

THE ASIAN ELEPHANT IN THE NILGIRI BIOSPHERE RESERVE

Aspects of its conservation biology explained

Jean-Philippe Puyravaud



Copyright © 2012 United States Fish and Wildlife Service.
Permission is granted to copy, distribute and / or modify this document.

Note: A color copy of this book is available on the website: **www.ecostrust.org**

About the author: Dr. Jean-Philippe Puyravaud is an ecologist and director of ECOS, a trust dedicated to conservation of biodiversity. He resides in India, collaborates on projects in conservation biology, and teaches postgraduate students at Pondicherry University.

Cover picture: A view from the Mukurthi National Park (J.-Ph. Puyravaud).

Back Cover picture: J.-Ph. Puyravaud.

Design: Gopinath S., TURNSTONE DESIGN.

This is the publication #1 of the project "Elephant habitats of the Nilgiri Biosphere Reserve: location, threats and management" funded by the Asian Elephant Conservation Fund of the United States Fish and Wildlife Service.

CONTENTS

1.	Acknowledgements	i
2.	Introduction	1
3.	The Asian elephant	7
4.	Description of the Asian elephant	7
5.	Classification	10
6.	Geographical Range	13
7.	The Ecology of the Asian elephant	17
8.	The population of the Asian elephant	19
9.	Elephant Intelligence	23
10.	Threats	26
11.	Protecting biodiversity	28
12.	Why should we protect species such as the elephant?	28
13.	How to protect species?	31
14.	Population viability	33
15.	The human - elephant conflict	35
15.	The Nilgiri Biosphere Reserve	40
16.	The Nilgiris	40
17.	Description of the Nilgiri Biosphere Reserve	42
18.	The NBR and its economy	45
19.	Schools in the NBR	48
20.	Curriculum (part)	50
21.	Your elephant project	54
22.	Elephants are friends, but...	56
23.	Tears of Love	58

Acknowledgements

This booklet is one of the outcomes of the project “Elephant habitats of the Nilgiri Biosphere Reserve: location, threats and management” funded by the Asian Elephant Conservation Fund of the United States Fish and Wildlife Service granted to Pondicherry University, the Tamil Nadu Forest Department and the Nilgiri Wildlife and Environment Association (NWEA). We are extremely grateful to the United States Fish and Wildlife Service for the confidence placed on us. We hope this booklet will convey relevant and interesting information about the biology of the Asian elephant, the problems it faces in the wild and the role of the Nilgiri Biosphere Reserve (NBR) in the conservation of the largest wild population of this endangered species.

We thank Dr. Meenakshi Nagendran, Program Officer, Asian Elephant Conservation Fund for her guidance and patience. Without her understanding, the project and this booklet would never have been possible.

Mr. R. Sunderaraju I.F.S., former Chief Wildlife Warden and Principal Chief Conservator of Forests, Tamil Nadu, and Dr. Rajiv K. Srivastava, I.F.S., Scientific Advisor and presently Joint Director, TANTEA, made this project come about. The present Chief Wildlife Warden, Mr. Rakesh Vasisht, I.F.S., and Dr. Raghuram Singh, I.F.S. Field Director have continued to support us enthusiastically.

When the project was initiated, our team understood that we had to reach a large number of people to help create an understanding for the Asian elephant. Scientific publications even though necessary for conservation,

were not enough to reach a wider audience. Dr. Priya Davidar, Principal Investigator and Professor of ecology at the Pondicherry University has been a constant support throughout the writing of the booklet. Mr. S. Jayachandran, former Honorary Secretary of the Nilgiri Wildlife and Environment Association (NWEA) and Awareness Coordinator, and Ms. Geetha Srinivasan, Vice President NWEA, understood the benefit of such an undertaking and we appreciate their commitment and support.

I am very grateful to Mr. Tarsh Thekaekara, founder of The Shola Trust, and Ms. Teresa Marston for their insights, suggestions and comments on the manuscripts.

Mr. Pratheesh C. Mammen and Mr. M. Rajkumar enthusiastically and generously organized a painting competition (also part of the project) for middle level school children among the tribal and other schools close to and within Mudumalai Tiger Reserve. They were assisted by Mr. W. Lamuel.

I warmly thank the teachers and children who participated to our painting competitions. I should have used all the paintings in this booklet because each represents some amount of affection for the elephant. Unfortunately, this was not possible, because the printed version would have been huge. But I kept all the drawings at home carefully, as a cherished memento of the widespread and innocent interest for the Asian elephant among the young. After the painting competition (where everyone won), half the kids wanted to become conservation biologists: talk about a successful outcome! I thank Ishana Srivastava for contributing a poem.

Some texts were taken from Wikipedia. Like millions of others, I am very appreciative to this generous foundation that help share knowledge. In the same spirit, this booklet can be used freely.

I had to venture into areas that were unfamiliar to me. I tried my best to make the booklet accurate. Any mistake is due to my shortcomings.

Introduction

The Nilgiri Biosphere Reserve (NBR), which lies between the states of Tamil Nadu, Kerala and Karnataka (India), is one of the most gorgeous places on Earth to live in (Figure1). Population density is still low, the air is relatively free of pollution except during the tourist season in summer, and its natural beauty is out of the world. This is why people flock here from Chennai, Bangalore, Cochin and all the megacities of India. A defining feature of the NBR is its large fauna that comprises the Asian elephant, the tiger, the sloth bear, the leopard and the gaur: the “big five” of southern India. The Asian elephant (*Elephas maximus*) on which we focus here, is becoming rarer and rarer and could disappear from the face of the Earth. The largest remaining wild population of the Asian elephant is in the NBR with a total between 5,000 to 8,000 elephants. Although it sounds like a lot, it is fewer than the number of people in an average Indian village. For any species, it is actually very, very small.



Figure1: Location of the Nilgiri Biosphere Reserve (NBR)

Protecting wild elephants and their habitats is a huge responsibility for the inhabitants of the NBR. If we compare similar situations in the United States of America or in Europe, we come to realize that even in affluent countries, large animals are not welcome. The wolf is heavily hunted in the US, whereas the brown bear has virtually vanished from France. It is to India's credit that it has had the wisdom to preserve the wild Asian elephant in spite of fading economic difficulties and a massive human population that increasingly requires land for cities, industry and agriculture.

The elephant is often perceived as an inconvenience. It is huge, dangerous and requires a large area. It tends to stray into fields where it creates havoc, damages properties and sometimes kills people. Why is the elephant such a problem?

There are several reasons related to biology, history and management. First of all the Asian elephant is the largest land animal in Asia. Its requirements in terms of food and territory are huge. It travels long distances to feed, drink and mate. Historically, villages were no hindrance to elephant movements. Villages were tiny and most of the land was "elephant country". Even when the villages' limits were established and mapped together with the reserved forests, village limits had no relevance to ecology. A settlement ended-up somewhere in the jungle where the next settlement was supposed to start. Elephants could roam freely in between villages. Today the villages are bursting and spilling beyond their limits and block the elephants' path. Major tracts of forests have become disconnected. The west of the NBR (Silent Valley and the Wynaad) is cut from the Mudumalai-Bandipur-Satyamangalam continuum. Because of cattle, wood harvest, plant invasion, the elephants' very habitat is damaged, their resources are limited and they look for food and water outside the reserves. The consequences for the elephants and for humans are drastic: the elephant sub-populations are divided and elephants that attempt to cross through human habitations end up creating problems.

As far as I know, there is no large-scale management plan for the NBR. There are conflicting interests and aspirations, many of which incompatible with the objectives of a Biosphere Reserve:

- Many people feel that there are too many elephants in the NBR, others consider there are too few. However, there is little data on how many elephants there really are and which areas they occupy.
- Village administrations consider that buffer zone regulations are as bad as any other regulation.
- Farmers assert that it is their right to grow sugar cane near a protected area.
- Livestock owners want protection from elephants and carnivores, but consider it their right to graze cattle in the national parks – for free.
- For eco-tourist operators NBR translates as “theme park”.
- Teachers don’t see the connection between wildlife on their doorstep and a course in zoology.
- Drivers associate speed limits within a protected area to the maximum speed their vehicle can reach. Wildlife road kills are just collateral damage.
- Tourists either consider wildlife as pets, or alternatively as objects they can throw stones at, shout and harass.
- House owners once they have built their house near a reserve, complain of elephants.
- Administrators at all levels, except in the Forest Department, have very little knowledge of wildlife management.

The risk associated with this chaotic state of affairs is enormous. Opposite and contradictory economic strategies could lead the elephant and the tiger to extinction. In this case the NBR would not be a biosphere reserve any more. It would lose its charm and would no longer be a tourist destination. Lower levels of income would be generated from tourism. The region would turn into another suburb with its surrounding fields from where small and polluted rivers would flow.

All development strategies cannot work together competitively, and choices need to be made. The region cannot be the water tank of three states, one of the main repositories of biodiversity of the Western Ghats, timber, tea, vegetable producer, a major eco-tourist destination, and have the same development strategy as say, Puducherry, a city that is now covered with concrete. The NBR status impacts the economic options the region has.

The NBR is first and foremost, by its definition, a reserve, a biological entity that also encompasses cities, villages and settlements with many different cultures. In theory, it has an objective -sustainable development- that should guarantee long-term coexistence of nature with the local economy. The “long term” survival of the Asian elephant is in harmony with the objectives of the NBR.

Where do we start if we wanted to devise a strategy for regional development? There are guidelines: what nature can locally deliver in terms of services and what it can't. For example the amount of obtainable water, grazing lands and wood production are not infinite. The availability is the final guide to how much can be used. Sustainability would require us to start considering the fundamentals like the geology and the climate, then the ecosystems (soil, forests, grasslands) and species, and finally we would address the human demography and the economy. The objectives of conservation of the elephant would include information on its population, the quality of its habitat, and plan to reduce conflicts with humans. Wildlife management has slowly shifted towards the exact sciences, thanks to various techniques that help better

predict management outcomes. For example, locations that are likely to be raided by elephants can easily be identified.

To be effective, a management plan would superimpose the human dimension with its diversity of cultures, population, fluxes and economy, on the “natural” background to make a strategy emerge, and give a direction to this patchwork of constraints, interests and hopes. It rests on a real dialogue among partners who are ready to negotiate.

Conservation of biodiversity does not stipulate that nature should be isolated and sealed. Conservation’s objectives are rather that, we and our descendants should enjoy a beautiful and healthy environment. The Asian elephant brings tourists and generates income. Everyone in theory could benefit from this situation, in an ethical and professional manner. Elephant rides, elephant shows, elephant interpretation centers could easily be added to the existing set-up in several parts of the NBR. Not to mention the rich tribal heritage, the historical past, the multitude of animals, plants and ecosystems that are a true wealth and a tremendous economic advantage for the region. Conservation biology is not against development but argues for a development that is more integrated and less wasteful.

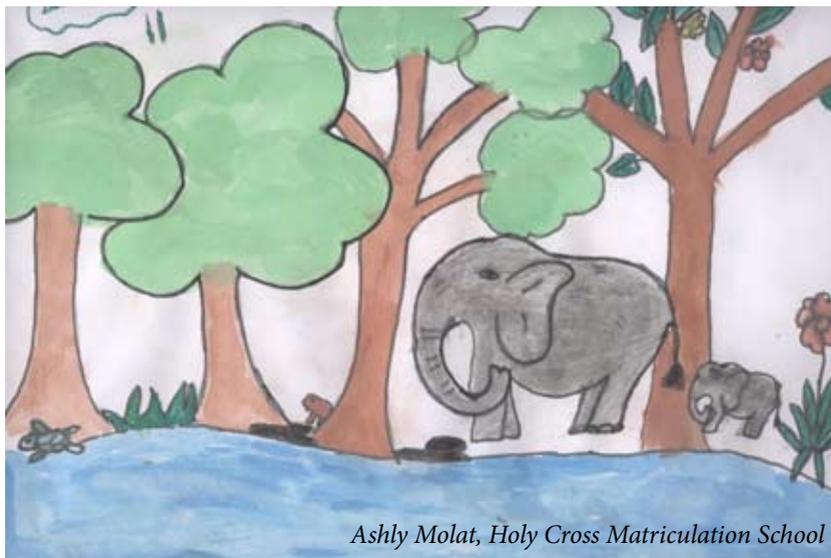
A conservation strategy for the Asian elephant rests on expert knowledge. But in order to understand why experts favor a certain approach, some explanations are needed. This is why, we feel, a booklet such as this one, can explain what we can do and what we can’t do with the elephant. If there is a message from this booklet, it would be: “elephant conservation need not be against development but should be integrated into the development strategy.” And the objective of the book is to introduce the reader to the constraints associated with elephant conservation so that everyone speaks the same language.

This booklet was written for the benefit of the general public including school teachers and young students. Surprisingly, most schools tend to overlook the fact that the protection of India’s biological wealth is of

great importance to the country. It is included in the school syllabus, portion of which is in this publication. Being in the NBR provides an extraordinary opportunity to learn biology. Not only does it provide economic returns, and a relatively better lifestyle, it is also an infinite source of knowledge. The presence of a natural ecosystem and unique wildlife has to become a source of inspiration and pride to teachers and students.

In writing this booklet, I relied heavily on a few websites. I used Wikipedia extensively and the website of the International Union for the Conservation of Nature (IUCN), which was very useful in providing information on elephant populations and the threats they faced. Texts reproduced ad-verbatimim have been clearly marked. Sources I found important have been cited although I preferred not to overburden the reader with references. Teachers and biologists can easily refer to specialized literature if they wish.

It is my hope that this booklet contributes in whatever modest way, to establish a new, peaceful human - elephant interaction in the NBR.



The Asian elephant

Description of the Asian elephant

The Asian elephant is called *Elephas maximus* by scientists who always use the standard Latin names to identify species. The first name (*Elephas*) is the genus and the second name (*maximus*) is the name of the species. The Asian elephant is distributed in Southeast Asia from India in the west to Borneo in the east. The Asian elephant is smaller than the African bush elephant: its back is convex or level, the ears are smaller with dorsal borders folded laterally. All cultures that have come in contact with elephants acknowledge their memory and intelligence.

The Asian elephant is the largest land animal in Asia. Its size, the trunk and tusks make it distinctive. Large bull elephants weigh up to 5,400 kg and attain a height of 3.2 m at the shoulder. Females weigh up to 4,200 kg and adults reach 2.5 m at the shoulder. Humans are large, but when compared to a male elephant they are what a chicken would look to us. The elephant's body mass has direct consequences on its structure. The skeleton constitutes about 15% of its mass, whereas for cattle it is only 10%. Asian elephants are relatively long-lived, with a maximum recorded life-span of 86 years. This is due to the physiology associated with body volume: in general, larger mammals live longer.

The proboscis or trunk consists entirely of muscular and membranous tissues. It is an elongation of the nose and the upper lip combined. It may extend to 2 m and contains as many as 60,000 muscles. The nostrils are at its tip with a single finger-like extension. Elephants use their trunk for breathing, drinking, feeding, touching, dusting, communication, washing, etc. It is such a versatile organ that it can be compared to a human hand.

Tusks are teeth and are made of ivory, the same material found in human teeth. Tusks can be more than a meter long and weight over 30 kg each. Tusks are used for digging for water, to debark trees, as levers for maneuvering fallen trees and branches. But tusks are also effective weapons during combat between males or against any threat. Only males have tusks. Female usually lack tusks; if tusks are present they are called “tushes”, are barely visible, and can only be seen when the mouth is open.

Elephants are herbivores, both browsers (animals feeding on tree leaves) and grazers (animals feeding on grasses). The proportion of different plants chosen varies regionally and seasonally. Fruits, bulbs, leaves, stems, branches and roots are also consumed. Elephants tend to forage on plant types in proportion to their availability. Cultivated crops such as sugar cane, paddy, banana trees, have been improved upon by humans in order to increase productivity. In doing so, these plants have lost some of their natural defenses against herbivores. They have become tender, nourishing, sweeter and grown in large quantities. This is why they are so attractive to elephants.

The daily intake of dry matter by Asian elephants is between 1.5-1.9% of their body weight¹, which works out to be around 100-150 kg of dry fodder per day. This seems a lot but humans need to eat relatively more than elephants and have a richer diet. Smaller animals need more food relative to their body weight. Elephants are therefore not gluttons; on the contrary, they eat rougher plant materials compared with other animals. The plant parts eaten by elephants can be very coarse, this is why their teeth are flat and full of enamel.

Elephants are gray in color, which may be masked by dirt because of dusting and wallowing. The epidermis and dermis of the body is 18 mm thick on average; the skin on the back is 30 mm thick. Skin temperature varies from 24 to 32.9 °C. Body temperature averages 35.9 °C, and is regulated partly by the ears that act as heat radiators. Their feet have a five nails on each forefoot, and four on each hind foot.

1. <http://www.nagonline.net/Technical%20Papers/NAGFS00497Elephants-JONIFEB24,2002MODIFIED2.pdf>

Smell

*Elephants have a powerful sense of smell that helps them find food and water and detect other animals. It has even been suggested that an elephant's sense of smell may be as much as 14 times stronger than that of an average dog. In 1998 we trained a semi-domestic African elephant (*Loxodonta africana*) to use its sense of smell to track cattle and to find calves that had been separated from their mother.*

In 1998, one of our elephants successfully tracked criminals who'd burgled our neighbor's house. The criminals had crossed a river twice and had walked through a village where their scent had been mixed with that of many other people. After about four kilometers the elephant signaled that they were close and thus that the trail had ended. Police entered the house the elephant was standing in front of and found the stolen goods.

-- Michael Hensman

Teeth

The average tooth weighs about 5 kilograms and it adapted to the elephant's diet. The molar teeth are shed periodically. They move forward in the jaw to displace old and worn teeth that fragment and usually fall out on their own or are swallowed. The only incisor in the upper jaw is the tusk. The elephants don't have canines (they don't eat meat) but three premolars and three molars. It is astonishing to imagine that tusks are incisors, but evolution tends sometimes to "play" with parts of the animal bodies and use organs originally

designed for one purpose, for another unrelated purpose.

The dental formula of adult elephants is $I \ 1/0 \ C0/0 \ PM \ 3/3 \ M \ 3/3$. "I" means incisor, "C" canines, "PM" premolar and "M" molar. The formula gives the number of teeth on one side only, the first number being relevant to the upper jaw and the second number to the lower jaw.

The dental formula gives the total number of teeth: $2 \times (1 + 0 + 3 + 3)$ for the upper jaw and $2 \times (0 + 0 + 3 + 3)$ for the lower jaw. The total is 26 teeth.

Classification

Classifying plants and animals with long and complicated names is not meant to annoy biology students. Classification helps to identify species. It also reflects our understanding of evolution.

Evolution is the process by which organisms changed over time, 'descent with modification' as Charles Darwin stated over a century ago. Randomness (chance events) and adaptation to competition, cooperation, pests and predators, are the main reasons why organisms evolve. As a result, species give rise to new species relatively better adapted to an ever challenging environment. From the inert molecules which were the precursors to life to complex organisms like apes, there are thousands of species. Species are related to each other and classification attempts to arrange them in terms of their relatedness, by comparing their genes and morphology. The elephants are classified as follows:

Kingdom: Animalia
Phylum: Chordata
Subphylum: Vertebrata
Class: Mammalia
Order: Proboscidea
Family: Elephantidae

It is a sort of identity card that provides a summary of what the elephant is. Zoologists translate this into: elephants are animals, organized along an embryonic longitudinal axis, with vertebrae. They are mammals and their long nose is a proboscis. They belong to the Proboscidea or Elephantimorpha, the family of elephants and mammoths. Cousins of the elephants like the mammoths and mastodons have become extinct. The relatives of the Asian elephants are:

- Elephantimorpha (Proboscidea)
 - Elephantida
 - Elephantidae (elephants and mammoths)
 - †*Primelephas*
 - Loxodonta*
 - Elephas*
 - †*Mammuthus*
 - †*Stegodon*
 - †*Stegolophodon*
 - †*Stegotetrabelodon*
 - †*Stegodibelodon*
 - †Gomphotheriidae (Gomphothere)
 - †Mammutida
 - †Mammutidae (mastodons)
 - Mammut*
 - Zygodolophodon*
- † extinct

Species die out. Large dinosaurs like the famous *Tyrannosaurus rex* became extinct 65 million years ago because a meteorite hit the Earth (other reasons have been cited for the decline of the dinosaurs). This meteorite, after the immediate destruction that it caused, also hurled dust into the atmosphere and caused forest fires. The sun light was blocked for years, which cooled the planet. Large herbivores could not be sustained on reduced plant productivity and with insufficient prey, the carnivores disappeared. As a result, most dinosaurs vanished. Fortunately some managed to survive: the birds.

Of the eight genera of Elephantidae, only two remain: *Elephas* and *Loxodonta*. Some of these extinctions may have been partially caused by humans during pre-historic time, approximately 10,000 years ago. Today, there are only three species of Proboscidea: the Asian elephant (*Elephas maximus*), the African bush elephant (*Loxodonta africana*) and the forest elephant (*Loxodonta cyclotis*), found in African forests. Most of the extinct animals were giants. The Imperial Mammoth

(*Mammuthus imperator*) for example, was endemic to North America from the Pliocene (ca. 4.9 million years ago) through the Pleistocene (ca. 11,000 years ago). It was a giant reaching 4.9 m at the shoulder. By comparison, the Asian elephant (3.2 m at the shoulder) is a midget. The Imperial Mammoth went extinct at approximately the same time that humans spread into the North American continent.

Mammals

The word “mammal” comes from the Latin mamma (“breast”). Mammals (Class Mammalia) are air breathing vertebrates that can regulate their body temperature with the help of specialized sweat glands. They are covered with hair, have specialized teeth and mammary glands that produce milk to feed their young. All female mammals nurse their young with milk, which comes from mammary glands. There are approximately 5,700 species of mammals. The mammalian brain, with its characteristic neocortex, regulates body temperature and the circulatory system. Mammals range in size from the 30 – 40 millimeter bumblebee bat to the 33-meter blue whale.

Elephants, like us, are mammals and feed their young with milk, developing a very close relationship with their babies, not found in most reptiles and frogs. A baby elephant is brought up by the family consisting of its mother and aunts who nurture and protect it for several years. The family bonds are very strong and when elephants are isolated from their family members, they become stressed and depressed. Dr. Gay Bradshaw, discovered that elephants suffer from post-traumatic stress when another elephant is killed, in the same way soldiers do during a war. They are very much like people and should be respected and loved for their caring and intelligent nature.

Geographical Range

Elephants originally occupied a large area before humans became a major threat. The original range (or territory) of the Asian elephant extended from present-day Iraq to China (Figure 2). There were probably millions of elephants before humans expanded to conquer the world. We can only imagine thousands of herds of elephants converging towards large rivers and lakes, where now we have cities.

Biogeography, the science that studies distribution of species on the Earth, states that the largest body size of terrestrial animals is determined by the range size. The larger the territory, the bigger the animal can potentially become. Small islands cannot produce large animals and there was absolutely no possibility in finding a King-Kong sort of ape on a remote island. Why is that so?

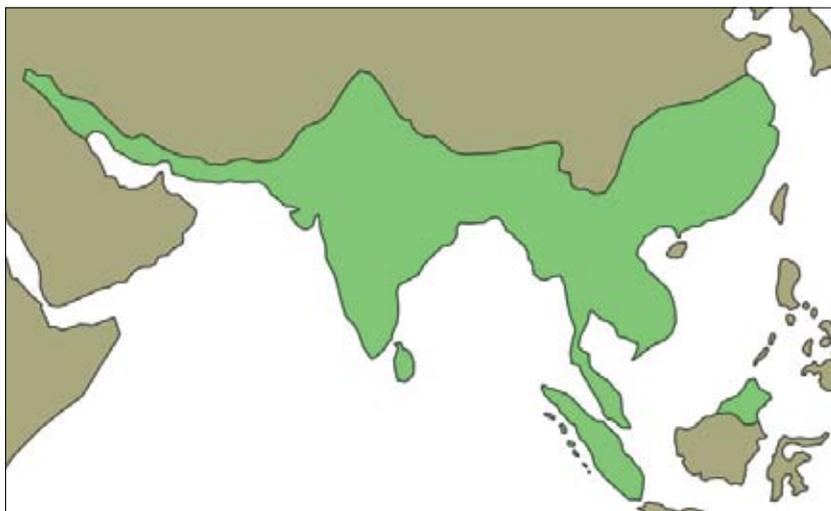


Figure 2. Former distribution of the Asian elephant (modified), after C. Santiapillai and P. Jackson (1990) in the Quantum Conservation website, modified.

Elephants need large quantities of food. Food productivity in an ecosystem varies regionally with climate and locally with weather. In case of a bad year at a given place, plant material becomes scarce. Elephants then migrate hundreds of kilometers if necessary, to find better feeding grounds. This cannot happen on islands where there is no possibility for migration. In case of famine, the population crashes. Those who cannot find enough food because they are larger, die first. Asian elephants are typically continental cruisers. They need continents without boundaries to remain what they are.

Elephants can live on islands. For example, the Sumatran Elephant (*Elephas maximus sumatranus*), one of the subspecies of the Asian Elephant, and native to the Sumatra island of Indonesia, is slightly smaller than the Indian elephant, reaching a shoulder height of between 2 and 3.2 m and weighing between 2,000 and 4,000 kg. Geologists also have found fossil remains of dwarf elephants on Mediterranean islands and in Asia: Sulawesi, Flores, Timor and in the Lesser Sundas. However, island species or subspecies are smaller than continental species. Dwarf elephants, some prehistoric members of the order Proboscidea, evolved to a fraction of the size of their immediate ancestors. Dwarfism in animals appears on islands when the size of the species shrinks dramatically over time due to limitation of food.

The Asian elephant occurs in a variety of biomes. A biome being the vegetation type found at the continental scale, influenced by climate, latitude and altitude. The common biomes in India (Figure 3) are the rainforest, dry forest, monsoon forests, semi-arid deserts, deserts and alpine grassland. Elephants were originally present in most biomes, from tropical and subtropical wet forests, dry and monsoon forests, semi-arid desert, xeric shrubland, dry steppe and Mediterranean vegetation. They are adaptable and can survive in drier vegetation during particular seasons as long as they find water. Therefore the relatively warm climate of South-Asia and water availability seems to be the ultimate factors that define their territory.

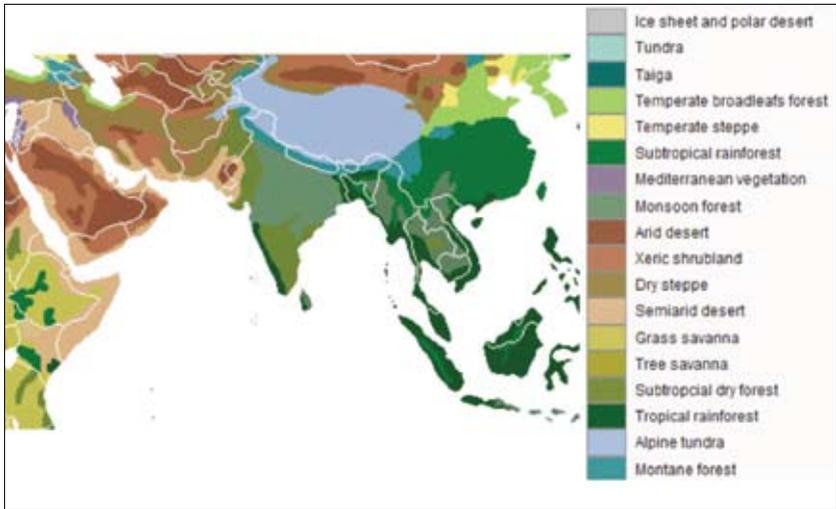


Figure 3. The biomes of south Asia (Wikipedia).



R. Lijosh, Holy Cross Matriculation School

When humans dispersed from Africa in pre-historic times, they hunted elephants. Much later when settled agriculture developed, the elephant habitat decreased in size. With development, the habitat got smaller and more divided. Nowadays, elephants survive in small pockets (Figure 4): these pockets cannot support large populations and the elephant is doomed to extinction with continuing loss and fragmentation of its habitat.

Finally, the Asian elephant, if it survives long enough (hundreds of generations), will become a dwarf species as predicted by biogeography, unless humans decide otherwise and maintain connection between territories.

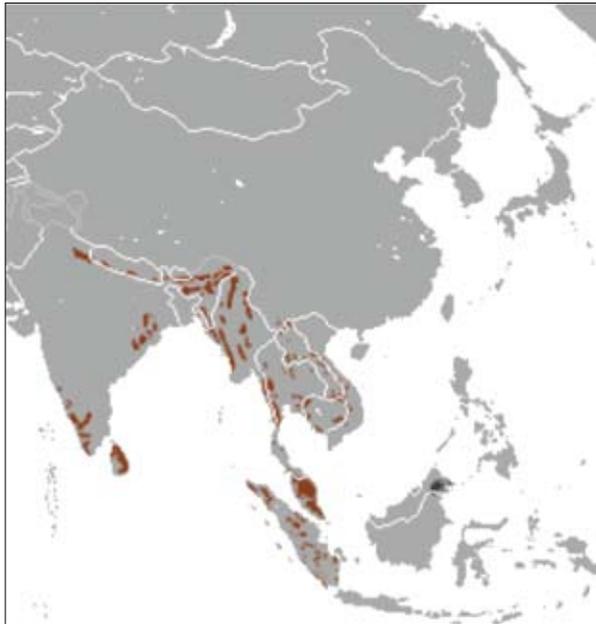


Figure 4. Present distribution of the Asian elephant. Wikipedia.

The Ecology of the Asian elephant

The Asian elephant can survive in a variety of habitats: from sea level to over 3,000 m. In some sites in the Eastern Himalayas in northeast India, it regularly moves up above 3,000 m in summer.

Elephant herds follow well-defined seasonal migration routes in search of food. These movements take place around the monsoon seasons, often between the wet and dry zones, and it is the task of the older elephants to remember and follow the traditional migration routes. When lands along these old routes are converted to agriculture, there is often damage to crops.

A herd of elephants is led by a female, an older cow, the matriarch. The herd or clan is organized along matriarchal lines. Herds may consist of a few individuals to dozens. Adult males do not attach themselves to a herd unless it contains a female in estrus. More than one adult male may accompany cows, but in general only the dominant bull will mate with the cows. Younger bulls will occasionally engage in mock fighting. Strong fights over access to females are rare. Bull elephants form small groups known as “bachelor herds”, but bulls may also roam independently at various times. Elephants communicate over long distances by infrasound, which are sounds of low amplitude not audible to the human ear.

Bulls reach sexual maturity around the age of 12–15. They undergo an annual phenomenon known as “musth”, when their testosterone levels increase to about 100 times the usual level. The musth gland is located on each side of the head between the eye and the base of the ear. Secretions containing pheromones (molecules producing scent) are shed during musth. At this time, they become particularly irritable and aggressive.

The female elephant usually has one calf, and rarely twins. The gestation period varies from 18 to 22 months. At birth, the calf weighs about

100 kg, and is suckled for up to 3 years. Once a female gives birth, she usually does not breed again until the first calf is weaned, resulting in a 4–5-year birth interval. Females stay on with the herd, but mature males are chased away. It has been observed that female African elephants under severe stress due to poaching in the wild (<http://www.africanconservation.org/forum/hunting-conservation/9395-gunfire-no-aphrodisiac-for-african-elephants>) and stressful conditions in captivity (<http://www.nottingham.ac.uk/burn/Noon.pdf>) have disrupted reproduction and often do not come into estrus.

Elephants' life expectancy averages 60 years in the wild and 80 years in captivity. An adult full grown healthy male Asian elephant has no natural predator, but there have been instances of tigers preying on young or weak elephants.

The population of the Asian elephant

Estimating the numbers of wild elephants is not an easy task. Specialists estimate their numbers because we need to know approximately how many there are, in order to predict the population viability. Small populations have a greater chance of going extinct.

Counting people in India is a huge undertaking: for instance the 2011 Census of India employed 2.7 million persons at the cost of 22 billion Rupees or 418 million dollars. The count indicated that there were 1.21 billion Indians.

There are fewer elephants than humans and they are larger in size. But it does not make the task of counting them easy. Contrary to expectations, despite its size, the Asian elephant is difficult to see. It avoids humans and likes dense vegetation cover, where it can easily hide. It also moves a lot and can travel 20 km in a day. It does not have either an identity card, though experienced people can recognize individual elephants by their physical features. Therefore estimating elephant numbers is problematic because firstly, sighting them is not easy, and secondly an elephant can easily be counted twice, which falsifies the count. Therefore their numbers need to be estimated using sampling procedures.

The IUCN webpage on the Asian elephant says that they are declining through their range. The write up (<http://www.iucnredlist.org/apps/redlist/details/7140/0>) laments that:

“the oft-repeated global population ‘estimate’ of about 40,000 to 50,000 Asian elephants is no more than a crude guess, which has been accepted unchanged for a quarter of a century. They argue that with very few exceptions all we really know about the status of Asian elephants is the location of some (probably most) populations, with in some cases a crude idea of relative abundance; and for some large parts of the species range we do not even know where the populations are, or indeed if they are

still extant. These differences of opinion are due in part to the difficulty in counting elephants in dense vegetation in difficult terrain, different survey techniques being used in different places, and a too-widely held belief that population monitoring is unimportant. Nevertheless, whatever the error margins, it appears almost certain that over 50% of the remaining wild Asian elephants occur in India.”

Therefore we don't really know how many Asian elephants there are in the wild. Their numbers are anyone's guess and most probably is below 40,000. We do not have a complete assessment of where the elephants are, with the exception of some protected areas.

At present, the Forest Department organizes elephant censuses involving the general public, which include wildlife enthusiasts. The enumeration consists of walking along paths with rangers and counting the elephants sighted. The census is done in one day over the entire territory of a protected forest, to avoid double counting. This is called the “block count method”. Such surveys are excellent initiatives as they bring enthusiasts to wilderness areas. But quite often people fail to realize the challenges of counting elephants. They usually talk loudly, wear bright clothes, use perfume and take pictures instead of attentively watching their surroundings. Spotting elephants in their habitat needs silence stealth and attention. In dense vegetation, most groups under-estimate the elephant numbers because they just don't see them.

Other methods are the “dung count method” consists of assessing the elephant population in an area by counting the dung and applying certain formulas for converting the quantity of dung to elephant estimates. Dung decay rate is a factor used in this estimation.

The number of Asian elephants in the Nilgiri Biosphere Reserve subject of debate. An unpublished report of AERCC indicates 6,300 elephants. This is an old report and we could not find recent consolidated updates in the scientific literature.

Estimating populations

A group of individuals that breed together in an area is called a population. Populations change over time. If we want to keep track of any population it has to be assessed at regular intervals. There are two ways of assessing populations: by counting and by sampling. In the Census of India 2011 for example, all Indian citizens were enumerated. Even though there was some uncertainty (a few persons may have been missed, people died and babies were born during the sampling period), the entire population was counted. Counting the population is fairly precise but expensive.

When it is impossible to count every individual, sampling is carried out. It consists in taking subsets at random, in which all individuals are counted. Sampling always comes with a sampling error. Therefore if the elephant population of a reserve is estimated,

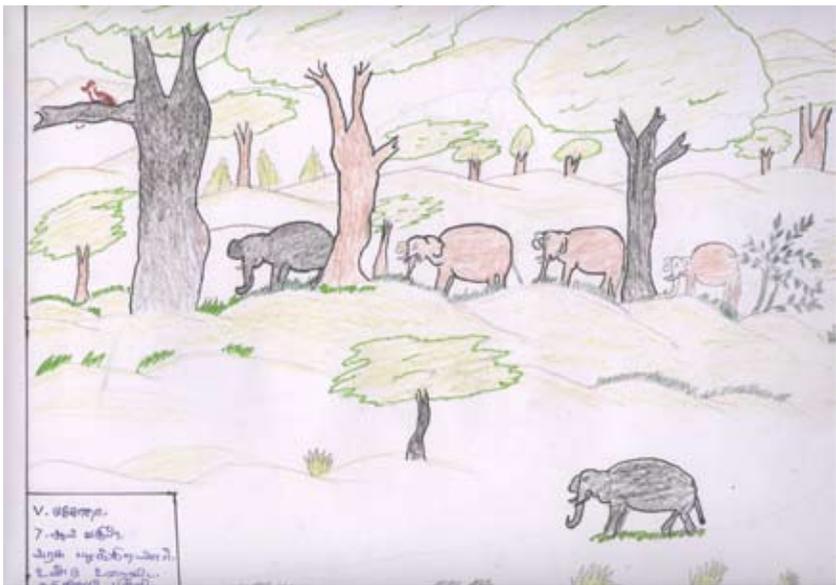
the result should say, for example that the reserve contains 1,000 elephants plus or minus 50 with a probability of 95%. This states that there is 95% chance to find the “real” population of elephants between 950 and 1,050.

The Forest Department uses the block count method for enumerating elephants. This method relies on direct observations of elephants in forest blocks. In theory, all elephants are counted. But if the vegetation is not open enough and the elephants not properly detected, the block count method should be considered to be a sampling method and treated as such. The “dung count method” is an indirect sampling method and needs corrections to provide the elephant population, with huge error margins.

Does it make sense to have the elephant population of a national park like we have the human population of a district? Yes, if the national park is isolated. However, in an area that belongs to a set of

reserves, elephants migrate and their local population varies. Elephants, contrary to humans, do not have an address where they can be found for sure. They search for food. For example in the Nilgiri Biosphere Reserve, elephants may move from Mudumalai to wetter areas like the Wynaad during the

dry season where they find more food and water. When several reserves are contiguous, it makes sense to study all of them at the same time to get a better estimate of elephant numbers. Such large-scale coordinated efforts have never been undertaken in the three states of the NBR to my knowledge.



V. Yeshodha, Govt. Tribals Residential Middle School

Elephant Intelligence

Harvard biologist Stephen Jay Gould explained in his book “The Mismeasure of Man” that intelligence is difficult to define. It has many components, among which is ability to calculate, to solve problems, to use tools, find food, avoid predators, just to be happy, and survive. Then, measuring intelligence is yet another challenge altogether. One century ago, gorillas were just dangerous apes, tigers were considered vermin. George Schaller was the first to discern that gorilla were peaceful and curious, and that tigers could live within families. Recently, a Japanese scientist, Naoko Irie, showed that elephants can count (<http://www.newscientist.com/article/dn14569-elephants-master-basic-mathematics.html>). This takes us to the strange realization that as we become more intelligent ourselves, we discover more intelligence in other species.

Elephants need to move about to remain alive, because if they stayed in one place, all vegetation would disappear in their stomach. To cross rivers, they estimate the flow, to climb down mountains, they compare slopes. Day after day, they need to be on the move, but at the same time, must remember their territory to find water, food, fruit, paths, etc. After a year of wandering, they still recall the time of year when a jackfruit tree will be fruiting. They will return to eat the fruits. This is not a small feat. Elephants have to have a map of their territory in their brain.

I heard that a tusker, a male elephant visited the same jackfruit tree at the same time every year. The house owner got annoyed by these annual visits and cut the tree down. When the elephant returned (without smelling the tree because there was no more fruit), he got angry and started damaging the house. Everyone understood that the elephant wanted to punish the people for cutting down the tree. What the elephant deliberated is open to interpretation. But if witnesses were correct, he had to put together several abstract lines of reasoning. He remembered the location of the tree, he had observed maybe somewhere else that

people cut down trees and concluded that the people in the house nearby had cut the tree down. If this is correct, it shows a profound sense of observation and analysis.

Obviously, Asian elephants are highly intelligent and also self-aware. You may have seen birds or cats attacking their reflection in a mirror. They are not aware that the bird or the cat they see in the mirror is an image of themselves. Elephants know it is their reflection. When a mark is put on an elephant and it faces a mirror, it will not attempt to react to the image, but will touch the spot from its body: it understands that the mirror reflects its own image.

Elephants have a very large and highly convoluted neocortex, the frontal lobes of the brain. This trait is shared by humans, apes, certain dolphins and some crows have their equivalent of the neocortex. Of all existing land animals, elephants have the greatest volume of cerebral cortex for cognitive processing. Extensive studies place elephants in the category of great apes in terms of cognitive abilities for tool use and tool making.

Land owners in the Nilgiris have lots of stories about elephants and electric fences. They have observed that elephants have understood that dry wood does not conduct electricity, therefore they drag and throw dead logs onto the fences to break them! Or some old males have realized that their tusks don't conduct electricity and use them to carefully break open the fences (Tarsh Thekaekara, personal communication).

Intelligence is perhaps most clearly apparent in social interactions. Elephants in a herd know each other as we know the members of our family. The mother, the baby, the cousins, all have different smells and different shapes. With the trunk, the elephant touch each other and smell each other in order to know who is who. African elephants have been seen touching the skeleton of relatives, particularly the head as they would do with each other in normal circumstances and become suddenly quiet, as if in remembrance. In all likelihood, they remember who the dead elephant was and seem to know he/she had passed away.

Their depth of attachment is simply impossible to describe. A Forest Officer, Dr. Rajiv Srivastava, the former Field Director, Mudumalai Tiger Reserve, witnessed a young elephant carrying water in his trunk to his dying mother in order to revive her. This is not only a display of intelligence: it is a display of emotions that are very... human.



M. Kumar, Panchayat Union Middle School

Threats

The worse threat to the elephant is land-use change: the transformation of its habitat into fields, plantations, villages, towns. Superimposed on this area loss is fragmentation: the splitting of the habitat into smaller units. Fragmentation is the second most dangerous threat. In addition poaching takes a heavy toll on bull elephants.

Direct loss of habitat has two major consequences. It lowers the quantity and quality of available food. The quantity of food impacts the carrying capacity or the maximum population size an ecosystem can sustain. When habitats are reduced, available biomass is reduced and the carrying capacity becomes lower. The elephant population goes down proportionally. This is why it is so important to maintain elephant habitats. Even small encroachments affect the elephant population.

When the habitat is transformed, some plants are lost. Elephants are generalist herbivores, they feed on almost anything. But in turn, elephants in the wild would probably have difficulty surviving on a few species even if they are available in large quantities. It might affect their nutrient requirements.

Fragmentation has dramatic effects. It splits populations and disrupts the genetics of the species. Sometimes, due to poaching, not enough males are available. This lack of mating opportunities outside the population, results in inbreeding, which affects the viability of the population. Sometimes the population is so small that it becomes upon separation, genetically distinct from the main population. As a result of this genetic simplification, populations are more sensitive to diseases and more prone to extinction. The only way to remedy population fragmentation is through restoration of the original habitat or maintenance of connectivity through corridors.

Degradation of habitat is a pernicious threat that is not easily assessed. Overgrazing by cattle and invasion by plants such as *Lantana camara* in Mudumalai, lower the carrying capacity. Cattle compete with elephants for food and invasive species may not be palatable. Some are even toxic. The lack of food drives the elephants to peripheral habitats such as mountain slopes where the vegetation is less disturbed, with fewer invasive plants. Lack of food also drives elephants in the agricultural fields around reserves.

Lastly, poaching poses a serious threat to dwindling populations. Higher mortality of males has adverse consequences. Firstly, it alters the proportion of males to females. Secondly, it changes the genetic make-up of the species by eliminating larger males with bigger tusks. And thirdly it deeply influences the behavior of the elephants. Young males lose their cultural references and misbehave, older males become more frightened and aggressive.

The levels of threats on elephants are so high and their population so small that the IUCN (see <http://www.iucnredlist.org/apps/redlist/details/7140/0>) considers the Asian elephant is an Endangered species. An endangered species has a population which is at risk of becoming extinct because it is either too few in number, declining in population, or if its range size is getting smaller.

The Asian elephant might become extinct in the wild within decades. There is only a very short time left to improve the fate of this species. If the Asian elephant appeared on Earth 5 million years ago (look at this nice website on elephant evolution <http://www.himandus.net/elefunteria/library/science+nature/evolution.html>), five decades represent 0.001% of its existence. Half a day of life to a human being.

Protecting biodiversity

Why should we protect species such as the elephant?

Humanity has evolved under pressure from predators, diseases and starvation. We have succeeded in overcoming most of these hazards, thereby increasing in number and improving our well-being. Our ancestors lived short and violent lives. We are relatively more comfortable. We have also learnt to kill the lion and the tiger, and anything on earth just for the pleasure of it. We have transformed the land to suit our needs and drained the resources for our species alone. In fighting the violence of nature, we have ironically become the most violent biological force for all of nature.

The question “why protect species such as the elephant?” is difficult to answer technically because it has many facets: religious, philosophical, ethical, economical, scientific, etc. The societal point of view however, is easier to respond to. Species have to be protected because many people, maybe the large majority of people in India, want them to be preserved.

Some persons think that life in itself is precious and that it is not for humans to decide who should live and who should die. Others feel that nature should be preserved for future generations to enjoy, as we do. Nature is our property, our common capital and heritage to be cared about. Still others remind us that we might find cures for lethal diseases in plants, animals and microorganisms. There is also the argument of ‘ecosystem services’ where nature provides the basis services to humanity, in terms of providing clean air and water, soils for the production of

food and fiber and also in regulating global climate and rainfall. We could list hundreds of reasons why biodiversity should be preserved.

The wisdom of common people throughout the world has literally pushed countries to enter into an agreement over biodiversity, called the Convention on Biological Diversity or CBD (<http://www.cbd.int/convention/>). The CBD was signed by 150 countries including India at the 1992 Rio Earth Summit. The Convention recognizes that biological diversity is more than plants, animals and microorganisms and their ecosystems – it is about people and their needs for food, security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live. Signatories accepted to put in place procedures like Environmental Impact Assessment (EIA) to measure the potential impact of projects on biodiversity. India acknowledges like many other nations that biodiversity is important for the well-being of its citizens, and that efforts should be made to conserve it. The Forest Department is actually the primary institution for the active protection of biodiversity. But other Government institutions are involved as well, like the Forest Research Institute, the Wildlife Institute of India and the many universities and research centers throughout the country. Investment in conserving biodiversity is in millions of dollars. The biodiversity capital of the country may be in trillions of dollars. The total value of some of the quantifiable ‘ecosystem services’ may be over 33 trillion US dollars every year, more than twice the global gross national product of all nations combined.

Among the international organizations dealing with biodiversity, one of the most important is the International Union for Conservation of Nature (IUCN). The IUCN (<http://www.iucn.org/>) also publishes the IUCN Red List, compiling information from a network of conservation organizations to rate which species are most endangered. Even though most countries, like India, have their own system to assess species status, scientists like to refer and contribute to the IUCN Red List since it is an international effort. For practical purposes however, experts refer to international, national and sometimes regional systems of species

classification. It happens that regions wish to protect species for specific reasons: tradition, usage, or their emblematic character, etc.

As we should realize, biodiversity conservation is not just a matter of opinion and interest. Nature is money and well-being. It contributes billions of dollars to the economy in the form of tourism, medicine, food, education, etc. The services provided by nature, if we can compare them in economic terms, are far superior to the GDP of the entire world economy. Can elephants provide wealth to a region? Yes, it can: a single elephant is worth several thousand dollars a year for the tourism industry. A real challenge is to properly redistribute income to the poorer segment of the population.

Finally, does science have a final answer to this debate? Not really. It just shows reality as it is, as in the climate change debate. We can warm up the atmosphere, science predicts the consequences and if we are willing to face them, all is well. In the same way, we can live in a world where the largest animal is the domestic dog. But would it be a good world?



R. Udayakumar, Govt. Tribal's Residential High School

How to protect species?

The way we protect species has changed over the years and will continue to change with need and knowledge.

King Ashoka who reigned circa. three centuries BC, was the first to establish wildlife reserves. The Indian subcontinent at that time must have been teeming with wildlife. For a long time, in India, as well as elsewhere, the protected areas were mostly for the dominant classes to enjoy hunting.

The first national park in the world was the Yellowstone National Park in the United States of America, established by the U.S. Congress and signed into law by President Grant in 1872. Ecology was in its infancy, and the park was established to protect the geological curiosities like the hot springs (geysers) and the beauty of the landscapes. Other national parks were then created, with the idea of protecting nature against human impact.

People were excluded from national parks on the basis of the belief that nature within parks is and should remain pristine. Sometimes, people were forcibly excluded from the national park limits, as happened at the creation of the Kruger National Park in South-Africa.

But with the continuous increase of populations in the 1950s, national parks became islands in a sea of development. As these areas were like small isolated islands, their conservation was a challenge. Isolation, size and human-related disturbance anywhere on Earth posed a real challenge to conservation. Scientists started to realize that national parks were already too small.

In countries like India, national parks were established on the former territory of tribal people, or the hunting grounds of the maharajas. Tribals were allowed to stay and continue with their traditional life-styles.

This did not pose a threat since their population density was low. But as soon as the market economy penetrated the lives of forest-dwellers, the equation changed and the damage to nature further increased.

The national parks and tiger reserves have a core zone which is strictly protected. They also have a buffer zone where selected activities like tourism are permitted. Then, a transition zone was created where environmentally friendly agriculture and economic development could be practiced.

In trying to decide what to conserve first, a range of 'prioritization schemes' have been created to suit particular conservation needs: Important Bird Areas (IBA), Endemic Bird Areas (EBA), Centers of Plant Diversity (CBD), Indigenous and Community Conserved Areas (ICCA), Alliance for Zero Extinction Sites (AZE) and Key Biodiversity Areas (KBA) among others. Likewise, a protected area or an entire network of protected areas may lie within a larger geographic zone that is recognized as terrestrial or marine ecoregions.

What will happen in the future? We may end-up with a mixture of these two opposing views where nature and civilization progressively merge from the city centers to the core areas of reserves. We can't live with tigers near schools. But, birds, insects, bats, small mammals can very well survive in our midst if we pay attention to them. Already, some cement manufacturers design bat-friendly tiles that allow nesting of these small mammals. In some countries of Europe, like Denmark, ten percent of the agricultural land is preserved for natural processes to develop and the protection of biodiversity. Not only are these lands better maintained, they are more beautiful, productive and need less pesticides as insect predators thrive.

In the near future, landscape engineering will pave the way towards elephant friendly management. It is not impossible to imagine tree plantations to separate core areas from agricultural lands. Architecture and landscaping can also be designed to passively repel these animals back into their ecosystems.

Population viability

With our experience with livestock and zoos, we wrongly conclude that anything can survive in enclosures. But this is not the case. Elephants in zoos breed poorly or not at all. Zoos, even though useful for conservation, are simply “nature in cans”.

The webpage of the Smithsonian Conservation Biology Institute (<http://nationalzoo.si.edu/SCBI/ReproductiveScience/ElephantBreedRepro/default.cfm>) reminds us:

“In zoos with both male and female elephants, potential pairs are sometimes incompatible or not the most genetically suitable for breeding together. In addition to the obvious challenges involved in moving them from zoo to zoo for breeding, is the fact that few zoos are equipped to handle adult males, whose breeding behaviors include prolonged periods of aggressive, potentially destructive and dangerous behavior. In addition, many female elephants in zoos do not display normal estrous cycles (the periods in humans). In fact, some don't cycle at all, and this precludes their being interested in mating and their being fertilized, even by artificial insemination.”

Most animals need wilderness to survive. To keep elephants in the artificial environment of zoos, they must be brought from protected areas. From the observations of the Smithsonian Conservation Biology Institute, it is possible to understand why. Elephants are social animals. Their reproduction is “controlled” by the group, as the reproduction in humans tends to be “controlled” by culture and family. Outside of their jungles, the females are not supported by their herd. Without other female elephants, the estrous cycles stop. Cut off from its home (habitat) and family (herd), the elephant has no role in the future of its species.

The only way to conserve elephants is to keep them in their natural habitat and through periodic monitoring ensure that they are doing

well. A viable population is a population with enough individuals in terms of gender and ages to make it sustainable for an indefinite future. Conservation genetics suggests that a population should consist of at least 50 to 500 breeding individuals, in order to be viable. But in recent years, theoretical advances make scientists believe that thousands, not hundreds of individuals, are necessary to make populations sustainable. The elephant population of the Nilgiri Biosphere Reserve, because of its size seems to be viable. This population should not be stressed any further because it may be one of the few remaining viable populations in the world.

Population viability analysis is an inexact science, and there is no single “magic” population size that guarantees populations’ persistence. However it is logical that only large numbers of elephants can survive into the future, and that depends on the care we are ready to extend to this species.



N.P. Anshidhe, Panchayat Union Middle School

The human - elephant conflict

Human - elephant conflict is a dangerous, maybe populist term. It sounds as if elephants are waging a war against humans. But it is actually similar to the resistance of the Jarawa tribe of the Andaman Island against “civilization”: the bows and arrows of a few hundred individuals against the whole force of our civilization and technology. This is neither war nor conflict. Elephants do not fight us. Their battle is the deplorable final distress behavior before death.

That said, contact with wild animals is dangerous. But it is mostly dangerous to the animals. In North-America, circa. 100 humans have been killed by grizzly bears (http://en.wikipedia.org/wiki/List_of_fatal_bear_attacks_in_North_America). However, around 200,000 grizzlies were eliminated from 98% of their original range in the United States (except Alaska) during a 100-year period (<http://bearinfo.org/grizzlies/history/>). In India, approximately 100 persons are killed every year by elephants. Elephants wander into field, frighten people and destroy properties.

To understand why elephants are aggressive, it is useful to identify people who live at peace with elephants. Tribal people of the Nilgiris, like the Betta kurumba, are one such example.

Tarsh Thekaekara noted:

“The tribe has had a long history of interaction with the elephants. Maharajas employed them to trap and tame wild elephants in keddah operations and this tradition was carried on by the British and the Indian forest department, who depended exclusively on this tribe to look after all the domestic elephants used in their forestry operations and timber trade. Even today, all the elephant mahouts in the Mudumalai Tiger Reserve are Betta kurumbas. They are also employed as guards

and watchers and as guides for tourists and researchers entering wildlife areas. Their traditional hunter-gatherer mentality and 'trust' relationship with nature that Tim Ingold describes is evident in their dealings with elephants. They believed that once the appropriate rituals were carried out before attempting to capture wild elephants, they only had to approach a herd of wild elephants, and some of them would separate out from the herd and give themselves up to be caught.

The Betta kurumba have developed a high tolerance for elephants and their livelihood depends on plants that are not attractive to elephants, and therefore less potential for destruction by elephants. If other crops are cultivated, they even tolerate some amount of destruction, sometimes saying: "it is fine, the elephant also has to live".

More recent immigrants who live at peace with elephants are people who do not develop agriculture on their land and allow elephants to move around freely. In other words, people who live at peace with elephants on a day-to-day basis are those who tolerate some economic loss caused by elephants, or are culturally inclined to do so. It is also worth noting that tea or coffee planters suffer much more from insect pests than from elephants.

People who have problems with elephants are those who cultivate crops that attract elephants and people who live close to habitats frequented by elephants (highly productive habitats, passage to rivers). Low tolerance for these animals has developed as a result of competition, itself the result of ill-inspired land-use.

It is also believed that one of the main reasons for the human - elephant conflict is land hunger for poverty alleviation. Does it make sense to open the last frontier - the elephant habitat - to the poor? Yes, of course, if no other options are possible at all. The trouble is that other options are available most of the time. But they are not adopted for a variety of reasons. The Nobel Prize Winner in Economics, Amartya Sen, demonstrated that famines are due to speculation resulting in unequal distribution of food, and not due to lack of food. It does not take a Nobel

Prize to understand that land hunger is due to unequal distribution of land due to speculation, and not because wildlife reserves that cover approximately 5% of the nation, take up all the available land.

The price of a life

A hundred people are killed by elephants in India every year. This is unfortunate and should not happen. Human death is always unacceptable.

When elephants kill people, newspapers tend to report the sad event by questioning the sanity of protecting elephants. Conservation is expensive and can even be dangerous - is often the conclusion. It is always important however, to keep in mind the larger general question of how people die in India. The first cause of mortality is coronary heart disease, strongly associated to lifestyle that kills approximately 1.5 million people per year.

To make a comparison with an important source of mortality, let us recall that in 2006 ca. 100,000 lives (unfortunately this has increased lately) were lost on Indian roads and 2,000,000 people injured, as reported by the

BBC. According to reported joke by New Delhi bus drivers', one life costs one lakh rupees' (1 lakh = 100,000) in compensation. The cost of road casualties corresponds to 3% of the GDP (\$915 billions). In spite of these alarming statistics, journalists never have reported that roads are expensive and dangerous, and should be closed. Death on the road is considered an accident whereas death by a wild animal, an aggression. Is it that simple? Why should we not consider that blatant negligence and lack of interest regarding 'road accidents' is not finally an act of aggression? A large part of "accidents" on the road and on the border of the jungle are actually both the consequences of mismanagement at some level: at some point, a decision-maker failed to make the proper decision. In one instance, the drivers who do not respect the rules are not punished. In the other instance, inappropriate land-use practices that provoke elephant aggression are not discarded.

If some simple and inexpensive rules were applied to road safety which saved say about 33,000 lives per year, approximately ₹400 crores (1 crore = 10 millions) would be spared. On the MoEF website, the 2005-2006 budget indicated that approximately ₹350 crores were necessary for the protection, research, education and training on terrestrial ecosystems. The cost of Project Tiger was ca. ₹35 crores and the Project Elephant ca. ₹15 crores (exact numbers can be found on <http://envfor.nic.in/pbudget/2007/chap5.html>).

Saving 33,000 lives would cover the budget earmarked for the protection of terrestrial ecosystems. There would be more than enough to address the problem of mortality caused by elephants. Saving lives, species and ecosystems costs nothing. Wasting them does.

●Imagine biodiversity was reintroduced in cities and people could walk, exercise and live better. The number of lives and the amount of money spared would probably cover the entire budget of the Ministry of Environment...

Environmental impact assessments (EIAs) and other reports

Decision makers and citizens sometimes need to refer to technical documents such as environmental impact assessments (EIAs). Many people are put off by the jargon and leave them to experts. However, EIAs should be understood by everyone: it is their objective. EIAs also have to be accurate and

independent experts should be able to reproduce the results.

Ecology and conservation biology are becoming exact sciences and not in the realm of personal opinion. For example, environmental impact assessments (EIAs) for biodiversity, should ideally measure the number of species in an area, list the threatened species with some information on their density or population size, assess the threats, and evaluate how the project will impact its population.

The report should thereby arrive at an expert conclusion. If a threatened species is further endangered by a project, either the project should be rejected or efforts should be made to mitigate the impact.

If you are not a specialist but you have to evaluate an EIA pertaining to biodiversity, this is the type of information you should verify:

- *Was the law strictly followed with no blatant short-cuts before the EIA was requested?*
- *Is there recent data on the topic of interest?*

- *Were all potential impacts listed and mapped?*
- *Were there reliable densities or population data on all the target (principally threatened) species?*
- *assessments of impacts on target species?*
- *Is the conclusion understandable and within the domain of the specialists?*
- *Does it make sense?*

If any of these questions was answered negatively, you should not hesitate to ask for clarification.



Photo: Jean-Philippe Puyravaud

Nilgiri Biosphere Reserve

The Nilgiris¹

The Nilgiris or Blue Mountains are a plateau with a mean elevation of circa. 2,000 m. The highest peak is the Doddabetta at 2,637 m.

The first recorded use of the word Nila applied to this region can be traced to 1117 AD in the report of a general of Vishnuvardhana, King of Hoysalas, who in reference to his enemies, claimed to have frightened the Todas.

The original inhabitants of the Nilgiri Hills were the Todas, the Badagas, the Kotas, the Irulas and Kurumbas who were part of the Chera Empire². Later, the area came under the rule of the Western Ganga Dynasty, and then Hoysala Empire in the 12th century. They then became part of Tipu Sultan's kingdom, who later surrendered to the British in the 18th century.

The first Europeans to attempt the grueling climb to the Nilgiris included an enigmatic Jesuit priest, Father Finicio, in 1603. No British had ventured to explore the region except for Dr. Ford and Capt. Bevan, who traversed the hills in 1809 with a party of pioneers, and some deputy surveyors under Colonel Monson, who partially mapped the area.

In 1819, John Sullivan, the British Collector of Coimbatore, set out to

1. This section is almost entirely a copy of Wikipedia.

2. Tarsh Thekaekara warned me that other hypotheses exist.

explore the Nilgiris after obtaining an order from the British East India Company charging him to investigate the “origin of the fabulous tales that are circulated concerning the Blue Mountains to verify their authenticity and to send a report to the authorities”. John Sullivan occupied the area by buying land from the indigenous tribal people, often buying up many square kilometers in a day for the price of a few meals. In 1822, he began the construction of the first house in the Nilgiris on a hillock in Ooty (also called Udhagamandalam or Ootacamund) to the east of the hollow where the race course now lies. In 1823 his wife, who had the distinction of being the first European woman in the Nilgiris, and his infant son moved into the house called Stonehouse. Government House was soon built a few meters away. Stonehouse now serves as the administration building for the Government Arts College, which is the former Government House.

After the early 1820s, the hills were developed rapidly. It was a popular summer and weekend getaway. In 1827 Ooty became the official sanatorium and the summer capital of the Madras Presidency. In 1899, The Nilgiri Mountain Railway was completed. In a few decades, the Nilgiri tahr and the tiger became rare and almost disappeared from this



Rashid, Holy Cross Matriculation School

extraordinary and beautiful environment.

Description of the Nilgiri Biosphere Reserve

The UNESCO defines Biosphere Reserves
(<http://www.unesco.org/mab/doc/faq/brs.pdf>):

Biosphere reserves are areas of terrestrial and coastal ecosystems promoting solutions to reconcile the conservation of biodiversity with its' sustainable use. They are internationally recognized, nominated by national governments and remain under sovereign jurisdiction of the states where they are located. Biosphere reserves serve in some ways as 'living laboratories' for testing and demonstrating integrated management of land, water and biodiversity. Collectively, biosphere reserves form a world network: the World Network of Biosphere Reserves (WNBR). Within this network, exchanges of information, experience and personnel are facilitated. There are over 500 biosphere reserves in over 100 countries.

Each biosphere reserve is intended to fulfill three basic functions, which are complementary and mutually reinforcing:

- a conservation function - to contribute to the conservation of landscapes, ecosystems, species and genetic variation;
- a development function - to foster economic and human development which is socio-culturally and ecologically sustainable;
- a logistic function - to provide support for research, monitoring, education and information exchange related to local, national and global issues of conservation and development.

Biosphere reserves are organized into 3 interrelated zones:

- the core area
- the buffer zone
- the transition area

Only the core area requires legal protection and hence can correspond to an existing protected area such as a nature reserve or a national park. This zonation scheme is applied in many different ways in the real world to accommodate geographical conditions, socio-cultural settings, available legal protection measures and local constraints. This flexibility can be used creatively and is one of the strongest points of the biosphere reserve concept, facilitating the integration of protected areas into the wider landscape.

The Nilgiri Biosphere Reserve is an International Biosphere Reserve in the Western Ghats, Nilgiri Hills range of southern India. The reserve encompasses 5,520 km² in the states of Tamil Nadu (2,538 km²), Karnataka (1,527 km²) and Kerala (1,455 km²). It forms an incomplete ring around the Nilgiri Plateau.

The Bandipur Tiger Reserve (874 km²), Nagarhole Tiger Reserve (643 km²), Wayanad Wildlife Sanctuary (344 km²), Mudumalai Tiger Reserve (321 km²), Nugu Wildlife Sanctuary (32 km²), Mukurthi National Park (78 km²) and Silent Valley National Park (90 km²) are protected areas within this reserve. It also includes zones of the Nilgiris open to forestry and tourism including: Nilgiris Districts North 448 km² and South 199 km², Erode District (Sathyamangalam forest, 746 km² and Erode, 49 km²) and Coimbatore District (696 km²) in Tamil Nadu.

The reserve extends from the tropical moist forests of the windward western slopes of the Ghats to the tropical dry forests on the leeward east slopes. Rainfall ranges from 500 mm to 7,000 mm per year. The reserve encompasses three eco-regions, the South Western Ghats moist deciduous forests, South Western Ghats montane rain forests, and

South Deccan Plateau dry deciduous forests. The habitat types include montane rain forest, semi-evergreen moist forest, thorn forest and scrub, montane grassland, and high-elevation shola forests.

Fauna includes approximately 100 species of mammals, 350 species of birds, 80 species of reptiles; about 40 species of fish, 30 amphibians, 60 species of reptiles, 300 species of butterflies and innumerable invertebrates. Rare and endangered animals include the tiger, the Asian Elephant, and the Nilgiri Tahr

Rumors

Tigers are dumped in the NBR

False: this is simply impossible. Firstly there are too few tigers living in the wild, less than 2,000 in India. When relocations happen, they are strictly controlled, expensive and dangerous for the tigers: if too many tigers share a habitat, they kill each other. Tigers will survive only when they have enough space for themselves and have adequate numbers of prey.

Elephants are given priority over humans

False: the objective of conserving the elephant is to prevent the last few thousand Asian elephants on earth from going extinct. Humans number around 7 billion and

occupy most parts of the globe. Therefore there are very few protected areas where elephants can roam freely.

Populations are forcefully removed for conservation

True: Frontline speaks of eviction (<http://www.frontlineonnet.com/fl2704/stories/20100226270409100.htm>). Evictions have happened but to my knowledge on a small scale. Population displacement is mostly the result of development projects (www.fmreview.org/FMRpdfs/FMR08/fmr8.9.pdf) or conflicts (<http://www.internal-displacement.org/>). Eviction for conservation (or any other reason) should be avoided unless there is blatant breaking of the law.

The NBR and its economy

When the Nilgiris and its surroundings was made into a biosphere reserve, the Government of India made an economic choice: development would have to be constrained by the presence of protected areas and large animals. Some activities are compatible with a Biosphere Reserve, others are not, depending upon the location of the proposed activity.

The region is not industrialized, the main activities being agriculture, plantations, forestry and tourism. Subsistence agriculture as traditionally practiced by the different tribes also exists. I will not touch upon this traditional lifestyle because of lack of knowledge on my part. However, traditional lifestyle should not be neglected by decision-makers as tribal people have managed to sustainably coexist with forests and wildlife.

Practicing irrigation agriculture in a dry area with wildlife is simply not sustainable. At some point water shortage will occur as the ground-water table falls, and this will affect farming. In the same vein, vegetable production on steep slopes is known to cause a disproportional amount of soil erosion.

Intensive agriculture even at small-scale, does not go well with the presence of wildlife. Elephants are attracted by many crops including paddy, banana and sugar cane. Monkeys prefer fruits and wild-boar, potatoes and other tubers. To keep wildlife away from settlements, zonation of agricultural activities seems to be a better option. Crops that do not attract animals should be promoted in priority on the outskirts of protected areas. That way, natural buffers would be natural deterrents. This spatial arrangement may not be necessarily have adverse economic consequence.

A real challenge would be to transform small farms with seasonal agriculture into pluri-annual crop production in order to reduce conflict with animals. Some crops, useful to the industry, can replace small-scale

agricultural production. However, the transition is dangerous for small farmer as their day-to-day income depends on their production. Clearly, this kind of transition cannot be effective without support from not-for-profit financial institutions and the farmers.

Forestry, tea and coffee plantations are much less problematic. Damage by wildlife is a fraction of the cost of that caused by insects, for example. Organic tea and coffee plantations have become trendy under the pressure of international markets. Some certifications insist on landscape management, the protection of streams by rows of trees and landscape connectivity for wildlife. Even though large plantations had destroyed a lot of ecosystems, their impact on wildlife is somehow lower than other types of land-uses because large mammals can move through plantations. Forestry should be encouraged among small investors using fast growing species that are not invasive.

Cattle grazing in protected areas, is destructive. It lowers the plant productivity, erodes the soil, transfers nutrients out of the reserve, via dung, and propagates invasive species and diseases. Free ranging cattle is no more an option in modern India. It is actually disappearing from more developed districts and regions.

Maybe the largest industry of the future for the NBR is tourism. But tourism often destroys its very source of appeal and income. In order to co-exist with the emblematic wildlife, the tourism industry must be a force in favor of conservation. Till date, resort owners have failed to understand the challenge of landscape connectivity and have made no effort to protect their clients in ways other than by fencing their properties. Architecture itself, at the onset of any project, can greatly reduce the threats posed by elephants to a building and its inhabitants.

By-and-large, local communities are excluded from mainstream tourism. Again, as long as the economy relies on imported models, it will need to import trained personnel as well. It is unthinkable that the knowledge of local tribes is barely used in present-day tourism. Most Indians and foreigners would be interested in learning more about them

in a dignified and respectful manner. Most would probably like to buy traditional handicrafts produced by tribals.

In conclusion, the economic choices for the NBR can only come from an out-of-the-box kind of thinking. “Classical” activities do not work well. To make any project successful, information is needed about wildlife, legal aspects of national parks, landscaping and architecture for wild animals, inclusion of local communities, etc. Businessmen with little technical knowledge on biodiversity should have consultations with specialists (not limited to biologists but also anthropologist and sociologists) in India or abroad and examine as many documents as possible before starting a new venture. Living in a region for twenty years and seeing elephants every day does not necessarily transform a person into a specialist!

The Nilgiri Region, with its constraints and extraordinary wildlife resources is a living experiment. Being part of an experiment is not easy, but it could bring new, innovative approaches that could serve as a model in other parts of India.



Akshay Dev, Holy Cross Matriculation School

Schools in the NBR

This booklet has been written keeping in mind the school syllabus of Tamil Nadu, knowing that the syllabi in Kerala and Karnataka are similar. We have kept in the “Curriculum” (next section) the themes pertaining to animals, so that teachers can take up activities on nature, including elephants. These activities are part of the syllabus and should be used by the teachers.

In most part of India, wildlife is nowhere to be seen. In the Nilgiri Biosphere Reserve, children and teachers have the chance to live in one of the most fascinating environment on Earth, with elephants and tigers closeby. This is a unique privilege that should be fully exploited. Each school should be able to rent a bus and organize a tour to one of the reserves. This would replace a visit to a zoo that schools are encouraged to undertake.

This book also gives some hints on the differences between domestic and wild animals. Children should be able to comprehend that domestic animals can easily live with humans, but not wild animals. Children can explore the reasons for this, from this booklet. The elephant diet has also been mentioned together with the oral morphology and dentition.

Portions from the entire curriculum have been touched at some point or the other in this book. Even though it was not specially designed to teach, this booklet is a reminder that the best way to learn is to encourage curiosity. Most children (and students) in the Nilgiri Biophere Reserve should have a deeper knowledge of wildlife than in other parts of India simply because they can make observations from their windows. Moreover, many resources are found on the Internet, particularly in Wikipedia, meant to be used and overused by those who do not have access to specialized books.

To learn about nature, nothing replaces observation. If you have a cat, you know when it is hungry, when it wants to play, when it does not want

to be annoyed. You know because of experience. If you tried to learn this from books without ever handling a cat, you would be clueless. Books are a good source of information. But nothing replaces experience.

To start making observations, purchase a notebook and a pencil. Each time you see an animal or bird, put the date, location and its identification. If you are not familiar with the animal or bird, draw it rapidly and note its size (proportional to a mouse, a cat, a dog, a cow; sparrow, pigeon, crow, eagle), its color, and any distinguishing feature. Try to count the animals if they are several in the group, and identify their gender, age, etc, if possible. Note what they do and what they eat. After a few months, you will have enough notes to help your teacher. If you have developed an interest in nature, you can eventually ask your parents to help you purchase binocular, books on birds and mammals. Fauna books are books where you can identify animals. Some very good books are sold by the Bombay Natural History Society (<http://www.bnhs.org/>) at reasonable prices.

Whilst doing observations, you should be particularly careful.

First rule: never go close to a wild animal, particularly an elephant. Find a safe place for observation. Wild animals are not nasty, but they need their privacy, like us. As soon as they are alerted about human presence, they disappear or they attack. To make good observations, make sure you do not disturb the wild animal.

Second rule: be totally silent and make no sudden movement otherwise you will be seen.

Third rule: never lose sight of an elephant when you walk in the jungle. It could come silently after you.

Fourth rule: don't throw plastic and other trash around, this is dangerous for the environment and for wildlife, don't make a noise, and don't annoy small animals. You should leave nothing behind when you leave.

Curriculum (part)

In this paragraph, we have kept notes pertaining to animals in order to help teachers to undertake activities on elephants that are part of the syllabus and will not take extra-time. With these lessons fully completed, the teachers will be ensured that the syllabus is covered maybe most importantly with “material” close at hand, with which children are familiar.

Std	Expected outcome of learning	Concepts and periods	Transactional strategy
1	Knows about the various animals and birds living around us.	7) Animals and Birds 7.1 Animals and birds around us(10 Periods)	Visits the children’s park or zoo
2	Comprehends the characteristics of domestic animals/ wild animals. Able to differentiate domestic animals from wild animals.	3) Animal Life 3.1 Domestic animals / Wild animals (10 Periods)	3) Animal Life 3.1 Domestic animals / Wild animals (10 Periods)
2	Understands the food habits of domestic and wild animals.	3.3 Food of animals (5 Periods)	Illustrates the interdependence of animals, insects with pictures and charts.

3	Understands the similarities and dissimilarities between plants and animals / Animals and Man.	1.3 Similarities and differences between plants and animals Differences between animals and man. (4 Periods)	Discusses the dependence of one form of life on another.
3	Understands the food habits of animals and their classification based on their food habits.	3) Animal Life 3.1 Animals and their food habits 3.1.1 Herbivores and Carnivores. (4 Periods)	Pupils analyse the food habits of animals seen in the environment.
3	Understands the concept of adaptation.	3.2 Adaptation observed in fishes, birds and man to suit their mode of living(4 Periods)	Studies the relationship between the structure and function of the organs of the animal body.
3	Understands the modification of various parts of the mouth seen in animal to suit their feeding habit.	3.3 Feeding habits in animals (insects, reptiles, birds, mammals) (3 Periods)	Explains using specimen/models.
3	Recognizes the types of teeth seen in herbivores, carnivores and omnivores.	3.4 Dentition - Types of teeth (3 Periods)	Illustrates with diagrams and pictures. Observes the different mouth parts in insects, reptiles, birds and mammals.

3	Understands the need for movement.	3.5 Movements of animal 3.5.1 Organs of movement seen in insects, reptiles, birds, mammals. (3 Periods)	Imitate the movement of animals and birds
4	Infers that dispersal is essential for the scattering of seeds.	1.6 Dispersal of seeds (3 Periods)	Explains with varieties of seeds, which disperse by wind, water and birds/animals.
4	Understands the importance of animals. Identifies animals that are helpful in farms that yield fur / skin and those that yield milk / meat.	2) Animal Life 2.1 Useful animals (4 Periods)	Visits tanneries to observe how skin is treated in factories. Discusses about ways to minimize pollution due to effluents from tanneries.
4	Comprehends the various ways of protecting domestic animals.	2.2 Ways to protect domestic animals (4 Periods)	Shows love and concern for domestic animals.
4	Realizes the importance of conserving and protecting wild life.	2.5 Wild Life and Sanctuaries (3 Periods)	Visits game sanctuaries and prepares the list of endangered animals. Matches the sanctuaries with the state in which they are located.

4	Understands the importance of conservation of nature.	2.6 Conservation and Preservation of Natural Resources(3 Periods)	Takes efforts to preserve and conserve nature's bounty.
5	Recognizes the importance of natural resources like plants, animals, air, water, mineral, metals and rocks.	9.2 Importance of natural resources(3 Periods)	Discusses the occurrence of natural resources.
5	Realizes rapid depletion of natural resources due to indiscriminate uses.	9.3 Protection of natural resources(3 Periods)	Discusses the steps taken to utilize and preserve the natural wealth of our country.
5	Understands the relationship between population increase and the destruction of natural resources.	9.4 Effect of over population (3 Periods)	Discusses the importance of recycling, afforestation, rainwater harvesting as measures to add to natural resources.
http://www.tn.gov.in/matricsyllabus/			

Your elephant project

Project 1

You often see elephants and would like to do a real elephant project? This is not complicated. Each time you see an elephant, take your notebook and note: its gender, size, behavior (for each elephant seen), and apparent health (fell-fed, skinny) together with the date, time and location. The gender of young elephants may not be easy to distinguish. The best is to do it in the same location. Take pictures and name the elephants, if possible, in order to be able to recognize them individually.

After a few weeks, months or years, you will start seeing trends: regular visitors, seasonal visits and even population changes throughout the years. Your data may not be perfect at the beginning, but who knows, maybe you will be able to write a paper one day for the Journal of Bombay Natural History Society.

Project 2

You probably know that elephants are killed by vehicles. You can easily start an awareness project with your friends targeting drivers. Tourists and local drivers usually don't know that it is very important to respect the speed limits within a national park. Usually, the speed limit is 40 km/h. It takes approximately 20 m for a vehicle to stop at 40 km/h. This is quite short and comfortable enough to avoid almost any large animal. At 90 km/h, a speed reached by car drivers in national park, the stopping distance is 80 m. At such speed, nothing can be avoided.

Project 3

If your village is frequently visited by elephants and people get frightened, you can create a watch group that will take rapid and appropriate actions in order to protect people and the elephants:

Inform people about elephants.

Make sure you have the Police and Forest Department phone numbers to alert them immediately when a jungle visitor appears.

Organize people's retreat to safe places.

Calm people and advise them not to make noise, movement and do nothing that would provoke the elephant's reaction.



G. Nandana, Panchayat Union Middle School

Elephants are friends, but...

Many people can't believe elephants are dangerous. Some tourists even say: "but elephants are herbivores, how can they harm us?" Jeffrey Masson, an animal psychologist and best-selling author lived part of his youth in India and came back to enjoy the natural environment of the country. At some point he came close to a female elephant and its calf. The female started flapping her ears and Jeffrey Masson thought it was a welcoming sign. He continued to approach. But suddenly, the elephant charged. He survived the encounter because he had been lucky, could hide behind a bush and was in good physical form. People who made the same mistake are numerous: never go close to an elephant.

In any case, friends are the persons you respect the most. If your friend is an Argentinian, you will not be shocked if he goes to a church, eats beef and practice rodeo even if you are a non-violent, vegetarian Buddhist. You accept the differences. This should be the same for elephants. They have to be accepted for what they are.

Elephants are big and powerful animals that do not like agitation around them. Observation of elephants should be done discretely and as far away as possible. If an elephant starts flapping its ears, pointing in your direction with its trunk or making sudden movements, the best is to slowly retreat, carefully watching the animal in case it charges. If the elephant charges, well, you know what to do: review your life in a flash and run madly with a feeling of fear that never griped you so vividly. If you have a loose item of clothing or something in your hand, throw it so that the elephant gets distracted.

In the recent past, loud noises and bursting crackers prevented elephants from coming to villages. But their exit routes to the jungle were easy: they turned around and went back to their habitat. Today, elephants are starving. The best productive lands have been taken by agriculture and the remaining wilderness is invaded by alien, unpalatable species

like lantana. Elephants then enter the maze of human habitations and cannot easily return to the forest even if they wanted too. Consequently, they get frightened when people are agitated. They become fearful and destructive.

When elephants enter villages, the best thing is to call both the Police and the Forest Department. People should retreat out of danger and hide in order not to provoke panic. Strongly advise people not to throw stones or shout as elephants will panic. No rash action should be taken as the elephant has no idea that it destroys property. The personnel of the Forest Department are trained to handle delicate situations and will use domestic elephants to peacefully chase out intruders.

While traveling through a reserve (the maximum speed being 40 km per hour), the best is to slow down to admire elephants. But never stop if you see an elephant because firstly, it is prohibited by law and secondly it annoys the elephants.



Mohammed Ansari, Holy Cross Matriculation School

Tears of love

Up and down the Hill,
In the beautiful Mountain,
Lived a majestic mama elephant,
With her cuddly gullible calf
They walked up and down
the hill
with her trumpets heard
far away
They played together in the river
Splashing water on each other
Nothing could separate them
From each other
but fate had written something
in their name.
One day when mama elephant
went away for a while
the calf got caught up in the flame
as it did not know how to fight this
calamity.
It could just make a faint trumpet
which the mama elephant heard and
ran to save her calf at once
but by the time she reached
it was late,
the smoke had choked
up the calf vein
The mama elephant broke down
and shed her tears of
emotions.
she stood up there
to wait for her calf to respond..

it took her time to
digest the fact
that her child was
free from the worldly land
and silently He
has snatched the
bond of love.

Ishana Srivastava, 11th Standard, Ooty.



M.S. Amal, Panchayat Union Middle School

