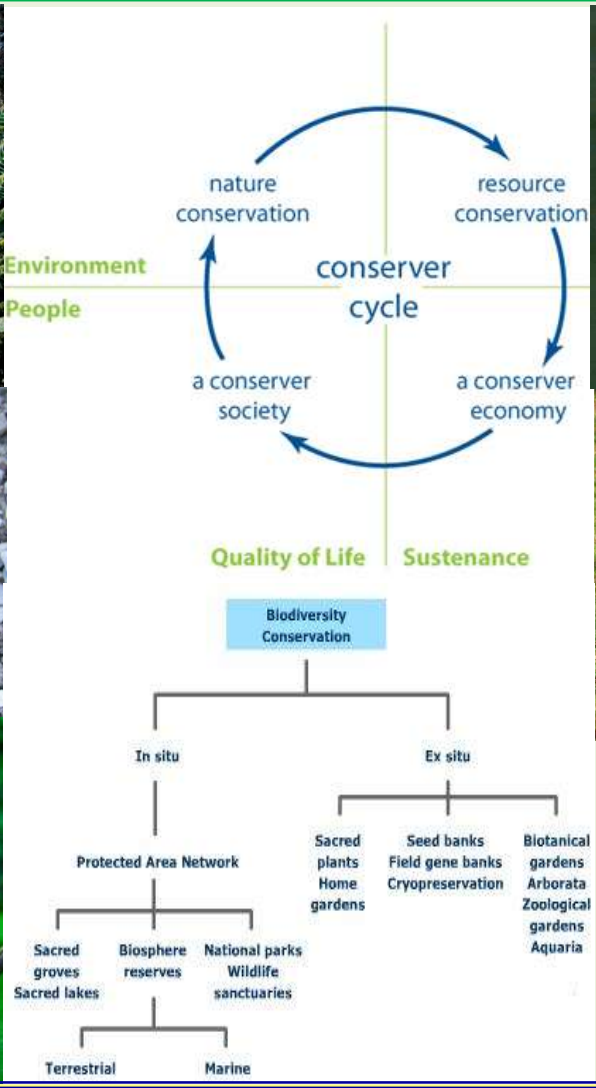
KARNATAKA STATE OPEN UNIVERSITY

MUKTHAGANGOTHRI, MYSORE – 570 006

M.Sc. in Environmental Science

(SECOND SEMESTER)



Course: ES 2.3 **Block III: Unit 9, 10, 11, 12**

BIODIVERSITY AND CONSERVATION

Karnataka State  **Open University**

Mukthagangotri, Mysuru - 570 006

Department of studies in Environmental science

M.Sc. in Environmental Science

Second Semester

Course: ES 2.3

Biodiversity and Conservation

Block III: Unit 9, 10, 11, 12

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Block Introduction

The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1964, is the world's most comprehensive inventory of the global conservation status of biological species. The International Union for Conservation of Nature (IUCN) is the world's main authority on the conservation status of species. A series of Regional Red Lists are produced by countries or organizations, which assess the risk of extinction to species within a political management unit.

The IUCN Red List is set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. The aim is to convey the urgency of conservation issues to the public and policy makers, as well as help the international community to try to reduce species extinction. According to IUCN (1996), the formally stated goals of the Red List are (1) to provide scientifically based information on the status of species and subspecies at a global level, (2) to draw attention to the magnitude and importance of threatened biodiversity, (3) to influence national and international policy and decision-making, and (4) to provide information to guide actions to conserve biological diversity.

Human should conserve biodiversity because of its benefit for example services and biological resources which are essential to live our life on earth. It leads to to conservation of essential ecological diversity to preserve the continuity of food chains, genetic diversity of plants and animals is preserved, ensures the sustainable utilization of life support systems on earth, provides a vast knowledge of potential use to the scientific community. It also a reservoir of wild animals and plants is preserved, thus enabling them to be introduced, if need be, in the surrounding areas. Biological diversity provides immediate benefits to the society such as recreation and tourism. Strategies for conservation of biodiversity are dealt in this block.

This block consists of four Units. In Unit 9, we dealt with endangered plants of India, in Unit 10, endangered animals of India, in Unit 11, conservation strategies and acts, and in Unit 12, wildlife conservation projects in India are covered.

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UNIT 9: ENDANGERED PLANTS OF INDIA

STRUCTURE

9.0 OBJECTIVES

Indian is one among the few countries on Earth that are blessed with the natural resources. This is true with plant resources also. There are number of useful plants in our country. We have varieties of plants belonging to all taxonomic groups. We have herbs, medicinal plants, spices, fiber, timber and many other useful plants. Many plants herald the heritage of our country. People in our ancient civilizations used these resources judiciously and protected the plants as treasure. However, moderation and industrialization of our country has led to mass depletion of the forests and natural reserves. Therefore many of our valuable have already become extinct and many others have become highly endangered and on the verge of extinction.

After reading this unit you will be able to

- Discuss the status of plants in India
- List out the endangered plant species of India

9.1 INTRODUCTION

India has a unique and at the same time diverse topography, climate and terrain that promote vegetation unsurpassed elsewhere in the world. The nation has thick rain forests, tropical forests, deciduous forests and coniferous forests that include many species of plants, herbs and trees. Because of vastness of the country and variety it is known for its vast natural resources, flora and fauna and forestry that are rich in herbs and medicinal plants. Ancient Indian civilizations indulged in the "herbal" way of life called Ayurveda, wherein all types of ailments, diseases and illnesses were treated through herbs and medicinal plants. Even to this day there are certain parts of India, such as Kerala and Orissa that follow the age-old tradition of Ayurveda.

It is estimated that there are 10 million species of herbs, plants and trees, among which half of them are grown in the tropical rain forests of India. These plants are robust in secondary metabolites that protect them from diseases and insect attacks and have great medicinal value. More than 121 prescription drugs sold worldwide contain plant derivatives specially sourced from these rain forests. Incidentally, this is only one percent of what nature has to offer us. There are many other useful plants and animals in our forests.

Many tribes in the Indian subcontinent are known to have lived off these forests and actually survived on the now endangered species of plants and trees. Increase in population

and modernization have led to neglect of these natural resources. The cutting down of rain forests and tropical forests for wood and other products or burning of these forests for land acquisition happens daily. While efforts are being mobilized by national and international organizations to save these forests, there is actually very little being done at the base level. This could lead to not only the extinction of rare plants and herbs but also cause imbalance in nature as the forests and the plants are ecologically very important. Today we have a big list of species which have become either endangered or threatened. If protection is not given to them they would soon become extinct. To strengthen our protection measures, we need to know which species are endangered.

9.2 MICROBES

It is said that the world is full of bacteria and they also can increase at a fast rat e. However, there are certain bacteria that are fast becoming an endangered species. The bacteria that live in the gut of humans are fast disappearing. These bacteria comprise of the good bowel flora that is needed to create vitamins and break down undigested foo d. Due to extensive use of antibiotics by humans, they are endangered. Another class of endangered species are those which synthesize food enzymes. These enzymes are needed for the optimum digestion of food. The body's own supply is diminishing day by day by eating mostly cooked food, and these enzymes are not being replenished through our modern diets. Food allergies, candida, irritable bowel syndrome and even cancer, are all symptoms of a lack of friendly bacteria and enzymes in our gut. It has been noted that no cancer patient has healthy bowel flora. Thus many microbes symbiotically associated with humans have become endangered. Even some bacteria found in the domestic livestock and other wild animals might have become endangered.

Even some microbes which cause disease are on the verge of extinction. Vaccines and improved hygiene have greatly reduced the numbers of various microorganisms. These microorganisms were and are known to us because they affect humans in adverse ways. For example the incidence of diseases caused by microbes such as small pox virus, rubella virus, tuberculosis bacteria, tetanus, diphtheria, cholera, measles etc. has drastically come down. This means these species have become endangered and they are gradually moving towards extinction. Of course they are pathogenic and harmful and their extinction may not cause any negative effect on humans or other organisms.

9.3 CRYPTOGAMS

Algae: There are also a few algal species which have become endangered. For example, there are at least five species of the genus *Nitella* which have become endangered around the globe out of which at least two are from India. Eighth International Phycological Congress held in Durban, South Africa during 2005, has identified nearly 450 species of algae including green and red alga as endangered. Conservation strategies to be adopted have also been worked out during this congress. In India no specific study on the endangered algae has been made and also a list of endangered algal species is available.

Fungi: Fungi are eukaryotic organisms lacking chlorophyll and vascular tissue and include mushrooms, yeasts, molds and smuts. There are two species of fungi which have been included in the IUCN Red list as endangered. They are, *Pleurotus nebradensis* and *Erioderma pedicellatum* (Lichen). These two species are not available in India and the status of fungi in here is not clear.

Bryophyta: Bryophytes, more commonly known as liverworts, mosses and hornworts, are non-vascular plants which generally favor moist habitats. Bryopthytes are distinguished from vascular plants by their lack of xylem and phloem (the vascular tissue) and the sporophyte (the spore-producing body) being dependent on the gametophyte (the easily visible and more familiar body of the plant). The species listed below are universally threatened by habitat loss. Taxitheliella richardsii, Thamnobryum angustifolium, Vandiemenia ratkowskiana, Bryopteris gaudichaudii, Phycodepidozia exigua. There is no information on endangered bryophytes from India.

Pteridophyta: The pteridophytes are non-flowering, vascular and spore-bearing plants including ferns and fern-allies. They are also often called vascular cryptogams. They grow luxuriantly in moist tropical and temperate forests and their occurrence in different eco- geographically threatened regions from sea level to the highest mountains are of much interest. The world flora consists of approximately 12, 000 species of pteridophytes of which around 1000 species distributed in 70 families and 192 genera are likely to occur in India. The pteridophytes being an important part of the flora of a region, form the next important part after the angiosperms. There are a large number of indigenous species of which a considerable percentage is rare and threatened. Due to over-exploitation of natural resources and large scale land transformations, the pressure on the threatened and endangered species has increased. Hence they may face the brunt of extinction in the coming years. Some pteridophytes are used for medicinal purposes, some are soil binders and some are grown as

ornamental plants**.**

The pteridophytes are classified in to two major classes; Lycopodiophyta and Monilophyta. Most of the living pteridophytes belong to these two groups. In addition to these living groups of pteridophytes are several groups now extinct and known only from fossils. These groups include the Rhyniophyta, Zosterophyllophyta, Trimerophytophyta, and the progymnosperms. Modern studies of the land plants agree that all the pteridophytes share a single common ancestor. However, they are not a clade (monophyletic group) because the seed plants are also descended from within this group—probably close relatives of the progymnosperms. The IUCN has done significant work in documenting the species which are facing threats and the red data book gives an insight into such species and their conservation status. Their World Conservation Monitoring Centre at Cambridge, England, listed 1650 threatened species of Pteridophytes world-wide. Some studies have also been carried out on the threatened pteridophytes of India. Bir and his co-workers have listed 104 rare and endangered species of pterydophytes from India. There are also area wise reports like that of Western Ghats, Rajasthan, Assam etc. Jenkins (2006) has suggested that a total of 219 species are at risk, out of which 160 were critically endangered. 82 species are considered to be near threatened while 113 species were considered under the rare category.

Equisetaceae is often called the horse tail family. All most entire group has now become extinct except the class equisitales. The only surviving genus is equisetum which consists of twenty species. They are large tree like ferns. The members of this group must have originated in the Devonian period and now majority of them exist only as fossils. Pseudobornia appears to be the oldest fossil to which all the modern equisitales belong to. *Equisitum diffusum* is the Indian species found in Himalayan region which is presently endangered. They are believed to have medicinal value, hence destroyed. The group Lycopodiaceae belonging to class Lycopodiopsida is a family of primitive vascular plants, including all of the core clubmosses. These plants bear spores on specialized structures at the apex of a shoot; they resemble a tiny battle club, from which the common name derives. There are three well known genera, Huperzia, Phlegmariurus and Phylloglosum. The spores of these plants are used in preparation of lycopodium powder, which is filled in violin. It also has medicinal value. Selaginella is a member of Lycopodiopsida which has more than 700 species. The species enjoys a good distribution. The indian species, *S. bryopteris* is known as Sanjeevini, which is believed to have medicinal value. Because of over exploitation some species are endangered.

9.4 PHANAROGAMS - GYMNOSPERMS

Gymnosperms form a group of Spermatophyta. They are also classified under tracheophytes. They possess xylem with tracheids and phloem with sieve cells but with out companion cells. They are all woody ever green perennials. They may be branched or unbranched. The tallest living gymnosperm is Sequoia semipervirens which is often commonly called red wood giant tree. It grows to a height of about 350 feet. The smallest gymnosperm is Zamia. These plants are heterosporous bearing both microspores and megaspores. All gymnosperms are pollinated through wind.

There are three classes of gymnosperms; Cycadopsida, Coniferopsida and Gnetopsida. About half of them are believed to be endangered. It is estimated that more than half of 182 species of cycadales are endangered or vulnerable and have become rare. Microzamia, a genus of 38-40 species are endangered or threatened. Avalicassia, a member of conifers is extinct. Presently about 65 genera and 720 species are remaining.

Among gneto psida, Ginko biloba is a unique species recognizably similar to fossils dating back to 270 million years. The trees grow to a height of 20-30 meters with angular crown of branches. This is considered as living fossil. Gingko has been said to have evolved in an era earlier to the birth of flowering plants. It is native of China and cultivated in various parts of the world. Medicinally it is an enhancer of concentration and it is used as an anti- vertigo agent.

Cycas beddomi is placed in red list of IUCN. It means the plant is critically endangered. The survivability is possible by micropropagation. It is a native of east India. Probably it was well distributed once in eastern ghat region including Thirumala hills, now their number has been dwindled.

Cycas circinalis is a species distributed in the whole of Indian subcontinent, now restricted to western ghats including Kerala, Karnataka, Tamil Nadu and south Maharashtra. It was found in Chamundi hill, Mysore some thirty years ago but now not even a single tree is found.

The causes for the destruction of these gymnosperms are habitat loss, over exploitation and other anthropogenic factors. Land clearing has destroyed about 50% of the habitat of gymnosperms. Because of medicinal value of pith, leaves and stem they have been overexploited. Today some conservation measures have been taken up by Karnataka Government and a few gymnosperms found in Melukote temple wildlife sanctuary and Nilgiri biosphere reserves are being protected. The Tropical Botanical Gardens and Research Institute (TBGRI) located at Palode-Trivandrum in Kerala is an alternate centre for ex-situ conservation centre for Cycas.

9.5 PHANAROGAMS - ANGIOSPERMS - DICOTS:

They are the flowering plants. They constitute the majority of the visible living plants. There are about 3,52000 species of flowering plants in the world. Among these the smallest is *Arceuthobium minutissimum* which is a parasitic flowering plant living on conifers and another free living plant Wolffia augusta. This plant is just one millimeter long. The tallest plant is *Eucalyptus regnans* found in Tasmania which grows to a height of more than 100 meters.

An adult angiosperm plant is a diploid sporophyte. The plants are either annual or biannual or perennial. They reproduce sexually by producing the flowers. Many of them are bisexuals with both ova and pollen produced in the same flower. The flowers are beautifully colored, variously shaped and even scented. Many plants produce flowers which give pleasant feeling. They have different mechanisms of pollination.

IUCN has listed several thousands of angiosperms which are grown in different parts of the world as endangered. In India around 1500 species are endangered. Some are threatened, some are vulnerable and some have become rare.

If you go through the literature, you will find about 179 species of angiosperms are critically endangered in India. The following are some examples. *Rawolfia serpentina, Gloriosa superaba, Balanophora polyandra, Cassipourea ceylonica, Stemona tuberosa, Ventilago madraspat ana, Ceropegia hirsutum, C.pusilla, C. spiralis, Tylophora rotundif olia, Tinospora sinensis, Carissa gangetica, Psychotria f ulva, Indiof era asfolethoides, Leucas clarkia, Acacia donaldii, Phoenix paludosa, Litsea glutinosa, Holossemia odokodien, Gymnema sylvastre, Pimpinella tiruptiensis, Pterocarpus marsupium, Aegel marmelos, Santalum album, Savala asoka, Syzygium travancorium* etc. The list is quite elaborate.

Several of the species of Asclepiadaceae are critically endangered like *Brachystemma, Ceropegia, Holostemma and Tylophora* etc. The reason for their dwindling is the encroachment of habitat, animal grazing particularly the domesticated animals like goats, sheep, cattle etc. The tubers of Brachystemma and Ceropegia are eaten by local people. These plants are dependent on insects for pollination. Very important crucial point of their becoming endangered is that they produce very few seeds.

A few species of Brachystemma kolarensis and *B. ciliatum* could not be collected in the last 33 years from anywhere in India. Perhaps they have become extinct or they have become so rare that they are not traceable now. There is a greater need to conserve many of these species.

Rawolfia serpentina is a member of Apocyanaceae. It is commonly known as snake root or Indian snake root. The root is a source of a substance called reserpine which is an alkaloid. This is extensively used to treat hypertension and as an antidote for snake bite. It was reported that Mahatma Gandhiji used sarpagandha throughout his life time but not as a tranquilizer. This plant has become endangered because of commercial production of resperine. The plant is also used in Ayurveda, Unani and in Folk medicine. It helps to reduce blood pressure, depression of central nervous system and act as a hypnotic substance.

Melanophora polyandra is critically endangered. It is a parasitic plant present in South China, India, Vietnam, Thailand and Nepal. While the plant acts as antipyretic antidote, hemostatic and hematopoietic substance. In Folk medicine, it is used to treat Gohorrhoea, Syphilis and other sexually transmitted diseases. The plant contains significant amount of phenolic compounds and serves as an antioxidant.

Listea glutinosa belongs to Lauraceae. It is also critically endangered. The bark extract has antimicrobial property against Pseudomonas, Aeroginosa, Salmonella typhii etc. Because of this medicinal value the plants are over harvested.

Phoenix paludosa is the common mangrove date palm. As per IUCN list this is a threatened species. Paludosa in latin means swampy. This is growing along the coastal regions of India, Bangladesh, Myanmar, Thailand, Malayesia and Peninsular India. These palms are threatened by exploitation for timber and leaves.

Cassipourea ceylonica belongs to Rhizophoraceae. It is a monotypic tree genus.
This has also reached critically endangered status as per IUCN red list.

Ventilago madraspatana is a large, woody, evergreen climber belonging to Rhamnaceae family. The branches hanging down in festoons; bark dark grey with vertical cracks exposing the vermillion inner bark surface. They bear numerous flowers which are 3 to 5 mm across, yellowish-green, with an offensive odour. The plant has medicinal value which is used as carminative, stomachic, tonic and stimulant (root bark) and antiallergic (plant).

Ceropegia hirsutum belongs to Asclepiadaceae. It is commonly called as hairy ceropegia. It is a climbing plant with subterranean tuber. The flower-tube is light beige colored and mottled olive-brown or purple upwards.

The petals are very broad and yellowish or apple-green coloured. In India the tubers are overharvested because they are eaten as a vegetable. Once they were abundant in parts of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu but now restricted to Coimbatore, Dindigul, Nilgiri and Tiruchchirappalli Districts of Tamil Nadu. Some species are found in Thailand.

Tylophora is a genus of climbing plant. Presently it is included under Apocynaceae. It consists of about 60 species from tropical and subtropical Asia, Africa, and Australia, most of which are perennial lianas. The name is derived from the Ancient Greek, tylos means knot, phoros means bearer. *Tylophora rotundifolia* is the Indian species which has been included in the red list as endangered.

Tinospora sinensis is clommonly called Malabar Gulbel. It belongs to the family Menispermaceae. The plant is a deciduous, climbing shrub with stem prominently having scattered lenticels. Flowers are formed in racemes from the axils of fallen leaves and also on the old stem, greenish yellow, many, 5 mm across. Male and female flowers are seen separately in the same plant. It is now considered a threatened plant.

Carissa gangetica belongs to Apocynaceae. It is a shrub with glabrous spines on branches. Leaves ovate or ovate-rhomboid and mucronate, apex acute or obtuse. Flowers white. Fruits ellipsoid, ovoid, glabrous. These plants now are found in Mahendragiri of Ganjam District of Orissa.

Psychotria belongs to the family Rubiaceae. There are two speices, *P. fulva* and *P. silhetensis* and both seem to be endangered.

Indigofera is a large genus of about 700 species of belonging to the family Fabaceae. The species are mostly shrubs, though some are herbaceous, and a few can become small trees up to 5–6 m (16–20 ft) tall. Most are of them are dry deciduous. The flowers are small, produced on recemes. Several of them and especially *Indigofera tinctoria* and *I. suffruticosa* are used to produce the dye indigo. Because of this the plants have lot of commercial value. The chemical aniline, from which many important dyes are derived, was first synthesized from *I. suffruticosa.* Several species of this group are used to alleviate pain. The herbs are generally regarded as an analgesic and anti-inflammatory activity. Some plants are used against tooth ache, insect bite and swelling. The Indian species *Indiofera asfolethoides* is included as threatened species.

Acacia donaldii belongs to Leguminosae. This species is endemic to India. It is listed as occurring in Bihar, Madhya Pradesh, Chhattisgarh, Orissa and West Bengal. However, today, no records for Bihar or West Bengal are found. It is believed that they are distributed in Maharastra at present. However, it is not listed in the Floras for this area, and may be an error, or may no longer be present here.

Pterocarpus marsupium, commonly called Indian Kino tree is a medium to large, deciduous tree that can grow up to 30 metres tall. It is native to India, Nepal and Srilanka, where it occurs in parts of the western ghats in Karnataka Kerala region. Parts of the Indian Kino (heart wood, leaves, and flowers) have long been used for their medicinal properties in Ayurveda. The heart wood is used as an astringent and in the treatment of inflammation and diabetes. The gum resin is the only herbal product ever found to regenerate beta cells that produce insulin in the pancreas. The trees are also used as timber. These trees are distributed in the western ghat region and because of overexploitation for timber and medicinal use it has become endangered.

Santalum album or Indian sandalwood is a small tropical tree, the most commonly known source of sandalwood. The height of this evergreen tree is between 4 and 9 metres. It is known for fragrance of woody parts. It also has medicinal value. Most important use of the plant is that it is used for wood working for preparation of arts. It is a semiparasite on the roots of other plants. It has long life and can live over hundred years. Because of semiparasitic nature it is difficult to cultivate them. The plant has become vulnerable because of overexploitation.

9.5 PHANAROGAMS - ANGIOSPERMS - DISTRIBUTION OF MONOCOTS:

Monocotyledons are the second major group of flowering plants or angiosperms. Monocot seeds typically have a single cotyledon in contrast to the two cotyledons typical of dicots. According to IUCN, there are 59,300 species of monocots. The largest family in this group (and in the flowering plants as a whole) by number of species are the orchids (family Orchidaceae), with more than 20,000 species. Monocots form an important group in the plant kingdom because majority of the consumable biomass is produced by monocots. The true grasses, family Poaceae (Gramineae), are the most economically important family in this group. These include all the true grains (rice, wheat, maize etc.) the pasture grasses, sugar cane and bamboo. Other economically important monocot families are the palm family (Arecaceae), banana family (Musaceae), ginger family (Zingeberaceae) and the onion family (Alliaceae), which includes such ubiquitously used vegetables as onions and garlic.

The monocots enjoy wide distribution. Because of the commercial value many of them are cultivated. They occupy a prime place in Agriculture because majority of the food plants belong to this group. They are found both in the terrestrial and aquatic habitats. There are also many wild species present. It is believed that the monocots have evolved about 140- 160 million years ago in the late Cretaceous period. It is also believed that the first evolved monocots were aquatic and then they became terrestrial. True grasses have evolved later to become highly specialized for wind pollination.

Although monocots enjoy wide distribution, many wild species are endangered. The reasons for their extinction are habitat destruction, over-exploitation because of their commercial importance, pollution and dwindling population of their pollinators. Following are some of the monocots which are endangered.

Gloriosa superaba is a small herb climbing by leaf tip tendril found in western part of Tamilnadu and Karnataka. This was noticed in Jharkhand in 2011 after several years. IUCN has declared it as endangered. Tubers are used for treatment of bruises, sprains, chronic ulcers, haemorrhage, and cancer. Most importantly it is used in preventing impotence, infertility and skin problems. The toxic alkaloids like colchesine, gloriosine are extracted from this plant.

Stemona tuberosa is a monocot belonging to the family Stemonaceae. It has lot of medicinal value in Chinese and Indian system of medicine. It also has insecticidal property hence used for treatment against headlouse and body louse.

Bactris nancibennis is a palm is found only in French Guiana. Two individuals are known; one has been moved to Orstom Botanical Garden, the other is found next to a road.

Aloe vera, commonly called bastard quiver is a familiar medicinal succulent plant. It is distributed in most part of India. Unlike *A. vera, A. pillansii* is capable of growing up to 10m in height. It is located mainly in the Richtersveld region of the Northern Cape Province of South Africa; reports of specimens north of this location are apparently unsubstantiated. The wild population does not appear to be regenerating; there has been little reproduction in the last century and older individuals are dying. The species is also threatened by collectors, overharvesting for its medicinal use, climate change and herbivory.

Paphiopedilum adductum is an orchid endemic to high elevation forests of Mindanao Island in the Philippines, P. adductum is subject to the same pressures and threats which face a great many of the Orchidaceae: habitat loss and disturbance, encroachment and collectors for local and international trade.

Fewer than 600 individuals of *Scilla morrisii,* a this perennial squill species are known, separated into three isolated sub-populations and all within an area of less than $2km^2$ in north- western Cyprus. The plant largely grows in the field layer of old oak woodlands or in shaded crevices and banks. The population appears to be stable. However, habitat conversion and road construction are present and growing threats. Many orchids in India also have become endangered.

9.7. SUMMARY

The slogan, unity in diversity applies not only to human population but also to flora and fauna of India. It has diverse topography, climate and terrain that promote vegetation unsurpassed elsewhere in the world. The country has rain forests, tropical forests, deciduous forests and coniferous forests that include many species of useful plants, herbs and trees.

It is estimated that there are 10 million species of herbs, plants and trees, among which half of them are grown in the tropical rain forests of India. There are many valuable trees in the forests which are used as fiber, firewood, timber and other purposes. Many plants and plant products have medicinal value. More than 121 prescription drugs sold worldwide contain plant derivatives specially sourced from the rain forests. Products like gums, pastes, resins, rubber etc. also are obtained from these forests. Because of habitat degradation, overharvesting and for other reasons some of these plants have become endangered. You are now familiar with those species which have become endangered. The endangered microbes, algae, fungi, bryophytes, pterydophytes, gymnosperms and angiosperms have been listed here. The causes of their depletion are also discussed. If protection is not given to them they would soon become extinct.

9.8. KEY WORDS

Algae, Ayurveda, Bowel flora, Endangered cryptogams, Fungi, Bryophytes, Pterydophyta, Gymnosperms, Angiosperms, Monocots, Herbal medicine, Food allergy,

9.9. QUESTIONS FOR SELF STUDY

1. List out the endangered micro-organisms. Explain why they have become endangered.
2. Some species of lower plants like algae, fungi and bryophytes have also become endangered. Why?

3. Substantiate the statement that when compared to angiosperms there are few gymnosperms and many of them are endangered.
4. Write an account on endangered dicotyledons and the causes of their depletion.
5. Discuss about the endangered monocotyledons.

9.10. REFERENCES AND FURTHER READING

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UNIT 10: ENDANGERED ANIMALS OF INDIA

STRUCTURE

10.0. OBJECTIVES

Today the position of wildlife is alarming, and many species are greatly endangered and losing the battle of survival. Some species are on the verge of extinction. The word endangered means, a species whose population size is dwindling and reached to a state of minimum numbers. Endangered species is also defined as a species with a population of organisms which is facing a high risk of becoming extinct because it is either represented by very few individuals, or threatened by changing environmental or predation parameters. The International Union for conservation of Nature (IUCN) periodically lists out the species which are endangered and publishes the list in the form of Red Data Book. Many animal species in India also are endangered.

After reading this unit you will be able to

- Identify the endangered animals ofIndia
- Learn about Red data book

10.1. INTRODUCTION

Nature is bountiful with its own flora and fauna. The fauna includes all categories of animals, microbes to mega mammals, herbivores and carnivores. Nature also has its own way of maintaining the ecological balance. But, man's greedy advancements in making progress have left a deep impact on other creatures. In an effort to create the situations according to his wishes, man has gone beyond his limits, and has made many animals as critically endangered. India is home to a vast diversity of plants, animals and bird species. It is believed that there are more than 400 mammals, 1200 birds. Many of these animals are endangered. As environmental science students you need to learn about these endangered animals of Indian continent. Following is a brief group-wise account of such endangered species.

10.2. RED DATA BOOK

On the basis of distribution, the species are classified as cosmopolitan, widespread and endemic. But this classification does not indicate the survival status of that species. On the basis of survival status species are classified as, threatened, endangered, critically endangered species etc. This classification is made by International Union for Conservation of Nature (IUCN) periodically and listed in the form of a book called Red data book. Red data book is an inventory of global conservation status of biological species. A series of regional red lists are produced by countries or organizations, which assess the risk of extinction to species within a political

management unit.

The IUCN red list is set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. The aim is to convey the urgency of conservation issues to the public and policy makers, as well as help the international community to try to reduce species extinction.

Major IUCN sponsored species assessors around the globe are BirdLife International, Institute of Zoology - the research division of Zoological Society of London, World Conservation Monitoring Centre, and many specialized groups within the IUCN Species Survival Commission. Collectively, assessments are made by these organizations and groups and included in the red list.

Generally IUCN intends to re-evaluate the status of every species every five years if possible, or at least every ten years. This is done in a peer reviewed manner through IUCN Species Survival Commission (SSC) Specialist Groups, which are Red List Authorities responsible for a species, group of species or specific geographic area, or in the case of BirdLife International an entire class, Aves.

Species are classified by the IUCN Red List into nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation. Following is the classification and the criteria for such classification.

1. Extinct (EX) – No known individuals remaining. The description of such animals is available only in literature. Animal is not sighted for long time in the wild nor any animal found in captivity. They are represented in black color. Examples: Atlas bear, Dinosaurs, Dodo, Passanger pigeon, Wooly mammoth etc.

2. Extinct in the wild (EW) - Known to survive only in captivity or found as naturalized population outside its original range. Animal is not found in the wild. They are represented in black color. Examples: Barbary lion, Catarina pupfish, Hawaiian crow, Northern white rhinoceros, Wyoming toad etc.

3. Critically endangered (CR) - Extremely high risk of extinction in the wild. It is represented by just a few individuals in the wild. They are represented in red color. Examples: Addax, Asiatic cheetah, Axolot le, Bactrian camel, Brown spider monkey, Gharial, Leatherback sea turtle, Lion tailed macaque.

4. Endangered (EN) – High risk of extinction in the wild. They are represented by small number of individuals which are in the danger of immanent extinction because of unfavorable environmental and human factors. They are represented in red color. Examples: Asian elephant, Asiatic lion, Blue whale, Dhole, Giant otter, Green sea turtle, Pygmy hippopotamus, Snow leopard, Tiger.

5. Vulnerable (VU) – High risk of endangerment in the wild. This is also called depleted species. These are species having sufficient number of individuals, but the organisms are threatened with depletion because of some factor which makes the population size decrease rapidly so that in near future the species can become endangered if the unfavorable environment continues to prevail. They are represented in yellow color. Examples: Clouded leopard, Cheetah, Dugong, Blue eyed cockatoo, Indian rhinoceros, Mandril, Sloth bear, Yak.

6. Near threatened (NT) – Likely to become endangered in the near future. The species enjoys good survival status at present but threatened with extinction in the near future because of inability to utilize the full biotic potential of the species such as reproductive ability, imbalance in sex ratio etc. Such species will recover when proper protection is given. These species are listed in pink pages and shifted to green pages upon their recovery. Examples: Asian golden cat, leopard, Blue billed duck, striped hyena, Tiger shark, White eared pheasant.

7. Least concern (LC) – These species are at lowest risk. They do not qualify for a more at risk category. Widespread and abundant taxa are included in this category. They are listed in green pages. Examples: Indian peafowl, Baboon, Baboon, Brown rat, Common wood pigeon, House mouse. Rock pigeon, Howler monkey etc.

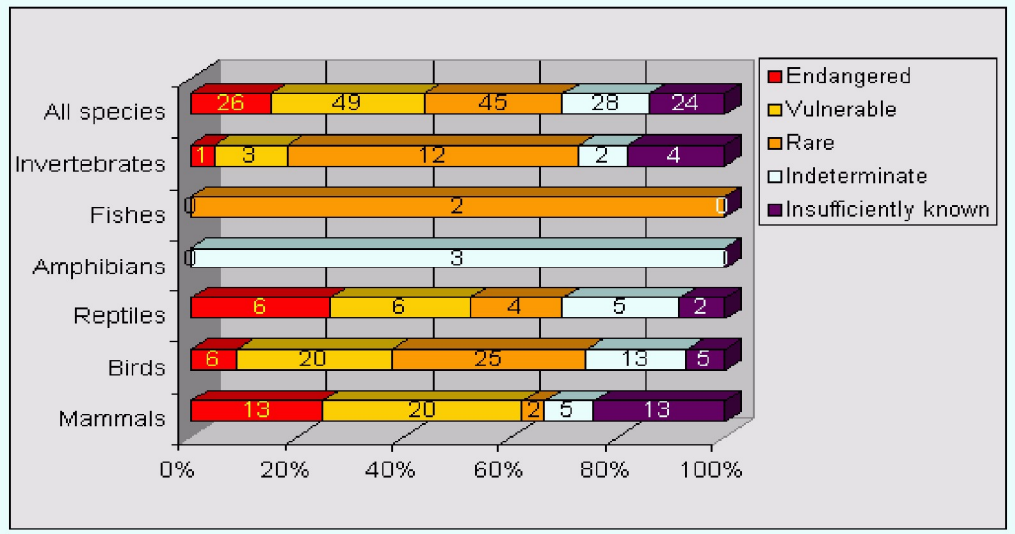
8. Data deficient (DD) – Not enough data to make an assessment of its risk of extinction is available for them.

9. Not evaluated (NE) – Has not yet been evaluated against the criteria.

10.3. INVERTEBRATES

The invertebrate fauna in India is diverse. There are large numbers of invertebrates representing different groups. There are more than 5070 known species of marine and non- marine molluscs living in t he wild in India. It is estimated that more than 1740 species of spiders, 282 species of ladybird, 450 dragonflies and damsel flies, 1450 species of butterflies, 1250 species of ants in addition to others.

All these species do not enjoy equal survival status. Species like monarch butterflies, gypsy moth, emperor moth etc. are supposed to be endangered. The above diagram shows the percentage of endangered, vulnerable and rare species in addition to others. Four insect species, two species of freshwater molluscs, and one species of freshwater plant have been assessed. The above percentages are only tentative and we really do not have a true figure of these. This percentage is calculated on the basis of the described species of invertebrates. It is also said that the check lists of invertebrates available now is only few species and there are many more species which are un-described. Obviously there must be many more species of invertebrates which are endangered than actually the figures projected.



10.4. LOWER VERTEBRATES

IUCN is preparing the list of endangered species on India after 13 years. Among fishes around 30 species in the Western Ghats and around 75 species in other parts of India have been included in the endangered species list and 15 species in the critically endangered. The Nilgiri shark, a fresh water fish is highly endangered. There has been no sighting of this species of fish from the Tamil Nadu region of the Western Ghats for the last 20 years. Species like *Puntius manipurensis, Schistura kanjupkhulensis, Schistura minutes, Schistura reticula, Pterocryptis barakensis, Badis tuivaiei* and *Psilorhynchus microphthalamus* are some of the species which have become critically endangered. It is estimated that among Indian fishes about 2% are endangered.

Among Indian amphibians, about 3% are endangered. The most endangered is the Himalayan newt or Indian salamander (*Tylotriton verrucosus* is of interest. This species was once distributed in eastern and northern India. It is now restricted to a small pockets of Darjeeling District of West Bengal, Sikkim, Arunachal Pradesh and Manipur. Habitat destruction and aquatic pollution seems to be the main reason for their shrinkage. The viviparous toad *Nyctophrine tuberculosa* is a very rare amphibian distributed in Malabar rain forests. The apodan *Ichthyophis* has become restricted to small pockets of Western Ghats. Garo hill tree toad, *Nyctophryne kempii* found in Garo Hills of Meghalaya is another small toad with webbed toes and fingers. The tips of the toes are rounded and the tympanum is hidden. There are also a few other frogs and toads found in Western Ghats which have been threatened.

10.5. REPTILES

All major groups of reptiles including turtle and tortoises, lizards, snakes and crocodiles are found in India. Among these, twelve to fifteen percent of Indian reptiles are believed to have become endangered and vulnerable. They are chiefly exploited for flesh and eggs as food, skin and shell for fancy leather articles and handicrafts, teeth and bones as charms, fat for medicinal purposes. Living snakes are caught by snake charmers.

The flesh of turtles, tortoises and terrapins is consumed throughout the country. They are collected from both inland and marine sources. Shells are also of high value. Because of this reason they are killed and have become rare. Particularly endangered are leatherback or trunk turtle - *Dermochelys coriacea*, the loggerhead or olive ridley - *Lepidochelys olivacea*, green sea turtle - *Chelone mydas*, and the hawks bill or tortoise shell turtle - *Erectmochelys imbricata*. The box turtle - *Butagar baska* and three keeled turtle - *Geomyda tricarinata* have also become greatly endangered.

All the three species of crocodiles *Crocodylus porosus* found in estuaries and bay islands, marsh crocodile *Crodylus paulustris* found in island marshes and larger water bodies all over India and the gharial *Gavialis gangeticus* found in big rivers are leading precarious life. There is some sign of recovery of *Crocodilus paulistris* because of captive breeding in snake parks and crocodile parks.

There are five species of monito r lizards; common Indian monito r - *Varanus bengalensis*, desert monitor - *V. griseus* found in arid and semiarid zones of western India, yellow monitor - *V. flavescens* found in northern India, water monitor - *V. salvator* found in the estuarine and fresh water swamps of eastern parts and clouded monitor - *V.nebulosa* found in eastern India and Bay islands

are greatly endangered. Among snakes, rock python - *Python molurus* found in dense forests and reticulated python - *P.reticulara* of tropical and subtropical forests of eastern and north eastern India are killed for the ornamental skin. The egg eating snake *Elachistodon westermanni* is a rare species found in Himalayan foot hills. In addition to these endangered reptiles many snakes and lizards are listed as threatened species by IUCN.

10.6. BIRDS

There are 2100 species of birds of which six percent are endangered, twenty percent are vulnerable and 25 percent are considered rare. Among ducks, geese and swans which belong to the family Anatidae, pink hued duck - *Rhodonessa caryophyllacea* occurred in the forest ponds and swamps along Himalayan foot hills and Terai from Nepal to Manipur and also sporadically in parts of Punjab and Tamilnadu. At present it is probably extinct from India. The white winged wood duck - *Carina scatalata* nesting in dense swampy forests of Assam, Arunachal Pradesh and Manipur has become endangered. The Andaman or grey teal
- *Anas gibberifrons albogularis,* an oceanic bird earlier found in Andaman group of islands is now confined to only northern Andamans. Migratory swans namely whistling swan - *Cygnus columbrianus*, the whooping swan - *C. cygnus*, mute swan - *C. olor*, are exceedingly rare vagrants or stragglers. All are now disappearing.

Indian black crested baza - *Aviceda leuphotes*, the blythis baza - *A.jerdoni* and black eagle - *Ictimactus malayensis* which are found in the tropical and sub-tropical evergreen and moist deciduous forests of the western Ghats and north eastern Himalayas, various species of hawks - *Accipitor* sp, eagles - *Aquila* sp. and falcons - *Falco* are widely distributed, but their number has drastically been reduced. White bellied sea eagle - *Heliaectus leucogaster* of Indian coasts now has small population size. *Megapodius freycinct*, which was once abundant has been affected by habitat destruction, increased human interference and exploitation specially for its eggs and flesh and now restricted to only Nicobar Islands.

Bamboo partridge - *Bambusicola futchii* restricted to open scrub and bamboo jungles from the plain to about 2000m altitude in north eastern India is fast losing its habitat due to human interference. The common red spur fowl - *Galloperdix spadice* distributed in Terai region in UP to Kerala, painted spur fowl - *G.lunulata* of the broken rocky areas of peninsular India are confronted with hunting pressure and increased human interference. The mountain quail *Ophrysia superciliosa* known only from a few specimens taken in the late 19th century in Kumoan region is now believed to be extinct.

The blood pheasant - *Ithginis cruentus* occurring at 2000 to 4500m altitudes of Himalayas from Nepal to Arunachal Pradesh, the western tragopan - *Tragopan melanocephala* of the western Himalayas extending from Kashmir to Garhwal, Crimson horned pheasant or satyr tragopan - *T.satyra* of Himalayas distributed from Garhwal to Arunachal Pradesh between 2500 to 4000m blyths tragopan - *T.blythi* found at 1500 to 3000m altitude and the temmonicks tragopan *T. temminckii* of Himalayas extreme east from 2000m altitude and above, the impeyan or monal pheasant - *Lophopharus imejanus* which occurs on slopes in dry temperate moist temperate and coniferous forests of Himalayas, schlaters or mishmi monal pheasant - *L.sclarari* of north eastern Himalayas between 2500 to 4500m altitude in most temperate and coniferous forests, the earned pheasant - *Crossoptilon* sp in Arunachal Pradesh between 3000 to 5000m, koklas pheasant - *Bucrasia macrolopha* of western and central Himalayas, chir pheasant - *Catreus wallichii* of western and west central Himalayas between 1500 to 3500m altitude, barrded back pheasant - *Syrmaticus humiae* of Nagaland, Manipur and Mizoram between 1500 to 3000m the peacock pheasant - *Polyplectron bicalcaratum* from Sikkin, North Bengal and Manipur are all endangered.

The Indian national bird peacock -*Pavo cristatus* although not endangered is threatened. In the family Gruiidae which includes cranes has many endangered species. Eastern common crane - *Grus grus lilfordi,* a winter migrant in the larger wetlands of northern India is now endangered. The black necked crane - *Grus nigricollis* is a greatly threatened bird of Ladakh. Hooded crane - *G.monacha*, a rare winter migrant bird of Assam, siberian crane - *G.leucogeranus*, a regular winter visitor of wetlands of north Indian plains are decidedly diminishing in their number. The masked finfoot - *Heliopais parsonata* found in eastern Assam and Arunachal Pradesh about fifty years has not been traced now.

Among bustards and floricans, the litter bustard - *Otis tetrax* and the houbra - *Chlamydolis undulata* are winter migrants in northern and north western India. The great Indian bustard *Ardeolis nigriceps*, the bengal florican - *Eupodotis bengalensis* lesser florican *Sypheotides indica* are resident species. They were abundant at one time now have shrunken greatly. The Indian skimmer *Rhynchops albicollis*, a resident species on Indias larger rivers and rarely on large lakes is now becoming rare. Nicobar pigeon - *Caloenus nicobarica* found in Nicobar group of islands is fast losing its breeding ground. Frogmouths are peculiar noct urnal predaceou s birds. They are also becoming rare. Ceylo n frog mo ut h - *Batrachostomus monilegre* of western ghats, Hodgsons frogmouth - *B.hodgsoni* of Sikkim, Darjeeling, Arunachal Pradesh are examples that are endangered.

Hornbills are large birds and most threatened due to deforestation, killing for flesh, bone and for witchcraft by tribal people. Their behavior also is so peculiar and because of that they are becoming endangered. During breeding season, the females reside in the nest which is usually a tree hole, lay eggs, incubate and the males seal the opening of the nest from outside. The male has to feed the female from outside through a small aperture. If the male is killed, the female as well as hatchlings in the nest would die of starvation. White throated brown hornbill - *Ptilolaemus tickelli* in eastern India, rufus necked hornbill - *Aceros ripalensis* found in central and eastern Himalayas, wrethed hornbill - *Rhyticeros undulates*, Narcondam hornbill *R. narcondum* of Narcondum islands of Andamans the great pied hornbill - *Buceros bicornis* of tropical and subtropical forests, Indian pied hornbill - *Anthracoceros malabaricus* of moist deciduous forests of Punjab, Bihar, Orissa, Andhra, Karnataka and malabar pied horn bill *A.coronatus* of evergreen and moist deciduous forests of south India are examples.

10.7 MAMMALS

There are about 350 mammals in India of which 13% are endangered and 20% are threatened. At least 2% are considered as rare species. There are 19 species of primates of which 12 are endangered. They are slender loris - *Loris tardigradus*, small bodied arboreal species found in south India. Slow loris - *Nycticebus coucang* is slightly bigger and inhabits denser forests of north east India. They are killed for flesh and because of medicinal value of some body parts. Among macaques, lion tailed macaque - *Macaca silenus* is one of the most endangered surviving only in pockets of Western gaht. The pigtailed - *M.nemtsetrina*, stump tailed - *M.arctoidesq*, assamese macaques - *M.assamensis* occur in the dense evergreen forests of north eastern India, while the crab eating - *M.fascicularis* restricted to few islands of Nicobar. All of them are exploited for flesh and medicinal purposes.

Among langurs, Nilgiri langur - *Presbytis johni*, is a multihabitat species occurring in addition to shoals in the semi evergreen and moist deciduous forests and even in evergreen forests of western ghats. Its status is not as precarious as that of lion tailed macaques but they are hunted for flesh, medicine and skin from drum and for fur. Capped langur - *P.pileatus*, golen langur - *P. geei*, phayres leaf monkey - *P. phayrei* inhabit tropical dense forests in north eastern India. The only ape of India hoolock - *Mylobates hoolock* found in hilly forests of north India is hunted for flesh. There are two pholidotes, chinese pangolin - *Manis pentadactyla* found in north eastern India and indian pangolin - *M.crassicaudata* in peninsular India. They are hunted for flesh and scales which have medicinal and magical properties.

The order Carnivora has 36 species belonging to seven families of which 28 are endangered. Among canids, the wolf -Canis lupus, the red fox - *Vulpus vulpus*, the indian fox - *V.bengalensis* and wild dog - *Cuon alpinus* were more or less well distributed but now isolated in certain pockets only. They are persecuted for the commercial value of their fur and also to protect poultry, goat and sheep from predation. Among bears, himalayan brown bear - *Ursus arctos* occurring in the upper reaches of Himalayas from Kashmir to Sikkim, the malayan sun bear - *Helarctos malayanus* inhabiting the hilly terrains of the north eastern India, south of Brahmaputra and the sloth bear - *Melursus ursinus* in the well wooded forests all over India are hunted for flesh and street play.

The family Procyanidae, the lesser panda or cat bear - *Ailurus fulgem* found in Nepal to Arunachal Pradesh is exploited for fur. The family Mustelidae has 14 species in India of which the ermine - *Mustela ermanea* occurs in the western himalayas and is hunted for its pelt. Ratel - *Mellivora capensis* is found all over the country but killed to protect poultry from it. Family Viveridae is represented by 15 species of which malabar civet -*Vivera megaspilla* occurs in coastal Kerala is nearly extinct. Tiger civet - *Prionodon pardicolor* ranges from Nepal to Arunachal Pradesh, binutrong - *Arctitis binturong* found in the same distribution range is a secretive animal. They have all become rare now. The striped hyena - *Hyaena hyaena*, common in open lowland forests is known for lifting livestock and occasionally children.

There are 15 species in the family Felidae of which tiger - *Panthera tigris* is a multihabitat species found throughout the country. It is killed for trophies, skin, flesh and fat for medicine, claws and other parts for magical purposes and sometimes eradicated as cattle lifters. Their number had declined to just 1500 in 2010 from around 40,000 during 1940s. The lion - *P.leo* found only in Gir forests of Gujarat whose number is just 205. The leopard - *P.pardus* and snow leopard *P.uncia* are the other two big cats of which former is found in higher woodland forests and the latter in the Himalayas. They are hunted for skin and protecting livestock. Among lesser cats the desert cat - *Felis silvestris*, lynx - *F.lynx*, caracal - *F.caracal* are found in arid and semiarid tracts of west and north, jungle cat - *F.chaus* leopard cat - *F.bengalensis* found all over the country once are now restricted to small area and are represented in small numbers. The pallas cat *F.namul* is restricted to the northern hilly terrain, the rusty spotted cat *F.rubiginosa* is distributed throughout the western ghats, the fishing cat *F.viverrina* has patchy distribution, the golden cat *F.temnickii*, marbled cat - *F.marmorata* and the clouded leopard *Neofelis nebulosa* are confined to west forest zones of the eastern and the north eastern parts of India. They are killed for pelt. Cheetah or hunting leopard *Acinonyx jubatus* has already become extinct.

The dugong - Dugong dugong among Sirenia occurs in the Gulf of Kutch on the coast of Malabar, Gulf of Mannar are killed for flesh. Among Perissodactyla, the great indian one horned rhinoceros - *Rhinoceros unicornis* as once extensively distributed in gangetic plains now is restricted to north Bengal and plains of Assam. It used to be killed for horn, its urine is credited with antiseptic property. In 1904, a dozen of them were survived in Khaziranga. Due to conservation their number has now increased to nearly 1000. The smaller one horned rhinoceros *R.sondaicus*, asiatic two horned - *Didermoceros sumatrensis* have been exterminated long ago from India. The Indian wild ass - *Asinus hemionus* is found only in Runn of Kutch. Its population from 5000 in 1946 to 870 in 1962 and now it is 720. The tibetan wild ass is seen in small number in Ladakh.

Among 32 species of Artiodactyla 20 are listed as endangered. Andaman wild pig *Sus scrofa andamanensis*, Nicobar wild pig - *S. scrofa nicobarensis* found in Andaman and Nicobar islands respectively, pigmy hog - *S.salvanius* found in eastern foot hills of Himalayas are hunted for flesh. In the family Cervidae out of nine species five are endangered. Kashmir stag or hungul - *Cervus elaphus* hungul restricted to Kashmir valleys has an estimated population size of only 300. The swamp deer barasingha has two subspecies, swamp dwelling *Cervus duvaucelli*, found in marshy tract from Terai in northern part to Gangetic plains of Assam, the hardland living *C.d.branderi* thrives on the open grassy land of Madhya Pradesh. Their total population now is 2500. The brow antlered deer - *C.eldi eldi* is confined to the floating swamps of tall reeds, grasses in Ladakh, lakes of Manipur. Their number was just 14 in 1975 which rose to 30 in 1979 and now perhaps about 70 due to conservation and protection. It is said that there are more number of deer in Zoos than in nature. Alpine musk deer - *Moschus sifanicus* occurs in the higher reaches of Himalayas from Chamba to Sikkim, forest musk deer - *M. chrysogaster* is found in Garhwal in the west to Arunachal Pradesh and Assam in the east. All the deer are hunted for trophy, fresh and musk deer for musk. The mouse deer - *Tragulus meminna* is also called indian chervotin species. It is found in grass covered rocky hill sides in south India and hunted for flesh.

Out of 21 species of Bovidae 14 are endangered. The black buck or indian antelope

- *Antelope cervicapra* occupies open plains, chinkara or Indian gazelle - *Gazella doreas bennetti* is basically a desert animal but lives in grassy plains also. Black buck population is about 10000 to 15000 but chinkara is only 500 in Gujarat. Tibetan antelope - *Pantolops hodgsoni*, Tibetan gazelle - *Procarpa* sp found in Ladakh, four horned antelope chowsingha

- *Tetraceros quadricornis* found in woody hilly country at south of Ganga are endangered. The gaur or indian bison *Bos gaurus*, wild yak *Bos grunniens*, first one in south India up to Assam and second in Ladakh are endangered. The wild buffalo *Bubulus*

bubulis found in swamps of Assam and Madhya Pradesh has a population of around 1000.

Urial or shapu - *Ovis orientalis*, markhor - *Capra falconer*, himalayan ibex - *C.ibex*, tibetan sheep - *Ovis ammon hodgsoni*, the serow - *Capricornis sumatrensis*, the takin - *Burdorcas taxicolor*, himalayan tahar - *Hemitragus jemblahicus*, nilgiri tahr - *H.hylocrius* are all endangered.

Among rabbits, out of four species assam rabbit - *Caprologus hispidus* found in Terai towards Brahmaputra valley is endangered. Rhodentia is the largest group of mammals with 95 species of which 11 are endangered. The travencore flying squirrel *Petinomys fuscocepilus*, the common giant flying squirrel - *Petaurista petaurista* widely distributed throughout the wooded parts of Kerala and other parts are endangered. The wooly flying squirrel - *Euphetaurus cinereus* found between Kashmir and Sikkim, smaller kashmir flying squirrel - *Hylopetis fimbriatus* found in Kashmir, hairy footed flying squirrel - *Belomys pearsoni*, lesser giant flying squirrel - *P.alborufus*, hodgson flying squirrel - *P. magnificus*, greys flying squirrel - *P. nobilis*, partly colored flying squirrel - *Hylopetis alboniger*, phayer flying squirrel - *H.phayeri* etc are found in low densities in patches of parts of the country. Himalayan marmot - *Marmota bobak*, long tailed marmot - *M.caudata* are also endangered.

There are about 25 species of cetacean in Indian limits which are endangered. The gangetic dolphin - *Plahenista gangetica* found in Ganga and Brahmaputra is only freshwater form. Others are marine. The baleen whale - *Balenoptera* sps., *Megaptera* sp, dolphins like *Kogia* sp, *Sotalia* sp, *Steno* sp, *Turscops* sp, *Legenorhynchus orchaella* sp, *Ziphius* sp, *Neomeris* sp and *Delphinus* sp have been exploited for flesh, fat, bone and ambergris. These species have also been endangered.

10.8. SUMMARY

There are more than 5070 known species of marine and non-marine molluscs living in the wild in India. It is estimated that more than 1740 species of spiders, 282 species of ladybird, 450 dragonflies and damsel flies, 1450 species of butterflies, 1250 species of ants in addition to others. All these species do not enjoy equal survival status. Species like monarch butterflies, gypsy mot h, emperor moth etc. are supposed to be endangered. We have good number of vertebrates, but there also situation is not different. Many amphibians and reptiles are endangered. It is believed that there are more than 400 mammals, 1200 birds in India. Out of these, 26% of species are endangered and about 49% of species are vulnerable. This means, many of these animals are endangered. On the basis of distribution, the species are classified as cosmopolitan, widespread and endemic. But this classification does not indicate the survival status of that species. Classification based on survival status species include threatened, endangered, critically endangered species etc.

This classification is made by International Union for Conservation of Nature (IUCN), which periodically and lists the species in the form Red data book. Red data book is an inventory of global conservation status of biological species. A series of regional red lists are produced by countries or organizations, which assess the risk of extinction to species within a political management unit. You have studied the list of species of different taxonomic groups and the causes of their depletion. You should make an effort to conserve these species in whatever way you can.

10.9. KEY WORDS

Amphibians, Birds, Critically endangered (CR), Data deficient (DD), Endangered (EN), Extinct (EX), International Union for conservation of Nature (IUCN), Invertebrates, Pisces, Least concern (LC), Mammals, Near threatened (NT), Not evaluated (NE). Red Data Book, Reptiles, Vulnerable (VU),

10.10. QUESTIONS FOR SELF STUDY

1. What is read data book? Who prepares it? What are the significant features of it?
2. Write a small note on the endangered invertebrates of India.
3. Discuss about the endangered lower vertebrates.
4. Write an account on endangered birds.
5. Write a brief account on the endangered mammals found in India.

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UNIT 11: CONSERVATION STRATEGIES

STRUCTURE

11.0. OBJECTIVES

In the previous chapters you have reviewed the list of wild plants and animals. You have also studied about the proportion of the endangered plants and animals. Many useful plants and animals are endangered and they are on the verge of extinction. You have also studied the cause of extinction of the species. Unless proper protection is provided to these species many o f them will become extinct in near future. Since most of these causes are manmade, it is possible to protect the wildlife from extinction. Now the question is how to protect them.

There are two methods of wildlife protection. They can be protected in places where ever they live, i.e. in their natural habitats. This method is called in situ conservation. The second method is to take them out of their habitat, creating special environments for their survival or protecting the wildlife through special artificial methods. This type of conservation is called *ex-situ* conservation. Among the two methods, *in-situ* conservation is more useful than the *ex-situ* conservation.

The *in-situ* conservation is made through following methods; 1. The establishment of protected areas such as national parks, sanctuaries, nature reserves, biosphere reserves, 2. Through enactment of appropriate legislation preventing the killing and trade, 3. Educating the people about the significance of wildlife.

The strategies involved in the *ex-situ* conservation are as follows; 1. Establishment of zoos and captive breeding of animals in protected areas, 2. By adopting special techniques such as in-vitro fertilization, cloning etc. 3. Cryopreservation etc.

Many of these conservation strategies are carried though legislation and through governmental and nongovernmental organizations. Government of India has enacted appropriate laws for the protection of wildlife in India.

After reading this unit you will be able to

- Learn about Wildlife Act.
- Out line the conservation strategies of wildlife
- Appraise about governmental and nongovernmental organizations towards conservation of wildlife

11.1. INTRODUCTION

The survey of the species of wildlife and the number of endangered species shows how alarming the situation is. Unless proper protection is provided there is the danger of extinction of many species as that of cheetah. Therefore conservation of wildlife is one of the most important challenges of the present day. This challenge could be easily addressed through enactment of appropriate laws. Many countries have their own laws for the protection of wildlife. According to these laws, damaging the natural habitat, killing of wildlife, involving in trade of wildlife and their products is punishable. Each country has its own set up to carefully watch the activities in the wild so that their wild species are protected.

In India legislation on wildlife protection was first made by Chandragupta, whose minister Koutilya framed the laws in his Arthashastra. He had considered wildlife and nature as the treasure of nation. Many kings and Nawabs had made rules against hunting or killing wild animals. British also had realized the significance of wildlife and made some policies on wildlife conservation.

The founding fathers of Indian constitution also had realized the need of wildlife conservation. In the constitution under the section on 'Directive principles of State Policy' under the duties of Indian citizen, it is written as "The state shall endeavor to protect and improve the environment and to safe guard the forests and wildlife of the country'. Article 51A of the constitution states 'It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have passion for living creatures'. In addition Government of India has also formulated appropriate laws, and these laws were placed in the parliament which was passed in the year 1972. This act is called Indian Wildlife Protection Act 1972. The content and the provisions of the act is as follows:

11.2. WILDLIFE ACT

The Wildlife Protection Act of 1972 refers to a package of legislation enacted in 1972 by the Indian Parliament. The Act provides for the protection of wild animals, birds and plants; and for matters connected therewith or ancillary or incidental thereto. Prior to the enactment of this act, the wildlife protection was completely governed by the state and the rules were mostly framed as shooting rules. Some special legislation was also made by different states such as Bombay wild animals and wild birds protection act, Elephant preservation act, Rhino preservation act, Game act etc. Apart from some control on shooting in some places some animals there was no coordinated programme for wildlife protection.

Since the wildlife and forests were the responsibility of state governments, Parliament had no power to make such laws unless the states pass a resolution that these matters shall be regulated by parliamentary laws. Initially 11 states passed such resolution and accordingly in 1972 Parliament passed the wildlife act. Now all states except Jammu and Kashmir have accepted it and the Wildlife Act 1972 is applicable to all states except Jammu and Kashmir. Jammu and Kashmir has its own laws but on the lines of this act. Based on the recommendation of an expert committee during 1978, the act was amended in the year 1980.

The act has seven schedules, each written in the form of a chapter. These schedules give varying degrees of protection to wild animals and plants. Chapter I includes two sections introduction, and definitions. Chapter II consists of six sections which is concerned about the appointment of authorities and bodies for wildlife protection. Rules regarding appointment of Directors and Wildlife warden, their duties, formation of different advisory boards etc are given in this chapter. Chapter III includes two parts. Part one includes nine sections, in which the prevention hunting and rules against hunting are shown. Permission for hunting in special cases, the authorities to grant license for such hunting at special occasions, maintenance of records of such animals hunted etc are written in this part. Chapter IIIA or part two indicates the rules regarding the plants. Whatever the rules framed against hunting of wild animals are also made for cutting of plants and their utilization.

Chapter IV also has two parts. Part one is concerned with establishment of sanctuaries, national parks and closed areas. There are 22 sections in this chapter dealing with formation, declaration of sanctuaries, national parks, their maintenance, supervision, permissions, extensions, fire etc. Before the enactment of this Act there were only five national parks in the country and now a number of them have been established under the provision of this act. Chapter IVA or part two is concerned with Central Zoo Authority. There are ten sections under this chapter which is mainly regarding the appointment of Chairpersons and members of Zoo authority at Central and State levels, establishment of Zoos, their maintenance, transport of animals from one zoo to another etc.

Chapter V is for regulation of trade or commerce at both national and international levels in wild animals, animal articles and trophies. According to these rules, sale of wildlife in full or part, preparation of trophies or animal articles without permission is offence and punishable. Any such animal or article prepared will be property of the Government. Rules regarding the issue of license, authorities to issue or cancel the license are all mentioned in this chapter.

Chapter VI is concerned with the prevention and detection of offences. There are nine sections in this chapter. The rules concerned with power of entry, search, arrest and detention, penalties, attempts and abetment, punishment for wrongful seizure, cognizance of offences etc are included. The last chapter includes miscellaneous matters such as rewarding the persons who are involved in protection, establishment of certain committees etc.

11.3. NGOs AND CONSERVATION

Although there are strict laws regarding the conservation of wildlife, the implementation is difficult in this vast country. There are many national and international level nongovernmental organizations (NGOs) which either directly or through special conventions assist the government in implementing these rules or protect the wildlife. Following are some of these bodies concerned with wildlife protection.

1. World Wide Fund for Nature

The World Wide Fund for Nature (WWF) is an international non-governmental organization working on issues regarding the conservation, research and restoration of environment. It was formerly known as world wildlife fund. The idea of initiation of WWF was made by IUCN with the suggestion from Victor Stolen to Julian Huxley. It was started in Morges, Switzerland on 29th April 1961 with Prince Bernhard, Julian Huxley, Max Nicholson, Peter Scott, Guy Mountfort and Godfrey Rockefeller as trustees. Its establishment is marked as Morges Manifesto. The mission of WWF is to "halt and reverse the destruction of our environment". Currently its office is located at Gland, Switzerland. Yolanda Kakabadse is the president at present.

It is the world's largest independent conservation organization with over 5 million supporters worldwide, working in more than 100 countries, supporting around 1,300 conservation and environmental projects. India also has the membership among the 23 member countries. WWF derives 57% of funding from individuals and bequests, 17% fro m government sources such as World Bank, DFID, USAID and 11% fro m corporations. It tries to focus its attention on biodiversity, forests, freshwater ecosystems, oceans and coasts. It is also concerned with endangered species, pollution and climate change. The giant panda *Ailuropoda melanoleuca* is its symbol.

Originally WWF worked for fund raising and providing grants to the NGOs for the protection of endangered species. With increase in resources it extended its operations into other areas such as the preservation of biodiversity, sustainable development, reduction of pollution and climate change.

For this purpose it has opened its office in different parts of the world. It also began to run its own conservation projects and campaigns, and by the 1980s started to take a more strategic approach to its conservation activities. In 1986, its name was changed to world wide fund for nature. In 1990 it revised its mission to 'Stop the degradation of the planets natural environment and to build future in which humans live in harmony with nature, by conserving worlds biological diversity, ensuring sustainable use of natural resources and promoting the reduction of pollution and wasteful consumption. WWF also works on a number of global issues driving biodiversity loss and unsustainable use of natural resources, including finance, business practices, laws, and consumption choices. Local offices also work on national or regional issues.

WWF is known for its simple approach for conservation and systematic management. The organization is working through the help of local people. It works with a large number of different groups to achieve its goals, including other NGOs, governments, business, investment banks, scientists, fishers, farmers and local communities. It also undertakes public campaigns to influence decision makers, and seeks to educate people on how to live in a more environmentally friendly manner.

WWF's current strategy for achieving its mission specifically focuses on restoring populations of 36 endangered species including elephants, tigers, tunas, whales, dolphins, porpoises etc. It loo ks after the important ecosystems and people and is trying to prevent the loss of cropland, grazing land, fishing, forestry and water and prevent carbon emissions. It publishes living plane index in collaboration with Zoological Society London. It also regularly publishes reports, fact sheets and other documents on issues related to its work, in order to raise awareness and provide information to policy and decision makers.

2. Wildlife Conservation Society of India

WCS, India was started in India in 1960s along with the study of tigers by George Schaller. Thereafter, it was inactive for two decades and it was rejuvenated by Ullas Karanth. Its programme focuses on the charismatic endangered mega fauna in protected reserves - ad the most social tactic for saving biodiversity. During its 15 years of development strategies for conservation, management and research programmes are envisaged.

3. Wildlife Preservation Society of India

This was established in the year 1958 at Dehradun. It is an NGO founded and funded by wildlife lovers of India. The aims and objectives of the society are 1) to promote interest in wildlife and impart knowledge in the protection of wildlife 2) to cooperate with the government in the matter of conservation 3) to assist in enforcing wildlife protection acts 4) to promote wildlife tourism and 5) to advise and help the government and wildlife administrators in the formation, maintenance and protection of national parks and sanctuaries. It is also a member of IUCN and it publishes a journal 'Cheetah'.

4. Wildlife Protection Society of India (WPSI)

WPSI was founded in 1994 by Belinda Wright, who was an award-winning wildlife photographer and filmmaker. She was the first Executive Director of the society. Its main aim has been to bring a new focus to the daunting task of tackling India's growing wildlife crisis. It does this by providing support and information to government authorities to combat poaching and illegal wildlife trade - mainly tigers. It has now broadened its focus to deal with human-animal conflicts and provide support for research projects.

With a team of committed environmentalists, WPSI is one of the most respected and effective wildlife conservation organizations in India. It is a registered non-profit organization, funded by a wide range of Indian and international donors. The Society's Board Members include leading conservationists and business people.

WPSI collaborates with state governments to monitor the illegal wildlife trade and provide them with hands-on training and support to combat poaching and the illegal wildlife trade. It conducts wildlife law enforcement workshops for forest, police and customs department officials and representatives of government organizations. They have prepared crime database including 20000 cases and 16000 criminals.

It has pioneered investigations into the trade in tiger parts and other endangered species valued in the illegal wildlife trade, and exposed widespread tiger poaching and its links to the use of tiger parts in traditional Chinese medicine. The death of a wild tiger no longer goes ignored and people now know how and why tigers are killed. It has helped the government to expose the working of what is called shahtoosh trade - involving the trade of tiger bones, skin, and other parts. WPSI also provides funds for conservation projects for species such as tiger, elephant and sea turtle. It also looks in to the issues such as human- animal conflict involving tigers , leopard and elephant s. In 2005 and 2006, WPSI and the UK- based Environmental Protection Agency (EIA) carried out a joint investigation into the tiger and leopard skin trade in Tibet Autonomous Region and other provinces in China. It disclosed large scale trade of the big cat skin which was worn as status symbol in Tibet.

These investigations were published as a report – "Skinning the Cat: Crime and Politics of the Big Cat Skin Trade". WPSI is supported by a number of Indian and international organizations, foundations and individuals.

5. Bombay Natural History Society

The Bombay Natural History Society, was founded on 15 September 1883. It is one of the largest and perhaps the oldest non-governmental organizations in India engaged in conservation and biodiversity research. Following seven persons Dr G. A. Maconochie, Dr D. MacDonald, Col.C.Swinhoe, Mr J. C. Anderson, Mr J. Johnston, Dr Atmaram Pandurang and Dr Sakharam Arjun joined together on that day at the then Victoria and Albert Museum Mumbai and formed the BNHS. Mr H.M.Phipson the second Honorary Secretary between 1886–1906 lent a part of his wine shop at 18 Forbes Street to the BNHS for its office. Initial idea of these founders was to meet once in a month and discuss about some special features of animal species and exhibit some interesting specimen. In 1911, R.C. Wroughton, a member of BNHS and a forest officer, initiated a survey of animals in the Indian sub continent and collected more than 50,000 species over a period of 12 years which were later exhibited in the BNHS museum. Many new species were described during these collections. It was one of the biggest animal collections in the world at that time. It also published number of books and monographs and also started the publication of the monthly periodical 'Journal of Bombay Natural History Society'. Later renowned naturalists, including the ornithologists Salim Ali, D.S Ripley were associated with it.

Today it is situated at the specially constructed building, Hornbill House in South Mumbai. It has adopted the great hornbill as its logo. Its objective is to collect information about fauna and flora throughout India, Burma, Sri Lanka and Pakistan. The society is propagating the significance of conservation of wildlife. It supports many research efforts through grants.

11.4. GLOBAL AND INDIAN BODIES CONCERNED WITH CONSERVATION

1. International Union for Conservation of Nature (IUCN)

It is an international organization dedicated to finding "pragmatic solutions to our most pressing environment and development challenges". The red data book or list of endangered species is published by IUCN. It supports scientific research, manages field projects all over the world and brings governments, non-government organizations,

United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice. IUCN is the world's oldest and largest global environmental network—a democratic membership union with more than 1,000 government and NGO member organizations, and almost 11,000 volunteer scientists in more than 160 countries. IUCN's work is supported by more than 1,000 professional staff in 60 offices and hundreds of partners in public, NGO and private sectors around the world. The head quarter of the IUCN is located at Gland, near Geneva, Switzerland.

IUCN's vision is "a just world that values and conserves nature". Its mission is to "influence, encourage and assist societies throughout the world to conserve the integrity and biodiversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable".

The move to start IUCN was made by the first Director General of UNESCO, Sir Julian Huxley, a renowned biologist. His intention was to establish a new environmental institution under UNESCO and to give a more scientific base to it and for this purpose he sponsored the first congress, which was held at Fontainebleau, France on 5 October 1948. 18 governments, 7 international organizations, and 107 national nature conservation organizations participated and all agreed to form the institution and signed a "constitutive act" creating an International Union for the Protection of Nature (IUPN). Charles Jean Bernard of Switzerland was the first President of IUCN. Mr.Ashok Khosla, an Indian was the president during 2008-12. In 1956 it was renames as IUCN.

IUCNs main objective is to ensure the perpetuation of wild nature and to maintain the intrinsic and cultural values. It fulfills its objectives through, 1) creating awareness through education 2) research to discover the best measures for conservation and to advance the study of ecology, 3) Assistance by providing data for conduct of practical conservation programmes 4) action on national and international scale by enlisting the cooperation of governments and international agencies in support of conservation programmes 5) strengthening legislation and improving its enforcement. The Union has three components: its member organizations, its six scientific commissions, and its professional secretariat.

The main contributions of IUCN are as follows;

In 1959, UNESCO decided to create an international list of National Parks IUCN took the responsibility. 1n 1961 it decided to create the world wildlife fund (WWF). In 1969, it was able to get Fort Foundation grant. In 1971 IUCN adopted the concept of natural heritage and in 1974 CITES agreement was made. In 1975 Ramsar convention was held which gave importance to protect the wetland ecosystem.

. The world conservation strategy was published in 1980. In 2001 the biodiversity conservation plan was prepared. IUCN holds general assembly once in three years to discuss the current problems. The 10th Assembly was held in Delhi during 1969.

Conserving biodiversity and ensuring sustainable use of biological resources, addressing some of the world's greatest challenges such as global warming, climate change, sustainable energy and improving human well-being and building a green economy are priorities of IUCN. IUCN publishes the red list of species or the species which are endangered. It also has one of the world's most comprehensive ranges of authoritative publications, report s, guidelines and databases for conservation and sustainable development. They publish or co-author more than 150 books and major assessments every year, along with hundreds of other reports, documents and guidelines.

2. Indian Board of Wildlife (IWBL)

It is a government organization set up by Government of India in 1952. It is the apex advisory body in the field of wildlife Conservation in the country and is headed by the Honorable Prime Minister of India. Its main function is to 1) advice the Central Government in the matter of conservation of wildlife and their habitat, 2) sponsor the setting up of national parks, sanctuaries, and reserve forests, 3) recommend the Central Zoo Authority to establish Zoo logical gardens, 4) device ways and means for the protection through legislature and practical measures, 5) promote public interest in wildlife, 6) prevent cruelty to beasts and birds, 7) advice the government on policy in respect of living animals and 7) make policies on trophies, skin, furs, feathers, ivory and other wildlife products and to 8) implement the provisions of Indian wildlife protection act 1972.

The IWBL has an executive committee consisting of Chairman, two Vice Presidents, one Secretary General, one Secretary and four Regional Secretaries. In addition, the IBWL also has a bird wing and a Zoo wing to supervise the preservation of wild birds and development of Zoological gardens and parks. There are also state boards which have been established to enforce the legislation at state level. IWBL celebrates the wildlife week in the first week of October every year. During this week awareness programmes and activities are taken up to educate the general public about the significance of wildlife and the need for their protection.

Some of the resolutions passed by the IBWL are as follows. 1) Wildlife and forests shall be declared priority sector at the national level for which funds should be earmarked.

2) Law enforcement agencies must ensure that those engaged in poaching, illicit trade in

wildlife and wildlife products, destruction of their habitat, and such other illegal activities are given quick and deterrent punishment. 3) Wildlife tourism should be encouraged without causing any damage to wildlife and its habitat. The revenue generated through it should be used to augment available resources for conservation. 4) Protecting interests of the poor and tribals living around protected areas should be handled with sensitivity and with maximum participation of the affected people. 5) They should have access to the minor forest produce, in the forest out side of national parks and sanctuaries. 6) People should be encouraged to take up afforestation and conservation in new areas. 7) No diversion of forest land for non-forest purposes from critical and ecologically fragile wildlife habitat shall be allowed. 8) Lands falling within 10 km. of the boundaries of National Parks and Sanctuaries should be notified as eco-fragile zones under section 3(v) of the Environment (Protection) Act and Rule 5 Sub-rule 5(viii) & (x) of the Environment (Protection) Rules. 9) Removal of encroachments and illegal activities from within forest lands and Protected Areas. 10) No commercial mono-culture to replace natural forests. 11) Mitigation measures for human-animal conflict and mechanism for crop insurance as also expeditious disbursements of ex-gratia payments should be instituted by States. 12) Forest Commission should be set up to look into restructuring, reform and strengthening the entire forest set up and affiliated institutions in the country.

3. Convention on International Trade and Endangered Species (CITES)

It is an international, multilateral treaty, drafted as result of a resolution adopted in 1963 at a meeting of members of IUCN. The convention was opened for signature in 1973, and CITES entered into force on 1 July 1975. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild, and it accords varying degrees of protection to more than 33,000 species of animals and plants. India joined CITES in 1976. The member countries of CITES are called Party. There are four major requirements specified for a Party, designation of Management and Scientific Authorities; laws prohibiting the trade in violation of CITES; penalties for such trade; laws providing for the confiscation of specimens.

Funding for the activities of the Secretariat and COP meetings comes from a Trust Fund derived from Party contributions. Trust Fund money is not available to Parties to improve implementation or compliance. These activities, and all those outside Secretariat activities (training, species specific programmes such as Monitoring the Illegal Killing of Elephants
- MIKE) must find external funding often from NGOs and bilateral aid.

CITES has introduced an international system of licensing and legal procurement of certificates to control the trade of all species. It works by subjecting international trade in specimens of listed species to certain controls.

These require that all import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a permitting system.

Each Party to the Convention must designate one or more Management Authorities in charge of administering the licensing system and one or more Scientific Authorities to provide advice about the effects of any proposed trade on the status of the species.

About 5,000 species of animals and 29,000 species of plants are protected by CITES against over exploitation through international trade. Three lists have been prepared as Appendices; each list reflects the extent of threat to a species and the control that should apply to the trade of that species. About 1200 species are listed in Appendix I, and they are threatened with extinction. Since they have the danger of becoming extinct, the trade of wild-caught specimens of these species is treated as illegal (permitted only in exceptional licensed circumstances). About 21,000 species are included in appendix II which are not necessarily threatened with extinction, but may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with the survival of the species in the wild. About 170 species are included in appendix III. They are not threatened hence the trade is permitted with license.

11.5. SUMMARY

There are two methods of wildlife protection; ex situ conservation and in situ conservation. The in situ conservation is made through 1. The establishment of protected areas such as national parks, sanctuaries, nature reserves, biosphere reserves, 2. The enactment of appropriate legislation preventing the killing and trade and 3. Educating the people about the significance of wildlife. Ex situ conservation is made through 1. Establishment of zoos and captive breeding of animals in protected areas 2. By adopting special techniques such as in vitro fertilization, cloning etc 3. Cryopreservation. Special provision is made in the constitution of India under the section on 'Directive principles of State Policy' of the duties of Indian citizen. Article 51A of the constitution states 'It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have passion for living creatures'. In addition Government of India has also formulated appropriate laws, and these laws were placed in the parliament which was passed in the year 1972 which is now called Indian Wildlife Protection Act 1972. You have studied the provisions of the act. There are also number of Governmental and Non Governmental Organizations which take care of protection of wildlife. Following national and international organizations are working in the direction of guiding and educating the people for wildlife protection; Wildlife Conservation Society of India, Wildlife Preservation Society of India (WPSI), Bombay Natural History Society (BNHS), Indian Board of Wildlife (IWBL), The World Wide Fund for Nature (WWF), International Union for Conservation of Nature (IUCN),

Convention on International Trade and Endangered Species (CITES). The establishment, organization and their objectives have been explained here.

11.6. KEY WORDS

Article 51A of the constitution, Biosphere reserves, Bombay Natural History Society (BNHS), Captive breeding, Convention on International Trade and Endangered Species (CITES), Directive principles of State Policy, Ex situ conservation, Indian Board of Wildlife (IWBL), In situ conservation, International Union for Conservation of Nature (IUCN), National parks, Nature reserves, Non Governmental Organizations (NGOs), Sanctuaries, The World Wide Fund for Nature (WWF), Wildlife Conservation Society of India (WCS), Wildlife Preservation Society of India (WPSI), Wildlife Protection Act 1972, Zoos.

11.7. QUESTIONS FOR SELF STUDY

1. Write brief notes on strategies of conservation.
2. What are the provisions available in the Wildlife Protection Act 1972 for conservation of wildlife?
3. Name the NGOs that are working towards conservation of wildlife in India. Explain their aims and objectives.
4. How international trade of animals and animal products monitored.
5. Write notes on any two of the following: IUCN, WWF, WCS, WPSI,

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UNIT : 12 WILDLIFE CONSERVATION PROJECTS IN INDIA

STRUCTURE

12.0. OBJECTIVES

The Indian wildlife and also those of other countries are facing the danger of extinction. You have already studied the list of species of animals which are having the threat. A number of animal populations have almost reached to a minimum size with just a few countable individuals. Unless special conservation measures are under taken, these species will become extinct soon. Establishment of Conservation Projects is one method of saving these endangered animals. Through projects special care is given specially to those animals which are on the verge of extinction. Realizing this, the Government has created a few conservation projects through both the animal and their habitats are protected.

After reading this unit, you will be able to

- List out the objectives of the conservation projects
- Summarize various conservation projects

12.1. INTRODUCTION

There are two main methods of conservation of wildlife. They can be protected in places where ever they live, i.e. in their natural habitats. This method is called in situ conservation. The second method is to take them out of their habitat, creating special environments for their survival or protecting the wildlife through special artificial methods. This type of conservation is called ex situ conservation. Among the two methods, in situ conservation is more useful than the ex situ conservation.

The in situ conservation is made through following methods; 1. The establishment of protected areas such as national parks, sanctuaries, nature reserves, biosphere reserves, 2. Through enactment of appropriate legislation preventing the killing and trade, 3. Educating the people about the significance of wildlife.

Most of the above conservation strategies are of general type and they will be useful for protection of all species living in a given area. Some animal species are extremely sensitive and they require special care for their survival. The species which are represented in small numbers or the species whose populations reach the final stages of extinction require such special care. These animal species are protected through establishment of special projects. Department of Environment and Forests, Government of India has established a few such projects to protect specific animals. Establishment of conservation projects is also one way of in situ conservation. Following are some of these projects established by law in India.

12.2. AIMS AND OBJECTIVES OF THE PROJECTS

These special projects have been instituted by the government with following specific aims and objectives.

1. Ecological restoration of existing natural habitats and migratory routes or territories of highly endangered species. .
2. To identify the limiting factors for the increase of the population of the wild animal and to mitigate them by suitable management.
3. To remove the damages done to the habitat and to rectify so as to facilitate the recovery of the animal population.
4. Development of scientific management planning for conservation of specific animal species.
5. Promotion of measures for prevention of human-animal conflict in crucial habitats.
6. Moderating impact of human and domestic live stock activities in crucial animal habitats.
7. Strengthening of measures for protection of specific wild animal species for which the project is established from poachers and unnatural causes of death.
8. Research and educational activities on the animal species which in turn be useful for the protection of that species.
9. To give require veterinary care for the wild animals in a manner which would not harm the other animals.
10. Eco-development of the habitats of these animals

12.3. PROJECT TIGER

In early 1900s the Indian tiger population consisted of about 40000 individuals which had declined to just around 1200 in 1972. This project was initiated in India in 1972 to protect the dwindling population of Bengal Tigers. It was launched on April 1, 1973 at Palamau reserve in Bihar and has become one of the most successful wildlife conservation ventures. The aims of the project was,

1) To eliminate all forms of human exploitation and biotic disturbance from the core area and rationalization of activities in the buffer zone.
2) Restricting the habitat management only to repair the damages done to the ecosystem by human and other interferences so as to facilitate recovery of the ecosystem to its natural state.

3) Monitoring the faunal and floral changes over time and carrying out research about wildlife.

The project covered the specially constituted tiger reserves, representing various bio-geographical regions throughout India. It strives to maintain a viable tiger population in their natural environment. In 2007, there were 28 Project Tiger wildlife reserves covering an area of 37,761 km². Project Tiger helped increased the population of these tigers from 1,200 in the 1970s to 3,500 in 1990s.

Various biotic and anthropogenic pressures in the second half of the 20th century led to the progressive decline of wilderness resulting in the disturbance of viable tiger habitats. At the International Union for Conservation of Nature and Natural Resources (IUCN) General Assembly meeting in Delhi in 1969, serious concern was voiced about the threat to several species of wildlife and the shrinkage of wilderness in India. In 1970, a national ban on tiger hunting was imposed and in 1972 the Wildlife Protection Act came into force. A task force was then set up to formulate a project for tiger conservation with an ecological approach.

The project was launched in 1973, and various tiger reserves were created in the country based on a 'core-buffer ' strategy. The core areas were freed from all sorts of human activities and the buffer areas were subjected to 'conservation oriented land use'. Management plans were drawn up for each tiger reserve based on the principles mentioned above.

Initially, 9 tiger reserves were established in different States during the period 1973- 74, by pooling the resources available with the Central and State Governments. These nine reserves covered an area of about 13,017km². These reserves are, 1) Manas (Assam), 2) Palamau (Bihar), 3) Similipal (Orissa), 4) Corbett (U.P.), 5) Kanha (M.P.), 6) Melghat (Maharashtra), 7) Bandipur (Karnataka), 8) Ranthambhore (Rajasthan) and 9) Sunderbans (West Bengal). Today we have 28 tiger reserves in India. You can see the list below.

The pro ject started as a Central Sector Scheme with the full assistance of Central Government until 1979-80. Later, it become a 'centrally Sponsored Scheme' from 1980-81, with equal sharing of expenditures between the center and the states. The World Wildlife Fund For Nature has given Project Tiger assistance in the form of equipments, expertise and literature worth US $ 1 million. The various States have given up forestry operations in the reserves leading to a loss of revenue. Project Tiger was a pet project of Smt. Indira Gandhi, the then Prime Minister of India.

Report s of widespread poaching of tigers in two of the premier Tiger Reserves of North India - Sariska and Ranthambore have prompted a high level inquiry by CBI and also the constitution of a National level supervisory committee to supervise the implementation of the project. Senior wildlife scientists and conservationists have been chosen for this committee to be headed by the Prime Minister himself.

Currently the project is making use of modern techniques such as space technology for interconnectivity and linking different tiger reserves together. Satellite and GIS modeling is used for mapping and data acquisition. A 'Tiger Atlas of India' and a 'Tiger Habitat and Population Evaluation System' for the country, is being developed using state-of-t he-art technology. Tiger data base is also getting ready. The modern census techniques such as camera trapping, satellite imagery technique and DNA fingerprinting etc are used for enumeration of tiger population.

The whole country is divided in to five units for the purpose o f easy management. Project Tiger is administered by the National Tiger Conservation Authority. The overall administration of the project is monitored by a *Steering Committee*. A *Field Director* is appointed for each reserve, who is assisted by the field and technical personnel. At the centre, a full-fledged *Director* of the project coordinates the work for the country.

Conservation of tigers and their prey species faces challenges from the need for income, lack of awareness, and lack of land use policy in landscapes having Tiger Reserves. On 24 July 2012, the Supreme Court coming heavily on several defaulting States for not having notified buffer zones as directed earlier by the court directed that there should be no tourism activity in the core region of a tiger reserve across the country. The court has also directed the States to carryout eco-tourism in the buffer zones of the tiger reserves so that the project does not suffer from resource crunch.

The main achievements of this project are excellent recovery of the habitat and consequent increase in the tiger population in the reserve areas, from a mere 268 in 9 reserves in 1972 to above one thousand in 28 reserves in 2006. Tigers, being at the apex of the food chain, can be considered as the indicator of the stability of the ecosystem. For a viable tiger population, a habitat should possess a good prey base which in turn will depend on an undisturbed forest vegetation. Thus, 'Project Tiger' is basically the conservation of the entire ecosystem and apart from tigers, all other wild animals population have also increased in the project areas. In the subsequent Five Year Plans, the main thrust was to enlarge the core and buffer zones in certain reserves, intensification of protection and eco-development in the buffer zones of existing tiger reserves, creation of additional tiger reserves and strengthening of the research activities.

List of Tiger Reserves in India

Sl. No.	Tiger Reserve	Total Area (sq km)	Year of Establishment	State
1	Bandhavgarh	1,161.47	1993-1994	Madhya Pradesh
2	Bandipur (Extension)	874.00 643.00	1973-1974 1999-2000	Karnataka
3	Bhadra	492.00	1998-1999	Karnataka
4	Bori-Satpur-Pachmarhi	1,486.00	1999-2000	Madhya Pradesh
5	Buxa	758.82	1982-1983	West Bengal
6	Corbett	1.134.00	1973-1974	Uttaranchal
7	Dampa	500.00	1995-1996	Mizoram
8	Dudhwa	811.00	1987-1988	Uttar Pradesh
9	Indravati	2,799.00	1982-1983	Chhattishgarh
10	Kalakad-Munda n thurai	800.00	1988-1989	Tamil-Nadu
11	Kanha	1,945.00	1973-1974	Madhya Pradesh
12	Manas	2,840.00	1973-1974	Assam
13	Melghat	1,618.00	1973-1974	Maharashtra
14	Nagarjunsagar-Srisailam	3,568.00	1973-1974	Andhra Pradesh
15	Namdapha	1985.23	1982-1983	Arunachal Pradesh
16	Nameri	344.00	1999-2000	Assam
17	Pakhui	861-95	1999-2000	Arunachal Pradesh
18	Palamau	928.00	1973-1974	Jharkhand
19	Panna	542.66	1994-1995	Madhya Pradesh
20	Pench	757.85	1992-1993	Madhya Pradesh
21	Pench	257.00	1998-1999	Maharashtra
22	Periyar	777.00	1978-1979	Kerala
23	Ranthambhore	825.00	1973-1974	Rajasthan
24	Sariska	800.00	1978-1979	Rajasthan
25	Simlipal	2,770	1973-1974	Orissa
26	Sunderbans	2,585.10	1973-1974	West Bengal
27	Tadoba-Andhari	626.00	1993-1994	Maharashtra
28	Valmiki	840.00	1989-1990	Bihar

12.4. PROJECT LION

This is also called the Asiatic Lion Reintroduction Project. It is an effort to save the Asiatic lion from extinction in the wild. It is believed that the Asiatic lion was found all over India but the last wild population is found on the in the Gir Forest region of Gujarath. The lion population is threatened by epidemic diseases, natural disasters in addition to human interference. The project aims to establish a second independent population of Asiatic lions in the Kuno Wildlife Sanctuary of Madhya Pradesh.

The population size in Gir Forest is declining gradually because they are highly over populated. There are large scale deaths in the population annually because of ever increasing competition between the human and animal overcrowding. Asiatic lion prides require large territories but there is limited space at Gir wildlife sanctuary, which is boxed in on all sides by heavy human habitation. Researchers from Wildlife Institute of India have confirmed that the Palpur-Kuno Wildlife Sanctuary is the most promising location to re-establish a free ranging population of the Asiatic lions and certified it ready to receive its first batch of translocated lions from Gir Wildlife Sanctuary where they are highly overpopulated. Therefore the project envisages the translocation of lions from Gir to Kuno sanctuary.

Kuno Wildlife Sanctuary was considered suitable for reintroduction of critically endangered Asiatic lion because it is in the former range of the lions before it was hunted into extinction in about 1873. It was selected following stringent international criteria and internationally accepted requirements and guidelines developed by IUCN/SSC Reintroduction Specialist Group and IUCN/SSC Conservation Breeding Specialist Group which are followed before any reintroduction attempt anywhere in the world. There were twenty four villages of Sahariya tribe in the remote core area of the Kuno Sanctuary which have already been shifted and rehabilitated in the village Agraa, a peripheral area and all basic amenities have been provided to them.

Government of India has plans to shift two or three prides of lions from Gir to Kuno sanctuary. Even though recent studies have shown that Kuno wildlife sanctuary is ready to receive its first pride of lions from Gir, a controversy has arised because the Gujarat government from where the Lions are to come from, is reluctant to let go of them as it considers Asiatic lions a state property and wants to keep its monopoly over the tourism revenue generated by the species which is extinct in all other places in the world. Hence Gujarat sees the lions as a tourist attraction and a source of direct and indirect revenue. Proponents of the plan hope that the Government of India and the state governments of Gujarat and Madhya Pradesh

can soon reach some consensus on relocating at least two or three lion prides from Gir Forest to Kuno wildlife sanctuary, thus securing the long-term survival of the species and produce, eventually, a more genetically-diverse population.

12.5. PROJECT ELEPHANT

It is a project sponsored by Department of Environment and Forests, Government of India, which was launched in February 1992 to provide financial and technical support to major elephant bearing States in the country for protection of elephants, their habitats and corridors. The project aims to ensure long term survival of viable conservation of elephant populations in their natural habitats by protecting the elephants, their habitats and migration corridors. Other goals of the project are supporting research of the ecology and management of elephants, creating conservation awareness among local people, providing improved veterinary care for captive elephants. It also seeks to address the issues of human-elephant conflict and welfare of domesticated elephants. The Project is being implemented in 13 States
/ UTs, viz. Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Meghalaya, Nagaland, Orissa, Tamil Nadu, Uttaranchal, Uttar Pradesh and West Bengal. 25 Elephant Reserves (ERs) extending over about 58,000 sq. km have been formally notified by various State Governments till now. The estimated population of wild elephants in 2002 was 26413.

Main activities of the Project are as follows:

1. Ecological restoration of existing natural habitats and migratory routes of elephants.
2. Development of scientific and planned management for conservation of elephant habitats and viable population of Wild Asiatic elephants in India.
3. Promotion of measures for mitigation of man elephant conflict in crucial habitats and moderating pressures of human and domestic stock activities in crucial elephant habitats.
4. Strengthening of measures for protection of Wild elephants from poachers and unnatural causes of death.
5. Research on Elephant management related issues.
6. Public education and awareness programmes.
7. Eco-development.
8. Veterinary care.

Project elephant covers about 25 elephant reserves throughout the country. It is supervised by MIKE (Monitoring of Illegal Killing of Elephants) programme of CITES. In addition to conservation activities the project has also funded a few other smaller research projects to various research institutes and universities. As a result of the efforts of the project elephant it is said that the elephant population has increased to about 40,000 at present.

12.6 PROJECT HUNGUL

This is a conservation project aimed to conserve the Kashmir Star (*Cervus affinis hunglu*) sponsored by the Government of Jammu and Kashmir State which has its own forest law. The Kashmir stag, also called Hangul is a subspecies of Central Asian Red Deer native to northern India. This deer lives in groups of two to 18 individuals in dense riverine forests, high valleys, and mountains of the Kashmir valley and northern Chamba in Himachal Pradesh. In Kashmir, it's found in Dachigam National Park at elevations of 3,035 meters. These deer once numbered from about 5,000 animals in the beginning of the 20th century. Unfortunately, they were threatened, due to habitat destruction, over-grazing by domestic livestock, and poaching. This size has dwindled down to as low as 150 animals by 1970. However, the state of Jammu & Kashmir, along with the IUCN and the WWF prepared a project for the protection of these animals. It became known as Project Hangul. This brought great results and the population increased to over 340 by 1980. In the year 2008 only 160 mature individuals have been counted. Trial to breed them in captivity is also one of the goals of the project in addition to the other conservation methods.

12.7. CROCODILE BREEDING PROJECT

Like many other wild animals, the crocodiles in our country also had become endangered in the early part of 20th century. There are three species of crocodiles, gharial (*Gavialis gangeticus*), mugger (*Crocodylus palustris*) and salt- water crocodiles (*Crocodylus porosus*). In response to declining crocodilian populations, in co-operation with the Government of India and State Governments, a crocodile conservation programme, the UNDP/ FAO Crocodile Breeding and Management Project, was launched in 1975.

The broad objectives of activities under crocodile project were as follows :

1. To provide baseline data prior to commencement of the project, in 1974 a survey of the status of the three species of crocodiles present in Indianwas made.

2. To protect the remaining population of crocodilians in their natural habitat by creating sanctuaries.
3. To boost reproductive output by collection of wild-laid eggs with subsequent incubation and rearing of young until of a size (less vulnerable to predation) suitable for release in the wild.
4. To locate, establish and manage a series of crocodile rehabilitation centres and sanctuaries in suitable habitats.
5. To rebuild natural population quickly through 'grow and release' or 'rear and release' technique - more than seven thousand crocodiles have been rest ocked - about 4000 gharial (*Gavialis gangeticus*), 1800 mugger (*Crocodylus palustris*) and 1500 salt- water crocodiles (*Crocodylus porosus*).
6. To promote captive breeding.
7. To take-up research to improve management.
8. To build up a level of trained personnel for better continuity of the project through training imparted at project-sites and through the (erstwhile) Central Crocodile Breeding and Management Training Institute, Hyderabad.
9. To involve the local people in the project intimately.

Before the commencement of the project in 1974, gharial - found in rivers of North India, was considered in danger of extinction due to habitat destruction, incidental catches in fishing nets and poaching. Similarly the estuarine crocodile *Crocodylus porosus* formerly found common along shores and rivers, by 1974 had become extinct in the States of Kerala, Tamil Nadu and Andhra Pradesh. Small populations persisted in deltaic areas of Orissa, the Sunderbans (West Bengal) and the Andamans. The third species mugger *Crocodylus palustris* which was formerly widespread and abundant, by 1974 was considered very depleted in numbers and rare in most, if not all, of its former range.

As a consequence of initiation of the project sixteen crocodile rehabilitation centres and 11 crocodile sanctuaries were established. A total of 879 gharials, 190 estuarine crocodiles and 493 mugger were captive-reared and released (all at 3-years of age). Successful breeding of mugger had taken place in 10 centers, of estuarine crocodile in two and gharial in one. The greatest achievement was the re-establishment of viable gharial breeding populations in Chambal and Satkoshia Gorge sanctuaries. Soon after project commencement it became apparent that for a successful crocodile conservation programme well-trained staff was needed. Thus a Crocodile Breeding and Management Training Institute was established in Hyderabad in 1980;

46 crocodile station managers were trained.

The Indian Crocodile Conservation Project is considered among the more successful of conservation initiatives in the world. It has pulled back the once threatened crocodilians from the brink of extinction and keep them on a good path of recovery. The Project has not just produced a large number of crocodiles, but has contributed towards conservation in a number of related fields as well.

12.8. RAMSAR CONVENTION

The ponds, lakes, rivers and the sea shore form an important ecosystem. These water bodies form unique habitats for variety of animals and plants. Like other areas, these ecosystems are also being degraded and this has resulted in the loss of animals and plants living in these areas. Realizing this the IUCN and other international conservation agencies have convened a meeting at Ramsar, Mazandran, Iran on February 2, 1971, hosted by the Iranian Department of Environment, and came into force on December, 21 1975. The agreement arrived at this meeting by the participating countries to protect their wetland habitat is known as Ramsar Convention or the Convention on Wetlands of international importance. It is an international treaty for conservation and sustainable utilization of wetlands of different participating countries. The aim of the convention is to prevent the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological importance of wetlands and their economic, cultural, scientific, and recreational value.

The Ramsar Convention works closely with five other organisations known as International Organization Partners (IOPs). These are Birdlife international, the International Union for Conservation of Nature (IUCN), the International Water Management Institute (IWWI), Wetland International and WWF international. These organizations support the work of the Convention by providing expert technical advice, helping implement field studies and providing financial support. The IOPs also participate regularly as observers in all meetings of the Conference of the Parties and as full members of the Scientific and Technical Review Panel.

The Ramsar List of Wetlands of International Importance now includes 1,950 sites (known as *Ramsar Sites*) covering around 1,900,000 km^2 (730,000 sq. mi), up from 1,021 sites in 2000. The nation with the highest number of sites is the UK at 168; the nation with the greatest area of listed wetlands is Canada, with over 130,000 km^2 (50,000 sq. mi), including the Queen Maud Gulf Migratory Bird sanctuary at 62,800 km^2 (24,200 sq. mi).

Presently there are 161 contracting parties, up from 119 in 1999 and from 21 initial signatory nations in 1971. Signatories meet every three years as the Conference of the Contracting Parties (COP), the first held in Cagliari, Italy in 1981. Amendments to the original convention have been agreed to in Paris (in 1982) and Regina (in 1987). There is a standing committee, a scientific review panel, and a secretariat. Its headquarters is located at Gland, Switzerland, shared with IUCN.

12.9 WETLAND CONSERVATION PROJECT

India is also one of the Parties of Ramsar Convention. But yet our country does not have strong national laws to prevent the misuse of the wetlands. There is no separate wetland protection act, and all wetlands at present are regulated under different protection acts like Wild life protection act, 1972, Environmental Protection Act, 1986, Indian Forest Act, 1927, Indian Fisheries Act 1897. Under these acts, wetland is not treated as separate ecosystem.

A study published by the Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore, says that between 1991-2001, India lost more than 40% of its wetlands, with some districts recording losses of over 88%. SACON has documented some 700 wetlands in the country, not including the smaller ones, and recommended the inclusion of about 200 of these wetlands in the Ramsar Convention. Sadly, India has only 25 listed wetlands as part of the Ramsar convention, and even these are under rapid decay. The National Wetlands Conservation programme, started in 1987, restricts itself solely to these 25 wetlands.

India's wetlands are extraordinarily diverse – ranging from lakes and ponds to marshes, mangroves, brackish waters and lagoons – and play a vital role in maintaining water balance, flood prevention, biodiversity and support food security and livelihoods. Yet these wetlands are considered as "wastelands" by the government. Wetlands are systematically converted into "real estate" by vested interests or simply used as a dumping ground for sewage and garbage and are receptacles for toxic waste. While community court actions are in process across the country, the lack of a legally enforceable national regulation has hampered any real progress in many of these cases. Very recently, the Ministry of Environment and Forests issued a draft notification on a regulatory framework for conservation of wetlands in July 2008, under the provisions of the Environment (Protection) Act (EPA), 1986.

In response to a Public Interest Litigation (PIL) filed by Dahanu Taluka Environmental Welfare Association an NGO Supreme Court issued an order to save the wetland in Dahanu because it is an ecologically sensitive area. After this historic judgment there is some progress in the conservation of wetlands in our country.

In 2006, the National Environmental Policy (NEP) first recognized the need of legal regulatory mechanism for protection of wetlands from degradation and to conserve their ecosystem. After several meetings by an expert group from multi disciplinary backgrounds, the draft was prepared. The rule was called the Wetlands (Conservation and Management) Rules, 2008. According to the provisions of this rule, the Central, State or District authorities will assess the conservation procedure of the wetlands and monitor and review the implementation of the regulations by setting up committees such as Central Wetland Conservation Committee (CWCC), State Wetland Conservation Committee (SWCC) and District Wetland Conservation Committee (DWCC) depending on the category of the wetland. The committees consist of members who are expert in wetland related disciplines. The committee would get constituted in every three years.

Four different categories namely, A, B, C and D have been identified among the wet lands. The CWCC, or SWCC or DWCC should verify the wetland identify a local body or organization and the committee would accept/or reject the proposal for declaration of an area as wetland. Subsequently an Action Plan should be prepared for its conservation. EPA would adopt the same for implementation.

Following progress has been made in India after the implementation of Wetland Rules, 2008.

1. Number of wetlands under Wetland Conservation Programme increased from 27 in 2004 to 103 in January 2008.
2. A brochure on 'National Wetland Conservation, an approach and Guidelines' was released on the eve of 2nd February, 2007 which has now been published and circulated to all the user agencies.
3. Management Action Plans (MAPs) of 36 wetlands have been approved and financial assistance sanctioned. Cases of 10 more M.A.Ps, for newly identified wetlands are being taken up.
4. Twenty five sites have already been designated as Ramsar sites in India.

After India became party of Ramsar Convention, it has been nominated on Board of Directors of wetland International. Meeting of Board of Directors of Wetland International was held in New Delhi at Manesar during 19-20 October, 2005; About 23 countries participated. India chaired one of the sessions and efforts made by India in Wetland conservation with in a short time were highly applauded by all the participating countries.

The National River Conservation Directorate (NRCD) is involved in conservation of rivers and lakes of our country. The directorate has supervised number of Action Plans including Ganga Action Plan (GAP-Phase I, GAP-Phase II), Yamuna Action Plan etc. A total of 27 rivers in the country and number of lakes have been covered under these action plans.

12.10. SUMMARY

Establishment of conservation projects is one way of in situ conservation. In India Government of India has created such special projects for conservation of tiger, lion, elephant, hungul and crocodile. The objectives of the projects are to, eliminate all forms of human exploitation and biotic disturbance in the habitat of each species, to restrict the habitat management to repair the damages done to the ecosystem by human and other interferences so as to facilitate recovery of the ecosystem to its natural state, monitoring the faunal and floral changes over time and carrying out research about those wild species. There are also specific objectives for specific projects. Wetland conservation project is concerned with conservation of all aquatic habitats. The proceedings of Ramsar Convention also has been briefly discussed in this unit. Establishment of these projects has given positive result and there is improvement in the population of crocodiles, elephant and hungul.

12.11. KEY WORDS

Central Wetland Conservation Committee (CWCC), Crocodile breeding project, National Environmental Policy (NEP), National River Conservation Directorate (NRCD), Project Elephant, Project Hungal, Project Lion, Project Tiger, Ramsar Convention, State Wetland Conservation Committee (SWCC), Wetland conservation Project, and District Wetland Conservation Committee (DWCC),

12.12. QUESTIONS FOR SELF STUDY

1. List out the importance of conservation projects
2. Give a brief account of project tiger and add a note on its success
3. Write a short essay on the project of shifting lion from Gir forests.
4. Give an account on the project hungul or elephant project.
5. What is the extent of success of crocodile breeding project?

6. Write a detailed note on Ramsar convention
7. What is the importance of wetland conservation project in saving bird species?

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