The role of sea-level change and marine anoxia in the Frasnian–Famennian (Late Devonian) mass extinction". *Palaeogeography, Palaeoclimatology, Palaeoecology* **263** (3–4): 107–118. doi:10.1016 /j.palaeo.2008.02.015.

Bowen, B. W. (1999). "Preserving genes, species, or ecosystems? Healing the fractured foundations of conservation policy". *Molecular Ecology*, 8:S5-S10.

Bradford, Phillips Verner and Blume, Harvey. *Ota Benga: The Pygmy in the Zoo*. St. Martins Press, 1992.

Brown, Paul (2004-01-08). "An unnatural disaster". *The Guardian* (London). Retrieved 2009-06-21.

Burney, D. A.; Flannery, T. F. (July 2005). "Fifty millennia of catastrophic extinctions after human contact". *Trends in Ecology and Evolution* (Elsevier) **20** (7): 395–401. doi:10.1016/j.tree.2005.04.022. PMID 16701402. Archived from the original on 10 June 2010. Retrieved 2009-06-12.

Campbell, AK (2003). "Save those molecules: molecular biodiversity and life". *Journal of Applied Ecology* **40** (2): 193–203. doi:10.1046/j.1365-2664.2003.00803.x.

Cardinale, Bradley; et al. (2012). "Biodiversity loss and its impact on humanity". *Nature* **486** (7401): 59–67. Bibcode:2012Natur.486...59C. doi:10.1038/nature11148. PMID 22678280.

Carduccia, J.P. and Jakobb, E.M., (2000). Rearing environment affects behaviour of jumping spiders. Animal Behaviour, 59: 39–46 [2]

Chivian E. and Bernstein A. (eds), 2008. *Sustaining Life: How Human Health Depends on Biodiversity*

"Citizens arrest". The Guardian. July 11, 2007.

Claes, A., Attur Shanmugam, A. and Jensen, P. (2010). Habituation to environmental enrichment in captive Sloth Bears-effect on stereotypies. Zoo Biology, 29: 705-714. doi:10.1002/zoo.20301

"Climate change and biodiversity". Intergovernmental Panel on Climate Change. 2005.

"Climate Change and Biological Diversity" Convention on Biological Diversity Retrieved November 5, 2009, From http://www.cbd.int/climate.

Cockell, Charles (2006). *Biological processes associated with impact events ESF IMPACT* (1. ed.). Berlin: Springer. pp. 197–219. ISBN 978-3-540-25735-6.

Coe, Jon C. 1987. What's The Message? Exhibit Design for Education. AAZPA 1987 Regional Conference Proceedings, American Association of Zoological Parks and Aquariums, Wheeling, WV, pp. 19-23.

"COHAB Initiative: Biodiversity and Human Health - the issues". Cohabnet.org. Retrieved 2009-06-21.

Cole, A. (2005-07-16). "Looking for new compounds in sea is endangering ecosystem". *BMJ* **330** (7504): 1350. doi:10.1136/bmj.330.7504.1350-d.

Connors, P. G. (1994) *Rediscovery of showy Indian clover*. Fremontia 22: 3–7

Conway 1995, pp. 259-276.

"Cooperative Alliance for Refuge Enhancement". CARE. Retrieved 1 June 2012.

Corvalan C. *et al.*, 2005 *Ecosystems and Human Well-being: Health Synthesis*. A report of the Millennium Ecosystem Assessment

Costello, John (June 9, 2011). "The great zoo's who". *Irish Independent*.

Dasmann, R. F. 1968. A Different Kind of Country. MacMillan Company, New York. ISBN 0-02-072810-7.

David Hancocks, Animals and Architecture, (London 1971), p. 129.

Davis (1996). *Museums and the Natural Environment*. Leicester University Press.

Davis. *Intro To Env Engg (Sie), 4E*. McGraw-Hill Education (India) Pvt Ltd. pp. 4–. ISBN 978-0-07-067117-1. Retrieved 28 June 2011.

Deghi, Gary *et al.* (1986) *Final Environmental Impact Report of the Pinole Valley Shopping Center*, City of Pinole, Earth Metrics Incorporated, California Environmental Clearinghouse.

Derr, Mark. "Big Beasts, Tight Space and a Call for Change in Journal Report," *The New York Times*, October 2, 2003.

Dhillion, SS; Svarstad, H; Amundsen, C; Bugge, HC (2002). "Bioprospecting: Effects on environment and development". *Ambio* **31** (6): 491–3. doi:10.1639/0044-7447(2002)031[0491:beoead]2.0.co;2. JSTOR 4315292. PMID 12436849.

Dixon, Jennifer. House panel told of abuses by zoos. *Times Daily*. 8 July 1992.

Dollinger, P. (2006). Marketing the conservation role of zoos and aquariums: Zoos' Print Magazine. 21(11):17

Kaginkar, Y.R. (2007). Role and importance of Human Resource Management in Modernization of zoos in India. Zoos' Print Magazine. 22(2): 14

Donahue, Jesse and Trump, Erik. *Political Animals: Public Art in American Zoos and Aquariums*. Lexington Books, 2007, p. 79.

Doney, Scott C.; Fabry, Victoria J.; Feely, Richard A.; Kleypas, Joan A. (1 January 2009). "Ocean Acidification: The Other CO Problem". *Annual Review of Marine Science* **1** (1): 169–192. Bibcode:2009ARMS....1..169D. doi:10.1146/annurev.marine.010908.163834.

Drakare, Stina; Lennon, Jack J.; Hillebrand, Helmut (2006). "The imprint of the geographical, evolutionary and ecological context on species-area relationships". *Ecology Letters* **9** (2): 215–227. doi:10.1111/j.1461-0248.2005.00848.x. PMID 16958886.

Dumont, E. (2012). "Estimated impact of global population growth on future wilderness extent." (PDF). *Earth System Dynamics Discussions* **3**: 433–452. Bibcode:2012 ESDD....3..433D. doi:10.5194/esdd-3-433-2012.

Duncan, I.J.H. and Wood-Gush, D.G.M., (1971). Frustration and aggression in the domestic fowl. Animal Behaviour, 19:500–504

Dyke, van F. (2008). *Conservation Biology: Foundations, Concepts, Applications*, 2nd ed. Springer Verlag. pp. 478. ISBN 978-1-4020-6890-4 (hc).

Edward O. Wilson (2002). *The Future of Life*. New York: Alfred A. Knopf. ISBN 0-679-45078-5.

Edward O. Wilson, editor, Frances M.Peter, associate editor, *Biodiversity*, National Academy Press, March 1988 ISBN 0-309-03783-2 ; ISBN 0-309-03739-5 (pbk.), online edition

Edward T. Bennett, The Tower Menagerie comprising the natural History of the Animals contained in that establishment; with anecdotes of their characters and History., (London, 1829), p. 154, cited by Loisel, op. cit., p. 292.

Fernandez-Arias, A.; Alabart, J. L.; Folch, J.; Beckers, J. F. (1999). "Interspecies pregnancy of Spanish ibex (*Capra pyrenaica*) fetus in domestic goat (*Capra hircus*) recipients induces abnormally high plasmatic levels of pregnancy-associated glycoprotein". *Theriogenology* **51** (8): 1419–1430. doi:10.1016/S0093-691X(99)00086-2. PMID 10729070.

Ferocity Training, *Sunday Morning Post*, Hong Kong, November 29, 1999.

Ferral, Katelyn (2010-07-15). "N.C. Zoo, bucking a trend, sets an attendance record". Newsobserver.com. Retrieved 2013-05-04.

Field, Richard; Hawkins, Bradford A.; Cornell, Howard V.; Currie, David J.; Diniz-Filho, J. Alexandre F.; Guégan, Jean-François; Kaufman, Dawn M.; Kerr, Jeremy T.; Mittelbach, Gary G.; Oberdorff, Thierry; O'Brien, Eileen M.; Turner, John R. G. (1 January 2009). "Spatial species-richness gradients across scales: a meta-analysis". *Journal of Biogeography* **36** (1): 132–147. doi:10.1111/j.1365-2699.2008.01963.x.

Gautaman Bhaskaran, Where past overshadows present, The Hindu, 14 January 2001

Gabriel, Sigmar (2007-03-09). "30% of all species lost by 2050". *BBC News*.

Gascon, C., Collins, J. P., Moore, R. D., Church, D. R., McKay, J. E. and Mendelson, J. R. III (eds) (2007). *Amphibian Conservation Action Plan*. IUCN/SSC Amphibian Specialist Group. Gland, Switzerland and Cambridge, UK. 64pp. Amphibians.org, see also Millenniumassessment.org, Europa.eu

Gaston, Kevin J. (11 May 2000). "Global patterns in biodiversity". *Nature* **405** (6783): 220–227. doi:10.1038/35012228. PMID 10821282.

Geist, V.; S.P. Mahoney, and J.F. Organ. (2001). "Why hunting has defined the North American model of wildlife conservation.". *Transactions of the North American Wildlife and Natural Resources Conference* **66**: 175–185.

Global Biodiversity Assessment. UNEP, 1995, Annex 6, Glossary. ISBN 0-521-56481-6, used as source by "Biodiversity", Glossary of terms related to the CBD, Belgian Clearing-House Mechanism. Retrieved 2006-04-26.

Goldston, Linda. February 11, 1999, cited in Scully, Matthew. *Dominion*. St. Martin's Griffin, 2004 (paperback), p. 64.

Grafton, R. Q.; Kompas, T.; Hilborn, R. W. (2007). "Economics of Overexploitation Revisited". *Science* **318** (5856): 1601–1601. Bibcode:2007Sci...318.1601G. doi:10.1126/science.1146017.

Grech, Kali S. "Overview of the Laws Affecting Zoos", Michigan State University College of Law, Animal Legal and Historical Center, 2004.

Guzoo Animal Farm, website about Canadian roadside zoos, accessed June 18, 2009.

Harvey L., 2008. *Natural products in drug discovery*. Drug Discovery Today

Hassan, Rashid M., et al. (2006). *Ecosystems and human well-being: current state and trends : findings of the Condition and Trends Working Group of the Millennium Ecosystem Assessment*. Island Press. p. 105. ISBN 978-1-55963-228-7.

Hawkins E.S., Reich; Reich, MR (1992). "Japanese-originated pharmaceutical products in the United States from 1960 to 1989: an assessment of innovation". *Clin Pharmacol Ther* **51** (1): 1–11. doi:10.1038/clpt.1992.1. PMID 1732073.

Hawkins, M. and Willemsen, M. (2004). "Environmental enrichment for amphibians and reptiles". Retrieved April 9, 2013.

Hawksworth, D. L. (1996). *Biodiversity: measurement and estimation*. Springer. p. 6. ISBN 978-0-412-75220-9. Retrieved 28 June 2011.

Hegland, Stein Joar; Nielsen, Anders; Lázaro, Amparo; Bjerknes, Anne-Line; Totland, Ørjan (1 February 2009). "How does climate warming affect plant-pollinator interactions?". *Ecology Letters* **12** (2): 184–195. doi:10.1111/j.1461-0248.2008.01269.x.

Helalsiddiqui, A. S. M. 1998. Present status of wild life, Human casualties by Tiger, and wildlife conservation in the Sundarbans of Bangladesh. Tiger Paper, 25(2): 28-32

"Hippo dilemma". *Windows on the Wild: Science and Sustainability*. New Africa Books. 2005. ISBN 1-86928-380-5.

Hornsby, A. S. 2007. Oxford Advanced Learner's Dictionary, 7th edition. Oxford University Press. 1779p.

Hughes, B.O., Gilbert, A.B. and Brown, M.F., (1986). Categorisation and causes of abnormal egg shells: relationship with stress. British Poultry Science, 27: 325-337

Hunter, M. L. (1996). *Fundamentals of Conservation Biology*. Blackwell Science Inc., Cambridge, Massachusetts. ISBN 0-86542-371-7.

Hurme, K., Gonzalez, K., Halvorsen, M., Foster, B., Moore, D. and Chepko-Sade, D., (2003). Environmental enrichment for Dendrobatid frogs. Journal of Applied Animal Welfare Science, 6: 285–299.

Hyson, 2000, p. 29; Hyson 2003, pp. 1356-1357.

IUCN, WRI, World Business Council for Sustainable Development, Earthwatch Inst. 2007 *Business and Ecosystems: Ecosystem Challenges and Business Implications*

IUCN's Classification of Direct Threats". Conservationmeasures.org. Retrieved 2011-09-24.

James S. Russell, Zoo Story (1989), Architectural Record, pp. 84 89.

Jaques Nouvel, The History, Present State and Evolution of Zoo Architecture, Zoo Design 1 (Paignton, U. K. 1975), pp. 29-32.

Jeffrey K. McKee (December 2004). *Sparing Nature: The Conflict Between Human Population Growth and Earth's Biodiversity*. Rutgers University Press. p. 108. ISBN 978-0-8135-3558-6. Retrieved 28 June 2011.

Jensen, Derrick and Tweedy-Holmes Karen. *Thought to Exist in the Wild: Awakening from the Nightmare of Zoos*. No Voice Unheard, 2007, p. 21; Baratay, Eric and Hardouin-Fugier, Elisabeth. *Zoo: A History of the Zoological Gardens of the West*. Reaktion, London. 2002.

Jim Chen (2003). "Across the Apocalypse on Horseback: Imperfect Legal Responses to Biodiversity Loss". *The Jurisdynamics of Environmental Protection: Change and the Pragmatic*. Environmental Law Institute. p. 197. ISBN 1-58576-071-4.

Jon C Coe (1993), AAZPA School for Professional Management Development: Design Directions 218, reprinted in ZOO ZEN, vol. X, No. 1, August 1994, p. 1.

Jon C. Coe, “The Evolution of Zoo Animal Exhibits”, The Role of Zoos in Biological Conservation: Past, Present and Future, 1992, AAZPA Symposium, reprinted in ZOO ZEN vol. X, No. 1, August 1994, p. 31.

Jones-Walters, L.; Mulder, I. (2009). "Valuing nature: The economics of biodiversity". *Journal for Nature Conservation* **17** (4): 245. doi:10.1016/j.jnc.2009.06.001.

Kannan, R.; James, D. A. (2009). "Effects of climate change on global biodiversity: a review of key literature". *Tropical Ecology* **50** (1): 31–39. ISSN 0564-3295. Retrieved 2014-05-21.

Kemppinen, N., Hau, J., Meller, A., Mauranen, K.,Kohila, T. and Nevalainen, T., (2010). Impact of aspen furniture and restricted feeding on activity, blood pressure, heart rate and faecal corticosterone and immunoglobulin A excretion in rats (Rattus norvegicus) housed in individually ventilated cages. Laboratory Animals, 44: 104-112

Kenneth J. Polakowski, Zoo Design: The Reality of Wild Illusions, (Ann Arbor, Michigan 1987), p. 82.

Koh L. P., Dunn R. R., Sodhi N. S., Colwell R. K., Proctor H. C., Smith V. S. (2004). "Species Coextinctions and the Biodiversity Crisis" (PDF). *Science* **305** (5690): 1632–4. Bibcode:2004Sci...305.1632K. doi:10.1126/science.1101101. PMID 15361627. Archived from the original on 2009-03-26.

Kumar, B.V. (2003). Opinion Understanding "Ecotourism". Zoos' Print Magazine. 18(12): 6 SAZARC (2002). Zoo Management for conservation and welfare of wildlife-Briefing Book 3rd Annual Meeting, Dhaka Zoo, 6-11 October, Section. 2.

Laws, N., Ganswindt, A., Heistermann, M., Harris, M., Harris, S. and Sherwin, C., (2007). A case study: fecal corticosteroid and behavior as indicators of welfare during relocation of an asian elephant. Journal of Applied Animal Welfare Science, 10: 349-358. doi:10.1080/10888700701555600

Lecky, W.E.H. *History of European Morals from Augustus to Charlemagne*. Vol. 1, Longmans, 1869, pp. 280-282.

Lewis M.H., Presti M.F., Lewis J.B. and Turner, C.A., (2006). The neurobiology of stereotypy I: Environmental complexity. In *Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare*, G. Mason and J. Rushen (Editors). CABI. pp. 190-226. doi:10.1079/9780851990040.0190

Loarie, Scott R.; Duffy, Philip B.; Hamilton, Healy; Asner, Gregory P.; Field, Christopher B.; Ackerly, David D. (24 December 2009). "The velocity of climate change". *Nature* **462** (7276): 1052–1055. Bibcode:2009Natur.462.1052L. doi:10.1038/nature08649. PMID 20033047.

Lovejoy, edited by Thomas E.; Hannah, Lee (2005). *Climate change and biodiversity*. New Haven: Yale University Press. pp. 41–55. ISBN 0-300-10425-1.

Luck, Gary W.; Daily, Gretchen C.; Ehrlich, Paul R. (2003). "Population diversity and ecosystem services" (PDF). *Trends in Ecology and Evolution* **18** (7): 331–336. doi:10.1016/S0169-5347(03)00100-9.

Mahoney, Shane (May–June 2004). "The North American Wildlife Conservation Model". *Bugle* (Rocky Mountain Elk Foundation) **21** (3).

Malmud, Randy. *Reading Zoos. Representations of Animals and Captivity*. New York, 1998. ISBN 0-8147-5602-6.

"Man and Monkey Show Disapproved by Clergy", *The New York Times*, September 10, 1906.

"Manifesto for Zoos", John Regan Associates, 2004.

Maple, 1995, p. 25.

Margules C. R., Pressey R. L. (2000). "Systematic conservation planning" (PDF). *Nature* **405** (6783): 243–253. doi:10.1038/35012251. PMID 10821285.

Martin L.B., Kidd, L., Liebl A.L. and Coon, C.A.C., (2011). Captivity induces hyper-inflammation in the house sparrow (Passer domesticus). Journal of Experimental Biology, 214: 2579-2585. doi:10.1242/jeb.057216

Mason, G.J., (1991). Stereotypies - A critical review. Animal Behaviour, 41: 1015-1037. doi:10.1016/S0003-3472(05)80640-2

McPeek, Mark A.; Brown, Jonathan M. (1 April 2007). "Clade Age and Not Diversification Rate Explains Species Richness among Animal Taxa". *The American Naturalist* **169** (4): E97–E106. doi:10.1086/512135. PMID 17427118.

Mendelsohn, Robert; Balick, Michael J. (1 April 1995). "The value of undiscovered pharmaceuticals in tropical forests". *Economic Botany* **49** (2): 223–228. doi:10.1007/BF02862929.

Mendelsohn, Robert; Balick, Michael J. (1 July 1997). "Notes on economic plants". *Economic Botany* **51** (3): 328–328. doi:10.1007/BF02862103.

Mendl, M., Burman, O.H.P., Parker, R.M.A. and Paul, E.S., (2009). Cognitive bias as an indicator of animal emotion and welfare: Emerging evidence and underlying mechanisms. Applied Animal Behaviour Science, 118: 161–181.

Meyer, Carrie A. (1993). "Environmental NGOs in Ecuador: An Economic Analysis of Institutional Change". *The Journal of Developing Areas* **27** (2): 191–210.

Michael Hogan. 2010. *Deforestation* Encyclopedia of Earth. ed. C.Cleveland. NCSE. Washington DC.

Millennium Ecosystem Assessment 2005 *Ecosystems and Human Well-being: Opportunities and Challenges for Business and Industry.*

Min, Seung-Ki; Xuebin Zhang, Francis W. Zwiers, Gabriele C. Hegerl (Feb 17, 2011). "Human contribution to more-intense precipitation extremes". *Nature* **470** (7334): 378–381. Bibcode:2011Natur.470..378M. doi:10.1038/nature09763.

"Molecular Pharming" (2006) GMO Compass Retrieved November 5, 2009, GMOcompass.org

Myers N (1988). "Threatened biotas: 'hot spots' in tropical forests". *Environmentalist* **8** (3): 187–208. doi:10.1007/BF02240252. PMID 12322582.

Myers N (1990). "The biodiversity challenge: expanded hot-spots analysis". *Environmentalist* **10** (4): 243–256. doi:10.1007/BF02239720. PMID 12322583.

Myers, Norman; Mittermeier, Russell A.; Mittermeier, Cristina G.; da Fonseca, Gustavo A. B.; Kent, Jennifer; Mittermeier, Cristina G.; Da Fonseca, Gustavo A. B.; Kent, Jennifer (24 February 2000). "Biodiversity hotspots for conservation priorities". *Nature* **403** (6772): 853–858. Bibcode:2000Natur.403..853M. doi:10.1038/35002501. PMID 10706275.

"Nandankanan Zoo to start Adopt-an-Animal scheme soon". *orissadiary.com*. OrissaDiary.com. 23 March 2008. Retrieved 17 April 2011.

"Nandankanan Zoo". *khordha.nic.in*. Khorda. Retrieved 17 April 2011.

Niasari-Naslaji, A.; Nikjou, D.; Skidmore, J. A.; Moghiseh, A.; Mostafaey, M.; Razavi, K.; Moosavi-Movahedi, A. A. (2009). "Interspecies embryo transfer in camelids: the birth of the first Bactrian camel calves (Camelus bactrianus) from dromedary camels (Camelus dromedarius)". *Reproduction, fertility, and development* **21** (2): 333–337. doi:10.1071/RD08140. PMID 19210924.

Nicol, C.J. (2007). "Environment enrichment for birds". Retrieved April 9, 2013.

Norton, Bryan G.; Hutchins, Michael; Stevens, Elizabeth F.; Maple, Terry L. (ed.): *Ethics on the Ark. Zoos, Animal Welfare, and Wildlife Conservation*. Washington, D.C., 1995. ISBN 1-56098-515-1

Organ, J.F.; V. Geist, S.P. Mahoney, S. Williams, P.R. Krausman, G.R. Batcheller, T.A. Decker, R. Carmichael, P. Nanjappa, R. Regan, R.A. Medellin, R. Cantu, R.E. McCabe, S. Craven, G.M. Vecellio, and D.J. Decker (2012). *The North American Model of Wildlife Conservation.. The Wildlife Society Technical Review 12-04.* (Bethesda, Maryland: The Wildlife Society). ISBN 978-0-9830402-3-1.

Paul Ehrlich and Anne Ehrlich, *Extinction*, Random House, New York (1981) ISBN 0-394-51312-6.

Penman, Danny. "Animals torn to pieces by lions in front of baying crowds: the spectator sport China DOESN'T want you to see", *The Daily Mail*, January 1, 2008.

Peters, Shanan. "Sepkoski's Online Genus Database". University of Wisconsin-Madison. Retrieved 10 April 2013.

Philip Pregill and Nancy Volkman, Landscapes in History: Design and Planning in the Western Tradition, (New York, 1993), p. 513.

Pimm, S. L.; Russell, G. J.; Gittleman, J. L.; Brooks, T. M. (1995). "The Future of Biodiversity" (PDF). *Science* **269** (5222): 347–350. Bibcode:1995Sci...269..347P. doi:10.1126/science.269.5222.347. PMID 17841251.

Rabosky, Daniel L. (1 August 2009). "Ecological limits and diversification rate: alternative paradigms to explain the variation in species richness among clades and regions". *Ecology Letters* **12** (8): 735–743. doi:10.1111/j.1461-0248.2009.01333.x. PMID 19558515.

Rahman, Z. February 2009. **Wild animal**. Metropolitan printers and publisher, Dhaka.

Raup, D. M. (1994). "The role of extinction in evolution". *Proceedings of the National Academy of Sciences* **91** (15): 6758–6763. Bibcode:1994PNAS...91.6758R. doi:10.1073/pnas.91.15.6758. PMC 44280. PMID 8041694.

Rene S. Ebersole (November 2001). "The New Zoo". *Audubon Magazine* (National Audubon Society). Retrieved 2007-12-18.

"Rice Grassy Stunt Virus". Lumrix.net. Retrieved 2009-06-21.

Roadside zoo animals starving. *Free Lance-Star.* 11 Jan. 1997.

"Robert E. Jenkins". Nature.org. 2011-08-18. Retrieved 2011-09-24.

Robinson 1987a, pp. 10-17; Robinson 1987b, pp. 678-682.

Roopesh, J. et al. (10 February 2008). "Marine organisms: Potential Source for Drug Discovery" (PDF). *Current Science* **94** (3): 292.

Sala, Osvaldo E.; Meyerson, Laura A.; Parmesan, Camille (26 January 2009). *Biodiversity change and human health: from ecosystem services to spread of disease*. Island Press. pp. 3–5. ISBN 978-1-59726-497-6. Retrieved 28 June 2011.

Sanderson, James; Moulton, Michael (August 18, 1998). *Wildlife Issues in a Changing World, Second Edition [Paperback]*. CRC Press. ISBN 978-1-56670-351-2.

Sarah Rossbach, Central Park Zoo (1989), Landscape Architecture, pp. 80 83.

See Kisling, Vernon N. (ed.): *Zoo and Aquarium History*, Boca Raton 2001. ISBN 0-8493-2100-X; Hoage, R. J. Deiss and William A. (ed.): *New Worlds, New Animals*, Washington 1996. ISBN 0-8018-5110-6; Hanson, Elizabeth. *Animal Attractions*, Princeton 2002. ISBN 0-691-05992-6; and Hancocks, David. *A Different Nature*, Berkeley 2001. ISBN 0-520-21879-5

Sheperdson, D.J., Mellen, J.D. and Hutchins, M. (eds)., (1998). *Second Nature: Environmental Enrichment for Captive Animals.* Smithsonian Institution Press. Washington, D.C.

Shepherdson, D.J. (1998) “Tracing the path of environmental enrichment in zoos” in Shepherdson, D.J., Mellen, J.D. and Hutchins, M. (1998) Second Nature – Environmental Enrichment for Captive Animals, 1st Edition, Smithsonian Institution Press, London, UK, pp. 1 – 12.

Smith, T. (2004) Zoo Research Guidelines: Monitoring Stress in Zoo Animals. BIAZA(Formerly The Federation of Zoological Gardens of Great Britain and Ireland), London.

Somdatta Basu, Endangered singles bug matchmakers, Times of India, 10 August 2005

Soule M. E.; Soule, Michael E. (1986). "What is conservation biology?". *BioScience* **35** (11): 727–734. doi:10.2307/1310054. JSTOR 1310054.

Soule, M. E. (ed.) (1986). *Conservation Biology: The science of scarcity and diversity*. Sinauer Associates Inc.

"Southern Corn Leaf Blight". Retrieved 2007-11-13.

Staff reporter, Bird headcount kicks off, The Telegraph, 9 January 2005.

"Statistics". *nzpnewdelhi.gov.in*. National Zoological Park. Retrieved 24 July 2011.

"Study: Loss Of Genetic Diversity Threatens Species Diversity". Enn.com. 2007-09-26. Retrieved 2009-06-21.

Suchetana Haldar, Where have all the birds gone?, Kolkata Newsline, 3 January 2006

Sultana, M. (2007). Human Resource Management Practices in Dhaka Zoo, MBA (Management) Thesis, IBAIS University, Dhaka, Bangladesh.

"The Foreign Assistance Act of 1961, as amended" (PDF). Retrieved 2011-05-01.

Tittensor, Derek P.; Mora, Camilo; Jetz, Walter; Lotze, Heike K.; Ricard, Daniel; Berghe, Edward Vanden; Worm, Boris; Jetz, Walter; Lotze, Heike K.; Ricard, Daniel; Berghe, Edward Vanden; Worm, Boris (28 July 2010). "Global patterns and predictors of marine biodiversity across taxa". *Nature* **466** (7310): 1098–1101. Bibcode:2010Natur.466.1098T. doi:10.1038/nature09329. PMID 20668450.

Tor-Björn Larsson (2001). *Biodiversity evaluation tools for European forests*. Wiley-Blackwell. p. 178. ISBN 978-87-16-16434-6. Retrieved 28 June 2011.

Trivedi. P. R. and Raj Gurdeep., 1997. **Environmental wildlife and plant conservation**. New Delhi: Akashdeep publishing house. Printed at Mehra Offset Press, Delhi.

Tudge, Colin. *Last Animals in the Zoo: How Mass Extinction Can Be Stopped*, London 1991. ISBN 1-55963-157-0.

"TWS Final Position Statement". Retrieved 2011-04-04.

U.S. Fish and Wildlife Service, Arcata Division, 1655 Heindon Road, Arcata, Ca.

Vandermeer, John H. (2010). *The ecology of agroecosystems*. Sudbury, Mass.: Jones and Bartlett Publishers. ISBN 9780763771539.

Wahl, GM; Robert de Saint Vincent B; Derose, ML (1984). "Effect of chromosomal position on amplification of transfected genes in animal cells". *Nature* **307** (5951): 516–20. Bibcode:1984Natur.307..516W. doi:10.1038/307516a0. PMID 6694743.

Walther, Gian-Reto; Roques, Alain; Hulme, Philip E.; Sykes, Martin T.; Pyšek, Petr; Kühn, Ingolf; Zobel, Martin; Bacher, Sven; Botta-Dukát, Zoltán; Bugmann, Harald (1 December 2009). "Alien species in a warmer world: risks and opportunities". *Trends in Ecology and Evolution* **24** (12): 686–693. doi:10.1016/j.tree.2009.06.008.

WAZA (2005). Building a Future for Wildlife-The World zoo and Aquarium Conservation Strategy, Pp. 74 WAZA (2003). Code of Ethics and Animal welfare. Proceeding of the 58th Annual Meeting, San Jose. 139- 142. WAZA Executive Office, Berne.

Wilcox, Bruce A. 1984. In situ conservation of genetic resources: determinants of minimum area requirements. *In National Parks, Conservation and Development, Proceedings of the World Congress on National Parks,, J.A. McNeely and K.R. Miller,* Smithsonian Institution Press, pp. 18–30.

Wilcox, C.S., Patterson, J. and Cheng, H.W., (2009). Use of thermography to screen for subclinical bumblefoot in poultry. Poultry Science, 88: 1176-1180. doi:10.3382/ps.2008-00446.

"Wildlife Conservation". Conservation and Wildlife. Retrieved 1 June 2012.

"World Conservation Strategy" (PDF). Retrieved 2011-05-01.

World's First Zoo - Hierakonpolis, Egypt, *Archaeology Magazine,* http://www.archaeology.org/1001/topten/egypt.html

"WWF in Brief". World Wildlife Fund. Retrieved 2011-05-01.

Young, R.J. (ed.), (2003). *Environmental Enrichment for Captive Animals*. Universities Federation for Animal Welfare (UFAW), Potters Bar, Herts.

Zimmerman, P.H., Lundberg, A., Keeling, L.J. and Koene, P., (2003). The effect of an audience on the gakel-call and other frustration behaviours in the laying hen (Gallus gallus domesticus). Animal Welfare, 12: 315–326

"Zoo," *Encyclopaedia Britannia*, 2008.

"Zoo: Procurement and care of animals," *Encyclopaedia Britannica*, 2008.

http://autocww2.colorado.edu/~toldy2/E64ContentFiles/BiologicalPrinciples/Biodiversity.html

http://designforlife.com.sg/thesis/21moat.html#sdfootnote38anc

http://en.banglapedia.org/index.php?title=Zoological_Garden

http://nzpnewdelhi.gov.in/managements.htm

http://timesofindia.indiatimes.com/city/bhubaneswar/Veterinary-hospital-interpretation-centre-at-Nandankanan-zoo/articleshow/22051165.cms

http://www.banglapedia.org/HT/Z_0023.htm

https://en.wikipedia.org/wiki/Alipore_Zoological_Gardens

https://en.wikipedia.org/wiki/Nandankanan_Zoological_Park

https://en.wikipedia.org/wiki/National_Zoological_Park_Delhi

Millenniumassessment.org

Appendices

Appendix-I

List of some common zoo animals and their Scientific name

Sl No.	English Name	Scientific name
Mammals		
1.	Asian Elephant	*Elephas maxima*
2.	Hippopotamus	*Hippopotamus amphibius*
3.	Great Indian Rhinoceros	*Rhinoceros unicomis*
4.	Reticulated Giraffe	*Giraffa camelpardalis reticulatus*
5.	Western, Easter Lowland and Mountain Gorilla	*Gorilla gorilla*
6.	Chimpanzee Bonobo	*Pan tropglodytes*
7.	Pygmy Chimpanzee	*Pan paniscus*
8.	Orang Utan	*Pongo pygmaeus*
9.	Baking Deer	*Muntiacus muntjack*
10.	Chital, axis, spotted Deer	*Cervus axis*
11.	Sambar	*Cervus unicolor*
12.	Nilgai, Bluebull	*Boselephus tragocamelus*
13.	Gaur, Indian Bison	*Bos gaurus*
14.	Banteng	*Bos banteng*
15.	Gayal	*Bos frontalis*
16.	Dromedary	*Camelus dromedarius*
17.	Arabian Gazelle	*Gazella arabica*
18.	Guanaco	*Lama guanicoe*
19.	Lechwe Waterbuck	*Kobus leche*
20.	Nubian ibex	*Capra ibex nubiana*
21.	Laristan Sheep	*Ovis ammon*
22.	Barbary Sheep	*Ammotragus lervia*
23.	Bengal Tiger	*Panthera tigris tigris*
24.	Siberian Tiger	*Panthera tigris altaica*
25.	Lion	*Panthera leo*

26.	Leopard, Panther	*Panthera pardus*
27.	Jaguar	*Panthera onca*
28.	Cheetah, Hunting Leopard	*Acinonyx jubatus*
29.	Puma, Mountain Lion	*Felis concolor*
30.	Fishing Cat	*Fellis viverrina*
31.	Jungle Cat	*Felis chaus*
32.	Large Indian Civet	*Viverra zibetha*
33.	Rhesus Macaque	*Macaca mulatta*
34.	Common Langur	*Presbytis entellus*
35.	Olive Baboon	*Papio anubis*
36.	Hoolock Gibbon	*Hylobates hoolock*
Aves		
37.	Indian Peafowl	*Pavo cristatus*
38.	Red junglefowl	*Gallus gallus*
39.	sarus Crane	*Grus antigone*
40.	Pied Hornbill	*Anthracoceros malabaricus*
41.	Greylag Goose	*Anser anser*
42.	Mute Swan	*Cygnus olor*
43.	Spotted Dove	*Streptpellia chinensis*
44.	Hill Muna	*Gracula religiosa*
45.	Grey heron	*Ardea cinerea*
46.	Pond Heron	*Ardeola grayii*
47.	Purple Moorhen	*Porphyrio porphyrio*
48.	Whitebreasted waterhen	*Amouromis phoenicurus*
49.	Water Ccock	*Gallicrex cinerea*
50.	Little Cormorant	*Phalacrocorax fuscicollis*
51.	Greater Flamingo	*Phoenicopterus roseus*
52.	White Pelican	*Pelicanus onocrotalus*
53.	Redivented Bulbul	*Pycnonotus cafer*
54.	Magpie Robin	*Copsychus saularis*
55.	Spotted Munia	*Lonchura punctulata*
56.	Ostrich	*Struthio camelus*
57.	Emu	*Dromaius novaehollandiae*

58.	Humboldt's Renguin	*Sphenicus humboldti*
59.	Roseringed parakeet	*Psittacula krameri*
60.	Sulphur-crested Cockatoo	*Cacatua sulphurea*
61.	Blue and Gold Macaw	*Ara ararauna*
Reptiles		
62.	Esturaine Crocodile	*Crocodilus porosus*
63.	Marsh Crocodile	*Crocodilus palustris*
64.	Nile Crocodile	*Crocodilus niloticus*
65.	Gharial	*Gavilais gangeticus*
66.	India Python	*Python molurus*
67.	Reticulated Python	*Python reticulata*
68.	Rat Snake	*Coluber mucosus*
69.	Indian Cobra	*Naja naja*
70.	King Cobra	*Ophiphagus hannah*
71.	common Krait	*Bungarus caeruleus*
72.	Banded Krait	*Bungarus fasciatus*
73.	Russell's Viper	*Vipera russellii*
74.	Elongated Tortoise	*Indotestudo elongata*
75.	Burmese Brown Tortoise	*Manouria emys*
76.	Brahminy River Turtle	*Hardella thurji*
77.	Roofed Tortoise	*Kachuga tecta*
78.	Asiatic Softshell	*Chitra indica*
79.	Peacock Softshell	*Aspideretes hurum*
80.	Bengal Monitor	*Varanus Bengalensis*
81.	Yellow Monitor	*Varanus flavescens*

Appendix-II

List of zoo association in the world

Global

- World Association of Zoos and Aquariums (WAZA)
- International Marine Animal Trainers Association (IMATA)
- International Species Information System (ISIS and ZIMS database)
- Alliance of Marine Mammal Parks and Aquariums (AMMPA)
- International Zoo Educators Association (IZE)
- ZooLex Zoo Design Organization (ZooLex)

Regional

- Asociación Mesoamericana y del Caribe de Zoológico i Acuarios (AMACZOOA)
- Asociación Latinoamericana de Parques Zoológicos y Acuarios (ALPZA)
- (American) Association of Zoos and Aquariums (AZA)
- African Association of Zoos and Aquaria (PAAZAB)
- Eurasian Regional Association of Zoos and Aquariums (EARAZA)
- European Association of Zoos and Aquaria (EAZA)
- South Asian Zoo Association for Regional Cooperation (SAZARC)
- South East Asian Zoos Association (SEAZA)
- Zoo and Aquarium Association (ZAA) (formerly ARAZPA)

National

- American Association of Zoo Keepers (AAZK)
- Asociación Colombiana de Parques Zoológicos y Acuarios (ACOPAZOA)
- Association Nationale des Parcs Zoologiques de France (ANPZ)
- Austrian Zoo Association (OZO)
- British and Irish Association of Zoos and Aquariums (BIAZA)
- Canadian Association of Zoos and Aquariums (CAZA)
- Central Zoo Authority of India (CZA), Governing Authority of all Zoos in India
- Danish Association of Zoological Gardens and Aquaria (DAZA)
- Dutch Zoo Federation (NVD)
- German Federation of Zoo Directors (VDZ)
- Iberian Association of Zoos and Aquaria (AIZA)
- Israeli Zoo Association (IZA)

- Italian Union of Zoos and Aquaria (UIZA)
- Japanese Association of Zoos and Aquariums (JAZA)
- Malaysian Association of Zoological Parks and Aquaria (MAZPA)
- Mexican Zoo and Aquaria Association (AZCARM)
- National Foundation of Zoological Parks and Aquaria (FUNPZA)
- Royal Zoological Society of Scotland (RZSS)
- Society of Brazilian Zoos (Sociedade de Zoológicos do Brasil) (SZB)
- Swedish Association of Zoological Parks and Aquaria (SAZA or SDF)
- Swiss Association of Scientific Zoos (ZOOSchweiz)
- Syndicat National des Directeurs de Parcs Zoologiques Français (SNDPZ)
- Union of Czech and Slovak Zoological Gardens (UCSZ)
- Zoo Outreach Organisation (ZOO), India is an NGO
- Zoological Association of America (ZAA)
- Zoological Survey of India (ZSI)
- The Zoological Society, Madras Christian College, Chennai (ZSMCC)
- Board of Directors of Polish Zoological Gardens and Aquaria (RDPOZiA)

Appendix-III

DEVELOPMENT PROJECT PROPOSAL (DPP)

Dhaka and Rangpur Zoo Modernization Project

Executing Agency: Department of Livestock Services

Sponsoring Ministry: Ministry of Fisheries and Livestock

Project Implementation Period: 01.7.2010 to 30.6.2015

Total Project Cost: Tk. 11454.50 Lakh

DEVELOPMENT PROJECT PROPOSAL (DPP)
PART –A

1.		**Project Title**	:	**Dhaka and Rangpur Zoo Modernization Project**
2.	**(a)**	**Sponsoring Ministry/ Division**	:	Ministry of Fisheries and Livestock
	(b)	**Executing Agency**	:	Department of Livestock Services
3.1		**Objectives of the Project (Please specify)**	:	To make a modern zoo of international level. To collect rare species of wild animal for increasing the attraction of visitor. To increase more facilities of research for saving the nearly extinct animals. To foster the zoo education and increase and conservation. To disseminate the **technology** acquired from the foreign zoo consultant to local zoo officials.
4.		**Location of the Project**	:	Dhaka and Rangpur (within the existing Government zoos)
5.	**(a)**	**Estimated Cost of the Project (In lakh Taka)**	:	(I) Total: 11454.50
	(b)	**Location wise cost break down to be attached, herever applicable.**		(II) GOB: *11454*.50 (III) P.A: Nil (IV) Others: Nil
	(b)	**Please mention exchange rate used with date.**	:	N/A
6.		**Location wise cost Break down to be attached.**	:	Total cost for Dhaka Zoo and Rangpur Zoo. **(Attached Annexure-I)**

7. Mode of Financing : (In Lakh Taka)

a. Mode of Financing with Source:

Mode of Financing	GOB (FE)	PA (RPA)	PA source
1	2	3	4
Loan/ Credit	Nil	Nil	N/A
Grant	11385.40 (Nil)	Nil	N/A
Equity	Nil	Nil	N/A
Others (specify)	---	---	---

b. Source of Financing GOB Fund against DPP's Year wise allocations:

(Taka In Lakh)

Whether the priority list of the projects has been made according to available resources in the Fiscal Year - 2010-2011 (If yes, give the sl. No.)	Yearwise GOB fund requirement		Source of required GOB Fund	In case of re-appropriation from other project (s) what will be the impact of that project (s)
	Financial Year	Amount		
No	2010-2011	606.17	Grant	Not applicable
	2011-2012	3097.15		
	2012-2013	1372.57		
	2013-2014	4620.32		
	2014-2015	1758.29		
	Total =	**11454.50**		

8. Project Implementation Period : I. Date of commencement 1/7/2010

II. Date of completion 30/6/2015

9. Components and estimated cost Summary: (Taka in Lakh)

Budget Head	Economic Code	Code Description	GOB	Foreign Aid/ Grant	Grand Total	% of total cost
1	**2**	**3**	**4**	**5**	**6**	**7**
A. Revenue component	**1. Pay and allowances:**					
	4500	Pay for 1 (one) Project Director of Grade-5 and 1 (one) Officer of grade-9. (Appendix-1)	25.95	0.00	25.95	0.22
	4600	Pay for total 30 staffs. Among them 04 (four) for PIU deputed staffs, 7 (seven) for Rangpur zoo newly recruited staffs and 19 (nineteen) for Dhaka zoo newly recruited staffs. (Appendix-1)	93.95	0.00	93.95	0.82
	4700	Allowances for Project Director, staff of PIU (4 persons) and newly recruited zoo staffs and Officer (20 persons), (Appendix-1)	116.91	0.00	116.91	1.02
		Sub-Total =	**236.81**	**0.00**	**236.81**	**2.26**

Budget Head	Economic Code	Code Description	GOB	Foreign Aid/ Grant	Grand Total	% of total cost
1	**2**	**3**	**4**	**5**	**6**	**7**
	2. Supplies and Services:					
	4801	TA/DA, Lump-sum both for Dhaka and Rangpur zoo.	20.00	0.00	20.00	0.17
	4813	CDST and VAT	50.00	0.00	50.00	0.43
	4815	Telephone installation	0.10	0.00	0.10	0.00
	4816	Telephone Bill: @ tk. 1000.00 per month for r PIU.	0.60	0.00	0.60	0.00
	4818	Internet Bill, 5 yrs for PIU, Dhaka zoo and Rangpur zoo, tk. 1000.00 per month for each institution.	1.80	0.00	1.80	0.01
	4823	Motor cycle, Pickup and Jeep fuel cost	20.00	0.00	20.00	0.17
	4829	Research on different areas of zoo animal	200.00	0.00	200.00	1.74
	4833	Advertisement Publication	5.00	0.00	5.00	0.04
	4840	Overseas training for Animal Caretaker and other sub technical staff 100 persons.	200.00	0.00	200.00	1.74
	4840	Overseas training for zoo officers and skill development of DLS officers including the training of Project Director (20 officers).	200.00	0.00	200.00	1.74
	4842	4 (four) Work shop/ Seminar	8.00	0.00	8.00	0.06
	4852	Chemicals and reagents, L.S. (Appendix-2)	50.00	0.00	50.00	0.43
	4867	Cost for Animal procurement including air freight. (Appendix-3).	1548.09	0.00	1548.09	13.51
	4868	Veterinary equipments for Zoo Veterinary Hospital (3 sets for Dhaka and 1 set for Rangpur). (Appendix-4)	75.00	0.00	75.00	0.65
	4874	Zoo Consultant (International), 12 (twelve) man month. (Appendix- 5).	60.00	00.00	60.00	0.52
	4874	Zoo Consultant (National), training, research and data management, 6(six) man month.	12.00	0.00	12.00	0.10

	4874	Zoo Consultant (National), disease monitoring, 6 (six) man month.	12.00	0.00	12.00	0.10
	4874	Consulting Engineer's fee for zoo civil work (2% of 7349.60 lakhs).	147.00	0.00	147.00	1.28
	4883	Honourium/ Fee for different committee for PIU, L.S. 1.00 lakh per year.	5.00	0.00	5.00	0.04
	4898	Mid term evaluation at 3rd and 5th yr. of project.	4.00	0.00	4.00	0.03
	4899	OCC and other cost like Stationary, Seal and Stamps for PIU office including both Dhaka and Rangpur zoo.	17.00	0.00	17.00	0.14
		Sub-total =	**2635.59**	**0.00**	**2635.59**	**23.00**

Budget Head	**Economic Code**	**Code Description**	**GOB**	**Foreign Aid/ Grant**	**Grand Total**	**% of total cost**
1	**2**	**3**	**4**	**5**	**6**	**7**
	3. Repairing and maintenance:					
	4901	Motor cycle, Pickup, Jeep maintenances, re-newels and fitness cost.	20.00	0.00	20.00	0.17
	4926	Repairing and maintenance of Existing zoo Residential structures -3000 sqm, for Dhaka zoo.	150.00	0.00	150.00	1.30
	4931	Modernization of Zoo museum with preservatives and maintenances of Existing animal stuffs of Dhaka zoo.	100.00	0.00	100.00	0.87
	4931	Modernization of Feed godwon of Dhaka zoo, 500 sqm	27.50	0.00	27.50	0.24
	4991	Repairing and maintenance of Existing Zoo cages -10000 sqm for Dhaka zoo.	200.00	0.00	200.00	1.74
		Sub-total =	**497.50**	**0.00**	**497.50**	**4.34**
		Total for A (1+2+3) =	**3369.90**	**0.00**	**3369.90**	**29.41**

Budget Head	Economic Code	Code Description	GOB	Foreign Aid/ Grant	Grand Total	% of total cost
1	**2**	**3**	**4**	**5**	**6**	**7**
	B.1. Capital component :					
	6807	Jeep, 1 (one) number for PIU	45.00	0.00	45.00	0.39
	6807	Pick up (Double Cabin), total 3 numbers, (1 for Rangpur zoo and 2 for Dhaka zoo.	90.00	0.00	90.00	0.78
	6807	Truck as animal carrier convertible for normal carriage and animal carriage, 1 (one) number for Dhaka Zoo.	90.00	0.00	90.00	0.78
	6807	Motor Cycle (100cc), 15 numbers, 1 for Rangpur zoo and 14 for Dhaka zoo.	20.00	0.00	20.00	0.17
	6812	CCTV camera, wire, booster etc, 4 sets for Dhaka zoo.	10.00	0.00	10.00	0.08
	6814	Air Cooler 1.5-2.5 ton (Split Type), 5 numbers, 1 for PIU, 1 for Rangpur zoo and 3 for Dhaka zoo.	5.00	0.00	5.00	0.04
	6814	Refrigerator, 280 liters, 10 (ten) numbers, 2 for Rangpur zoo and 8 for Dhaka zoo.	5.00	0.00	5.00	0.04
	6815	Computer, Printer, Scanner UPS, Voltage Stabilizer etc. and Computer Table, (2 sets for PIU, 18 sets for Dhaka Zoo and 2 sets for Rangpur Zoo).	22.00	0.00	22.00	0.19
	6815	Laptop, Multimedia Projector and related accessories, 1 (one) set for PIU, 1 (one) set for Dhaka Zoo and 1 set for Rangpur Zoo @ tk. 1.50 lakh per set.	4.50	0.00	4.50	0.03
	6815	Equipments for Children parks, L. S. both for Dhaka and Rangpur zoo.	250.00	0.00	250.00	2.18
	6817	Networking and Internet System at Dhaka and Rangpur Zoo including PIU office.	10.00	0.00	10.00	0.08
	6827	Photocopier with related accessories, 1 (one) set for PIU office, 1 (one) set for Dhaka zoo and 1 (one) set for Rangpur Zoo.	7.50	0.00	7.50	0.06

	6827	Fax machine with related accessories, 1 (one) set for PIU office, 1 (one) set for Dhaka zoo and 1 (one) set for Rangpur Zoo.	0.75	0.00	0.75	0.00
	6851	Wheel Paddle boat for lake, 25 boats (20 numbers for Dhaka zoo and 5 for Rangpur zoo).	62.50	0.00	62.50	0.54
	6845	Cost for Tree and Tree plantation both for Dhaka and Rangpur zoo.	20.00	0.00	20.00	0.17
	6851	Bi-cycle, 25 numbers. (20 for Dhaka zoo and 5 for Rangpur Zoo).	1.25	0.00	1.25	0.01
	6851	Rickshaw van: total 7 numbers, 5 for Dhaka zoo and 2 for Rangpur zoo.	1.00	0.00	1.00	0.00
	6851	Hand Traly, 30 numbers (20 for Dhaka zoo and 10 for Rangpur zoo).	9.00	0.00	9.00	0.07
	6821	Office furniture and Furniture including rest house for Dhaka Zoo and Inspection Banglo for Rangpur Zoo, L.S and 1 (one) set for PIU.	60.00	0.00	60.00	0.52
		Sub-total =	**713.50**	**0.00**	**713.50**	**6.22**

Budget Head	**Economic Code**	**Code Description**	**GOB**	**Foreign Aid/ Grant**	**Grand Total**	**% of total cost**
1	**2**	**3**	**4**	**5**	**6**	**7**
	B.2. Capital component (Pre Constructions):					
	7001	Land development of Dhaka zoo north lake	21.50	0.00	21.50	0.18
		Sub-total =	**21.50**	**0.00**	**21.50**	**0.18**
	B.3. Capital component (Construction):					
	7006	Construction of office cum food godown cum inspection Banglo for Rangpur zoo. Food godwon- 120 m2 @ 18000/= tk per m2, Office building- 300 m2 @ 20000/= tk. per m2 and Inspection Banglo 150 m2 @ 20000/= tk. m2.	111.60	0.00	111.60	0.97
	7011	Construction of 6 storied staff quarter with in Dhaka Zoo Residential area, 40 units each - 90 sqm area including stair for Dhaka zoo. 13,333/= Tk. per sqm.	480.00	0.00	480.00	4.19

	7011	Construction of 6 storied Dormitory within Dhaka Zoo Residential area, 100 units each -20 sqm area including stair for Dhaka zoo. Tk. 13400/= per sqm	268.00	0.00	268.00	2.33
	7011	Construction of officers' quarter, 4 storied foundation 2 units at 100 m2 each one (total 200 m2) for Rangpur zoo. Tk. 18000/= per sqm.	36.00	0.00	36.00	0.31
	7011	Construction of 6 units Dormitory for staff of Rangpur zoo 20 m2 for each unit. (Total for 6 units =120 m2). Tk. 18000/= per sqm.	21.60	0.00	21.60	0.18
	7016	3 storied parking spaces/ garage with 6 storied foundations (3X500 sqm) for Dhaka zoo. Tk. 17467/= per sqm	262.00	0.00	262.00	2.28
	7016	Modernization of shop around the zoo parking area of Dhaka zoo.	132.00	0.00	132.00	1.15
	7016	Construction of Visitor's shed, Restaurant, Bank and Auditorium at Zoo parking area 6 storied foundations 2x250 sqm for Dhaka zoo. Tk. 31,600/= per sqm.	158.00	0.00	158.00	1.37
	7016	Construction of Zoo Research and Education centre, Guest house 6 storied foundation 3x250 sqm for Dhaka zoo. Tk.34,933/= per sqm.	262.00	0.00	262.00	2.28
	7016	Construction of 25 number Visitor sheds (size of each shed is 20 sqm) within Zoo (20 at Dhaka zoo and 5 at Rangpur Zoo). Costing 6.55 lakhs tk. for each sheds. Tk. 32,750/= per sqm.	163.75	0.00	163.75	1.42
	7016	Construction of Toilet for visitor with refreshing arrangement (300 sqm for Dhaka Zoo and 150 sqm for Rangpur Zoo). Tk. 17467/= per sqm.	78.60	0.00	78.60	78.60

	7016	Re -Construction of Zoo boundary wall including barbed wire fencing for Dhaka zoo.	262.00	0.00	262.00	2.28
	7016	Construction of Semi natural Animal/Birds /Butterfly shed with in Dhaka Zoo.	1310.00	0.00	1310.00	11.43
	7016	Construction of 2 (Two) number of Tiger Moat for Rangpur Zoo at the size of 300 m2 each one, Total 600 m2. Tk. 13,108/= per sqm.	78.65	0.00	78.65	0.68
	7016	Construction of 2 (Two) number of Lion Moat for Rangpur zoo at the size of 300 m2 each one, Total 600 m2. , Tk.13000/= per sqm.	78.00	0.00	78.00	0.68
	7016	Construction of 1 (one) number of Bear Moat for Rangpur zoo at the size of 150 m2, Tk.13000/= per sqm.	19.50	0.00	19.50	0.17
	7016	Construction of 1 (one) number of Hyena Moat for Rangpur zoo at the size of 75 m2, Tk.13000/= per sqm.	9.75	0.00	9.75	0.08
	7016	Construction of 1 (one) number of Chita Tiger Moat for Rangpur zoo at the size of 300 m2, Tk.13000/= per sqm.	39.00	0.00	39.00	0.34
	7016	Construction of 1 (one) number of Snake Shed for Rangpur zoo at the size of 300 m2, Tk 10,000/= per sqm.	30.00	0.00	30.00	0.26
	7016	Construction of 1 (one) number of Hippopotamus shed for Rangpur zoo at the size of 75 m2, Tk.13000/= per sqm.	9.75	0.00	9.75	0.08
	7016	Construction of 1 (one) number of Crocodile shed for Rangpur zoo at the size of 100 m2., Tk 10,000/= per sqm..	10.00	0.00	10.00	0.08
	7016	Construction of 1 (one) number of Ghorial cage for Rangpur zoo at the size of 100 m2, Tk 10,000/= per sqm.	10.00	0.00	10.00	0.08
	7016	Construction of Monkey case for Rangpur zoo at the size of 370 m2, Tk 10,000/= per sqm.	37.00	0.00	37.00	0.32

	7016	Construction of Baboon case for Rangpur zoo at the size of 75 m2, Tk 10,000/= per sqm.	7.50	0.00	7.50	0.06
	7016	Construction of Auditorium for Rangpur zoo at the size of 370 m2, tk. 20,000/= per sqm.	74.00	0.00	74.00	0.64
	7016	Construction of quarantine shed for Rangpur zoo at the size of 300 m2, Tk 10,000/= per sqm.	30.00	0.00	30.00	0.26
	7016	Slaughter House for Rangpur Zoo at the size of total 20 m2, Tk 10,000/= per sqm.	2.00	0.00	2.00	0.01
	7016	Vertical extension of boundary wall 5000 sft/ 3.5 ft height, total 1525 RM. for Rangpur zoo., Tk.2000/= per RM.	30.50	0.00	30.50	0.26
	7016	Construction of Restaurants within Dhaka Zoo, 4 numbers each 250 sqm area with 500 sqm lawn, Tk. 26,300/= per sqm.	263.00	0.00	263.00	2.29
	7047	Installation of 2 numbers Deep tube well for Dhaka zoo.	60.00	0.00	60.00	0.52
	7047	Installation of 1 (one) number Deep tube well with service pipe line for Rangpur zoo including construction of an overhead tank.	30.00	0.00	30.00	0.26
	7056	Installation of Digital Display at main entry gate of Dhaka zoo.	65.50	0.00	65.50	0.57
	7081	Construction of internal Road, Boundary wall for residential area at Dhaka zoo.	131.00	0.00	131.00	1.14
	7081	Construction of 1 (one) Fowara at main entry gate and 3 (three) Fowaras at inside the zoo premises with all kinds of civil works for Dhaka zoo. Tk. 131.00 lakh per fowara.	524.00	0.00	524.00	4.57
	7081	Modernization of existing Parking area for Dhaka zoo.	131.00	0.00	131.00	1.14
	7081	Installation of Mural of rare species animal within two zoos. (20 species moral for Dhaka Zoo and 20 moral species for Rangpur Zoo). Tk. 1.625 lakh per moral.	65.00	0.00	65.00	0.56

	7081	Modernization of Zoo children park with modern sheds and equipment in both Dhaka and Rangpur.	543.00	0.00	543.00	4.74
	7081	Construction of Internal Road around north side Zoo boundary wall (20000 sqm for Dhaka zoo and 5000 sqm for Rangpur zoo), Tk.1315/= per sqm.	328.75	0.00	328.75	2.87
	7081	Construction of Suspension bridge over the lake within Dhaka Zoo.	264.00	0.00	264.00	2.30
	7081	Construction of parking area at west side of Dhaka Zoo (River side) with fancy boundary wall, Lawn, Ticket counter, complete in all respect.	265.00	0.00	265.00	2.31
	Sub-total for construction =		**6681.45**	**0.00**	**6681.45**	**58.33**
	B.4. Capital component (Construction):					
	Escalation cost 10% of total construction		668.15	0.00	668.15	5.83
	Total for construction (B.3 + B.4) =		**7349.60**	**0.00**	**7349.60**	**64.16**
	Grand Total for capital component (B.1 to B.4) =		8084.60	0.00	8084.60	**70.58**
	Grand total for the project (A + B) =		**11454.50**	**0.00**	**11454.50**	**100**

10. Log frame:

I. Planned date for project completion: 30 th June 2015.
II. Date of summary preparation: 25 th April 21, 2010.

	Narrative Summary	**Objectively Verifiable Indicators(OVI)**	**Means of Verifications (MOV)**	**Important assumption**
Project goal:				
	Development and modernization of Dhaka and Rangpur zoo for wild life conservation, research, education, breeding and amusement.	Modernization Research, Education, Breeding and Amusement, Manpower development and Ecology	Economic review, Evaluation Report, progress Report.	
Project Purpose:				
1	Development and modernization Dhaka and Rangpur zoo by Infrastructural Development.	Modernization of zoo	IMED report, Project Evaluation annual report	Other economic factors are remaining at desired level.
		Increase amusement		
2	Manpower development by Training and Education	Development of skill ness		Natural disaster will no disrupt the activities
3	Development of different technologies and improvement of efficiency of Scientist and other professionals.	Transfer of Technologies		
4	Establishment of Research and education Institute	Wild life Preservation and breeding.		
5	Establishment of Veterinary Hospital and Modern pathological laboratories in Dhaka zoo.	Disease diagnosis and treatment.		
		Feeds and fodder analysis.		
6	Collection of Wild animals, preservation and breeding at the zoo premises.	Increase preservation of wild life and breeding		
7	Development of awareness of the	Aware the people about wild life and		

	people and its technologist about wild life conservation.	zoo activities.		
	Out puts :			
1.1	Development and Modernization Dhaka and Rangpur zoo by Infrastructural Development and by collection of more wild animal.	Infrastructural Development by the year -2015	IMED report, Project Evaluation annual report	Other economic factors are remaining at desired level.
		Collection of Wild animal by the year -2015		
			Field verification	
			Project Director office.	
1.2	Wild animal procurement.	Collection of rare species Wild animal by the year -2015		
1.3	Development of Research and Technologies for wild life behavior, health management, feeds ands and fodder, Development of hospital and pathological lab and improving of efficiency of Scientist and other professionals. Feeds and fodder lab, Capacity Development of scientist and Professionals.	Inter organizational Coordination and training from abroad by the year 2015.		
	Input activities:			
1	Establishment of Inter organizational coordination among Universities, BLRI, DLS according to the work plan furnished in the DPP> Research and education Institute.		Project Management records.	Timely formation of committee.
2	Recruitment of Project Personnel	Disease diagnosis and treatment.	Office file, DPP	
3	Development of Land	North lake side developed.		

4	Infrastructural development	Increase preservation of wild life and breeding		
5	Establishment of Research and Education Institute			
6	Establishment Veterinary hospital and pathological Lab.			
7	Establishment Nutritional Lab.			
8	Procurements of animals and birds			
9	Training of officer and staffs			
10	Appointments of consultant			
11	Procurements of Instruments and equipment			
12	Conduct study on animals and birds.			
13	Development of disease control measures.			
14	Public motivation to make awareness about wild life.			
15	Research and education			
16	Wild animal breeding			
17	Feeds and fodders			
19	Development of awareness of the people and its Technologist about wild life conservation.			

11.	(a) Attach Proposed Management setup	:	Attached Annexure- II
	(b) Attach Procurement Plan	:	Attached Annexure- III (a) and III (b)
12.	Give year wise financial and physical target plan.	:	Attached Annexure-IV
13	After completion, whether the Project needs to be transferred to the Revenue budget	:	No, no need any extra budget from revenue head, simply the assets of the projects will be handed over to the Department of Livestock Services. The existing revenue man power of the department and the usual budgetary provision is enough to maintain the project assets after completion.
	If yes, briefly narrate the institutional arrangement and financial requirement for operation and maintenance	:	

Signature, name and designation of officers
Responsible for the preparation of the project

(Signature)	**(Signature)**	**(Signature)**
Asstt. Engineer	Scientific Officer	Livestock Statistical Officer
Department of livestock Services	Livestock Economic Section	Livestock Economic Section
	Department of livestock Services	Department of livestock Services

PART – B

PROJECT DETAILS

14 Back ground, Objectives, rationale, Linkage, targets and out puts/inputs of the project including findings of feasibility study/ Survey (if any):

Dhaka zoo is one of the largest recreation places at Dhaka city. Many people from both home and abroad have keen interest and endeavor towards Dhaka Zoo. This zoo also a conservation place of wild animal, Zoo education program, Breeding up of animal and birds. It was established in 1974, but so far any program for its modernization yet been taken. As a result of old type of structure with inadequate spaces facilities and management still exist. On the other side, Rangpur zoo is the most important recreation center for the northern part of our country. After establishment of this zoo, there is no development work done at this zoo. Due to sufficient accommodation spaces for animal and lack of adequate repairing and maintenance of zoo animal cages, management and zoo animal handling is in a great threatened at Rangpur zoo. Almost all other zoos in the world has transformed in to semi-natural cages for better animal health and environment, But Dhaka and Rangpur Zoo still remaining lack of this opportunity. It is imperative to modernize the Dhaka Zoo with proving semi-natural living accommodation and to create an optimum standard environment for Rangpur zoo.

The Children park within Dhaka zoo has no modern gaming tools and equipment. It needs infrastructural development to attract the visitors in the light of modern Children Park.

Dhaka zoo has 2 (two) big lakes. On is around 36 acres and other is 20 acres. On the other hand, Rangpur zoo has also a lake 8 (eight) acres. If there provide pedestal boat in the lake, more visitors will come to enjoy the boat driving in both Dhaka and Rangpur zoo. This system to be stopped during winter season for migratory birds-for three month like November, December and January.

If suspension bridge can be constructed over the lake, huge number of visitors will come to enjoy the natural view of Dhaka zoo.

In the bank of Lake, Plaza can be constructed with covered shed to enjoy the natural beauty of lake visitors of all level will come in zoo during there leisure period.

If the proposed project can be executed, there will be a firm reason to belief that the present revenue income from Dhaka zoo will increase enormously.

Project activities:

Construction works: Land development will be done only at the north lake of Dhaka zoo in a very few amount. Residential dormitory, staff quarter, officers' quarter construction both for Dhaka and Rangpur zoo. Repairing and maintenances

of existing residential and zoo infra structure (animal cages) of Dhaka zoo, some new animal cages are to build in both the Dhaka and Rangpur zoo. Internal roads to be build in both the zoos. Public toilet, guard shed, visitor's sheds are to be proposed to build in this project. Parking area, research centre and canteen to be built smartly in the Dhaka zoo. Suspended bridge is to be proposed to build in the Dhaka zoo. Provision of paddle boats both for rangpur and Dhaka zoo lake are included into the project. The storied building for store cum office cum inspection banglo is to be build through this project for Rangpur zoo, because from very beginning no office was built in this zoo. The very old structure of the then horticulture department has been using as office building for Rangpur zoo. The animal cages are very small and narrow in size, where the animals are seriously and very badly confined in the little space. For easy movement and comfort of animals, there needs to build some standard sizes of cages in Rangpur zoo and budgetary provision for animal cage construction is incorporated in this project. For easy entrance to the Dhaka zoo, it is proposed to build a new approach entry gate at the west side of the north lake. Repairing the canteen of Rangpur zoo and new construction of few canteens at the Dhaka zoo are proposed to build in this project. Moral of different rare species zoo animals are to be built through this project for both the zoos. Some Fowaras are established in the Dhaka zoo.

Office equipment, stationary material, furniture: 22 sets of decks top computer and 3 sets of lap top computers including other accessories, multimedia projector, 3 sets of photocopier and fax machines (1 for Rangpur and 2 for Dhaka zoo), furniture for Dhaka zoo rest house and Rangpur inspection banglo is included to procure in this project. Internet Modem including connection, LAN works both for Dhaka and Rangpur zoo are proposed in this project. Some equipment for zoo animal treatment (one set for Rangpur and 2 sets for Dhaka zoo) and some chemical and reagents to be purchased from this project for both of these zoo. (Appendix -2 and 4). The children park of both the zoos is to be well equipped for child's attraction. In both the zoo's children park, there is no equipment for playing of children. There is a provision of budget at this project to provide the modern equipments for these zoo's children parks.

Vehicles and transport: One jeep, 3 double cabinets pick up (one for Rangpur and 2 for Dhaka zoo), 15 motor cycles for both Rangpur and Dhaka zoo are proposed to procure in this project. Jeep will be procured for Project Director for supervision of the project activities in both Dhaka and Rangpur Zoo. Vehicle purchase cost including fuel, renewal charges and maintenance cost are estimated in the proposal. 25 bi-cycles are to be purchased for the staffs of both the zoo and 7 (seven) Rickshaw van will be purchased through this Project for carrying the various goods within the zoo premises of both zoos.

Manpower: Among the total **32** man powers proposed in this project, officer and staffs of PIU are **5** in number and are proposed to be deputed from DLS with full

time to this project. Including 1(one) officer a total number of **8** man powers are proposed to be newly recruited for Rangpur Zoo and for Dhaka zoo a total number of **19** staffs are proposed to recruit newly for Dhaka zoo through projects.

Man power for Project Implementation Unit (PIU): A project implementation unit will be formed in the DLS Head Quarter. PIU will be consisted of a Project Director (a senior, experienced and dynamic 5th grade officer will be deputed from DLS by Ministry of Fisheries and Livestock. Accountant- 1, Computer Operator- 1, Driver- 1, MLSS- 1 will be deputed by DLS to the PIU to help the Project Director for smooth running the project activities. (Total manpower = 5 nos. deputed from DLS for PIU). The deputed personnel from DLS will get Pay and Salary, TA/ DA and all other admissible allowances and benefits from the proposed project.

Newly recruited Manpower:

For Dhaka zoo: The existing and proposed man power of Dhaka zoo is shown in the following table.

Sl no.	Name of the post	Number of sanctioned post	Proposed in the Project	Remarks
1	Curator	1	---	Class-1
2	Deputy Curator (Admin)	1	---	Class-1
3	Deputy Curator (Animal Survey)	1	---	Class-1
4	Animal Nutrition Officer	1	---	Class-1
5	Veterinary Surgeon	1	---	Class-1
6	Scientific Officer	1	---	Class-1
7	Zoo Officer	1	---	Class-1
8	Publicity Officer	1	---	Class-1
9	Officer-in-Charge Museum	1	---	Class-1
10	Administrative Officer	1	---	Class-2
11	Security Supervisor	1	---	Class-2
12	Accountant's Officer	1	---	Class-2
13	Computer Operator cum Office Asstt.	---	1	Class-3
14	Accountant.	---	1	Class-3
15	Taxidermist	1	---	Class-3
16	Garden over share	1	---	Class-3
17	Head Assistant	1	---	Class-3
18	Steno typist	1	---	Class-3
19	Painter cum Artist	1	---	Class-3
20	Arboriculturist	1	---	Class-3
21	Store superintend	1	---	Class-3
22	Photographer	1	---	Class-3
23	Compounder	1	---	Class-3
24	Accountant	1	---	Class-3
25	Upper Division Assistant	3	---	Class-3
26	Electrician	1	1	Class-3

27	Assistant Electrician	2	---	Class -4
28	Store keeper	1	1	Class-3
29	Record keeper	1	---	Class-3
30	Casher	1	---	Class-3
31	Account Assistant	1	---	Class-3
32	Information Assistant	1	---	Class-3
33	Billing Assistant	2	---	Class-3
34	Office Assistant cum Typist	4	---	Class-3
35	Supervisor for ladies garden, children Zoo	1	---	Class-3
36	Driver	3	1	Class -3
37	Carpenter	1	1	Class -3
38	Booking Assistant	4	---	Class -4
39	Blacksmith	2	---	Class -4
40	Masson	1	1	Class -3
41	Duplicating Machine operator	1	---	Class -4
42	Dresser	1	---	Class -4
43	Plumber	1	1	Class -3
44	Pump driver	3	---	Class -4
45	Ferrier (ফেরিয়ার)	1	---	Class -4
46	Snake caretaker	2	---	Class -4
47	Mahut (মাহুত)	6	---	Class -4
48	Cart men	1	---	Class -4
49	Head Soarder (হেড সর্দ্দার)	1	---	Class -4
50	MLSS	8	2	Class -4
51	A.C.T	57	---	Class -4
52	Attendant	7	2	Class -4
53	Laboratory Attendant	1	---	Class -4
54	Store Attendant	2	---	Class -4
55	Coock	2	---	Class -4
56	Chef (বাবুর্চি)	1	---	Class -4
57	Guard	19	---	Class -4
58	Gate keeper	20	---	Class -4
59	Gardener	14	---	Class -4
60	Sweeper	7	1	Class -4
61	Door keeper (গেটম্যান)	4	---	Class -4
62	Helper to Plumber	---	1	Class -4
63	Helper to Mason	---	1	Class -4
64	Helper to Carpenter	---	1	Class -4
65	Welder	---	1	Class -4
66	Helper to Welder	---	1	Class -4
67	Helper to Electrician	---	1	Class -4
		210	**19 (Nineteen)**	

19 (Nineteen) number of newly recruited man power is proposed in this project for smooth running of the Dhaka zoo operation.

For Rangpur zoo: The existing and proposed man power of Rangpur zoo is shown in the following table.

Sl no.	Name of the post	Number of sanctioned post	Proposed in the Project	Remarks
1	Deputy Curator	1 (one)	---	Head of institute
2	Zoo-officer	1 (one)	---	
	Veterinary Surgeon	---	1 (one)	
	Veterinary Compounder	---	1 (one)	
3	Head Assistant	1 (one)	---	
4	Office Assistant	1 (one)	---	
	Computer Operator	---	1 (one)	
	Driver	---	1 (one)	
5	Carpenter	1 (one)	---	
6	Gardener	2 (two)	---	
7	Guard	6 (six)	2 (two)	
8	M.L.S.S.	2 (two)	---	
9	Animal Care Taker	2 (two)	---	
	Sweeper/Cleaner	---	2 (two)	
Total =		**17 (seventeen)**	**8 (eight)**	

The area of Rangpur zoo is 22.27 acres of land. Different species of valuable zoo animals are kept in the zoo. There is no sanction of post for Veterinary Surgeon, Veterinary Compounder, computer Operator, Driver and Sweeper/Cleaner since it was established. The number of Guard sanctioned post in this zoo are also very insufficient for safe and regular operations. For regular hygienic and veterinary care with sick animal treatment, man power like Veterinary Surgeon and Veterinary compounder is a must for a zoo. For smooth and fruitful operation of Rangpur zoo 1 (one) Veterinary Surgeon, 1(one) Veterinary compounder, 1 (one) Office Assistant cum Computer operator, 1 (one) Driver, 2 (two) Gaurds, 2 (two) Sweepers (a total number of 8 newly recruited man power are proposed for Rangpur zoo in this project.

Pay -salaries and all kinds of allowances for newly recruited man power of Dhaka and Rangpur zoo are estimated for 5 years of the project periods.

National and International consultant: There is provision of three consultants in this project. One international zoo consultant for 12 man months, one national zoo consultant (training) for 6 man months and one national zoo consultant (zoo animal disease) for 6 man months. The qualification, terms and references are enclosed **(Appendix- 5).**

Miscellaneous expenditure related with the project activities would be made from various component of estimated cost Summary section-9.

Project Evaluation and Monitoring: To evaluate the project activities, at least two evaluations and monitoring will be made by the proposed monitoring committee. One in

3rd year and other in 5th year to follow up the progress of the project. After completion of the project, a final report will be submitted to the ministry by the committee.

15	**Whether any pre appraisal/ pre-investments study was done before formulation of this project?**	**:**	Pre-appraisal/ pre-investments study was not done to formulate this project proposal. However, the proposed project has been prepared on the basis of the international standard and with our country limitation.
16	**If so, attach summary of findings and recommendations if terms of mentioning the following:**	**:**	
	a. Net present value (NPV)	:	
	(i) Financial	:	N/A
	(ii) Economical	:	N/A
	b. Benefit Cost Ratio (BCR)	:	
	(i) Financial	:	N/A
	(ii) Economical	:	N/A
	c. Internal Rate of Return (IRR)	:	
	(i) Financial	:	N/A
	(ii) Economical	:	N/A
17	**Lesson learnt from the similar nature of projects**	**:**	Previously some cages of animals were constructed in 1974 by PWD. But those concepts are obsolete now a day. Most of the zoo now has semi-natural cages. Present project proposes some animal cage as semi-natural type. The model of those cages can be constructed after verifying other international zoo of the World. For this, a high power construction supervision committee

will be formed. The committee will recommend the structural Planning and drawings and will receive the structures after completion. The committee will visit some zoos of international level of standard in the world as well neighboring country like India, Nepal, Srilanka, Singapur.

18 Indicates the basis of total and item wise cost estimate and the date of preparation of rate schedule:

Sl no	Items of works	Basis	Date of preparation
1.	Construction	PWD-2009-2010	March 2010
2.	Machinery and equipments	Existing market price and projects	March 2010
3.	TA/DA/Fuel	As per government rules	March 2010
4.	Others	Existing market price	March 2010

19 Give Comparative cost of major items of similar other projects:

	Sl no	Name of Project	Date of Completion	Name of major items	Unit /Cost (In Lakh taka)
	1	Proposed project	30.06.2010	As per Para sl. no. -9	PWD-2009-2010
	2	Similar Completed project	N/A		PWD-1974-2002= 2100.00
	3	Similar ongoing project	N/A		

Attached detailed annual phasing of Cost **:** Attached (Annexure- v)

Specification/ design of major components (attach, if possible) **:**

Justify whether the most cost-effective method has been selected in case of project whose benefit are difficult to quantify. **:** N/A

Briefly describe the effect/impact and specific mitigation measures there of (if any on) **:**

(i) Other projects/ existing installations **:**

The existing infrastructure, other amusement facilities and conservation, education and research about wild animals will be strengthened.

(ii) Environment like land, water, air bio-diversity etc. **:**

There will no adverse effect on land, water and bio-diversity. Besides the recent project will enhance to keep the environment friendly and maintain air bio-diversity.

(iii) Women and children:	The project will influence and improve the psychological behavior of the nature for women and children.
(iv) Employment alleviation etc:	Not necessary
(v) Institutional Productivity:	The project will establish the inter-organizational collaboration system among different agencies. After successful running of the project, this will help the common people and enrich the conservation technologies of the students and other academicians increase the skill ness of employees.
(vi) Regional disparity:	The proposed area of operation is very much prone to natural disasters almost every year. The project intervention will curve the regional disparity of development.

Specific linkage with PRS and MDGs (in terms of number and percentage of policy matrix of PRSP)	N/A
Whether private/Local Govt. or NGOs participation was considered? Describe how they will be involved.	Local consultant who worked for long time at Dhaka zoo will render their service how the present situation can be improved more in the light of Bangladesh atmosphere.
In case of foreign Aided Project mention the major conditionality	N/A

Does the project involve rehabilitation resettlement? If so indicate the magnitude and cost	No
Identify risks during implementation, operation and mitigation measures there of.	N/A
Risk :	1 Unavailability of equipment. 2 Difficulties in import of animal and birds. 3 Difficult to ensure health and age of wild animals 4 Delay in allocation of fund can raise the project Cost. 5 Possible price hike of Animals may delay in implementing the Project.
Mitigation:	Just time project official appointment, Appropriate measure in animal procurement, as per procurement plan construction works may reduce the project Cost Delay in allocation of fund can raise the project Cost.
Any other important details Technical or Otherwise eg. Sustainability, Governance, Steering committee, Project Implementation Committee etc.	In Bangladesh amusement place is not enough for common people. Dhaka has some amusement places where people pass the time with their family. Zoo is one of them where people of all level can enjoy together. Dhaka Zoo was established at Mirpur in the early of 1974. With the passes of times, concept of Zoo has changed. It can be treated as Research place, Conservation place, Education centre as well as amusement park. A Project Steering Committee will be established to conduct the project smoothly. The Committee will meet one in every year to monitor and evaluate the project activities.

For animal procurement from the abroad, some foreign money will be needed. Rather foreign consultant experienced in zoo management, animal behavior provision has been kept.

A Project Technical Committee comprising representative from university, DLS, BLRI will be formed. The technical Committee will provide technical guideline for implementing the program. The Committee will meet every six month or when ever required and review the program made and decision regarding implementation aspects of the Project.

All the construction work specially the model of cages can be constructed after verifying other international zoo of the World. For this, a high power Construction Supervision Committee will be formed. The committee will recommend the structural Planning and drawings and will receive the structures after completion. The committee will visit some zoos of international level of standard in the world as well neighboring country like India, Nepal, Srilanka, Singapur or others in the world.

Signature of the head of the Executing Agency
with seal and date

Recommendation and Signature of the Secretary
of the Sponsoring Ministry/Division with seal and date