

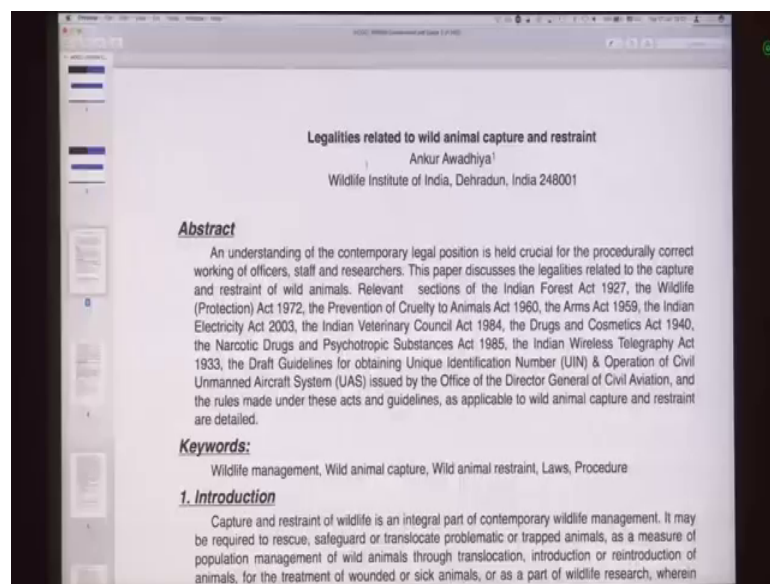
Wildlife Conservation
Dr. Ankur Awadhiya
Department of Biotechnology
Indian Institute of Technology, Kanpur

Lecture – 40

Revision – III

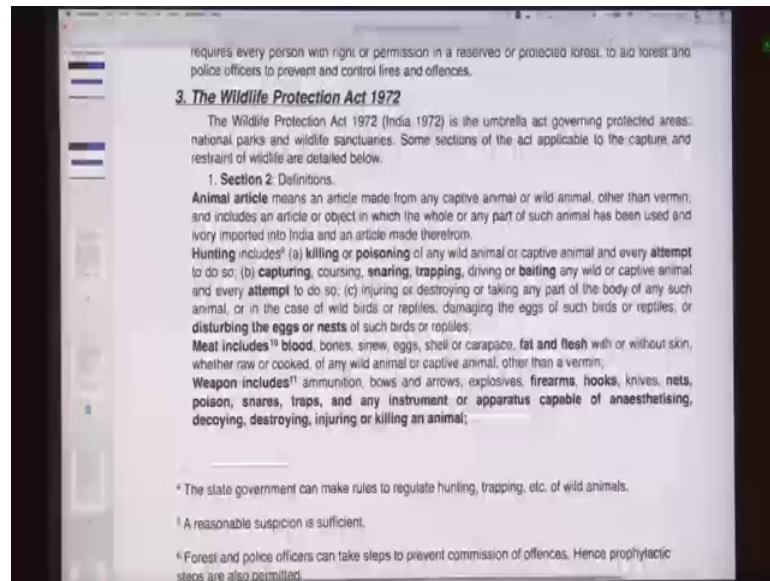
[FL]. So, now we have to come to the last lecture of this course which is the third Revision lecture.

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So, here we looked at so we are going to begin with legal aspects of capture and restraint. So, we had a look at the Indian Forest Act of 1927.

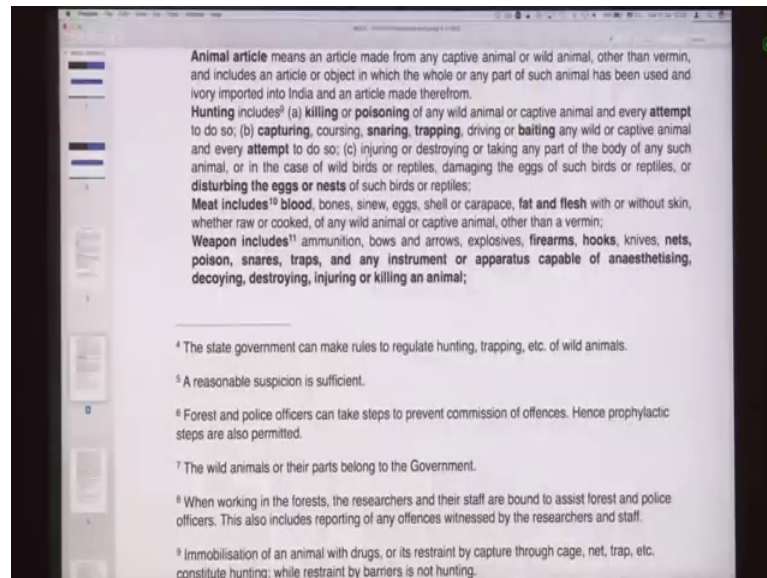
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The most important act for us is the Wildlife Protection Act. Now in this case section 2 is the most important one which defines animal article hunting. So, hunting includes killing or poisoning, capturing, snaring, trapping, baiting every attempt to do all of these.

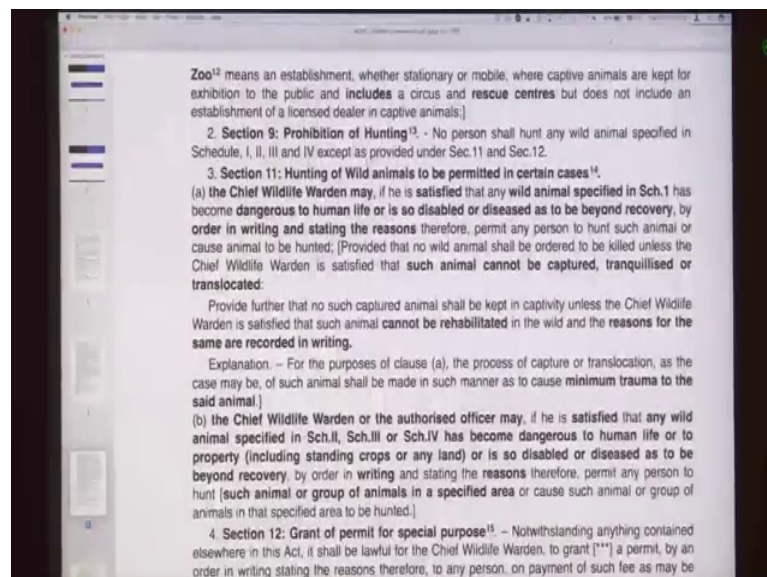
So, essentially when you are setting up a trap that is hunting under the Wildlife Protection Act. Then it defines meat, so meat includes blood fat flesh and so on. Weapon includes firearms, hooks, nets, poisons, snares, traps, and any other equipment, or apparatus that is capable of anaesthetizing, decoying, destroying, injuring, or killing of an animal.

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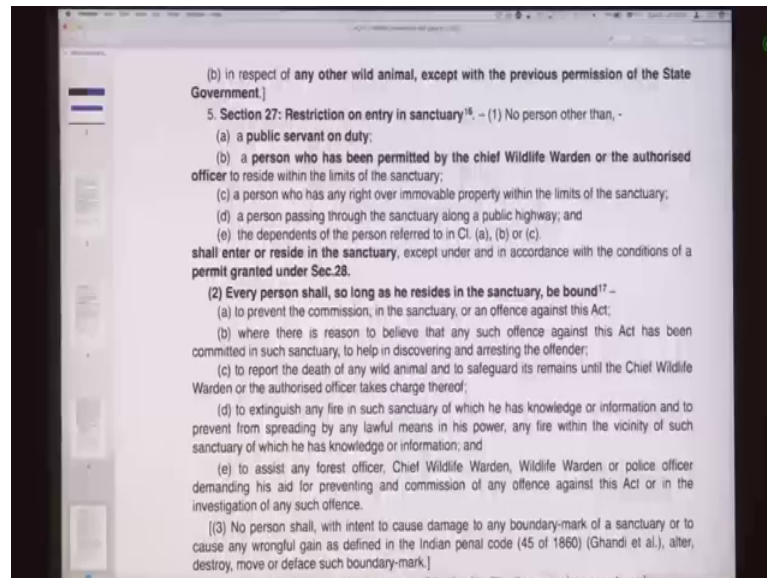
So, essentially when we look at these definitions we can understand that most of the things that we are doing in the name of captioning of animals are prohibited, and they are regulated unless explicitly permitted.

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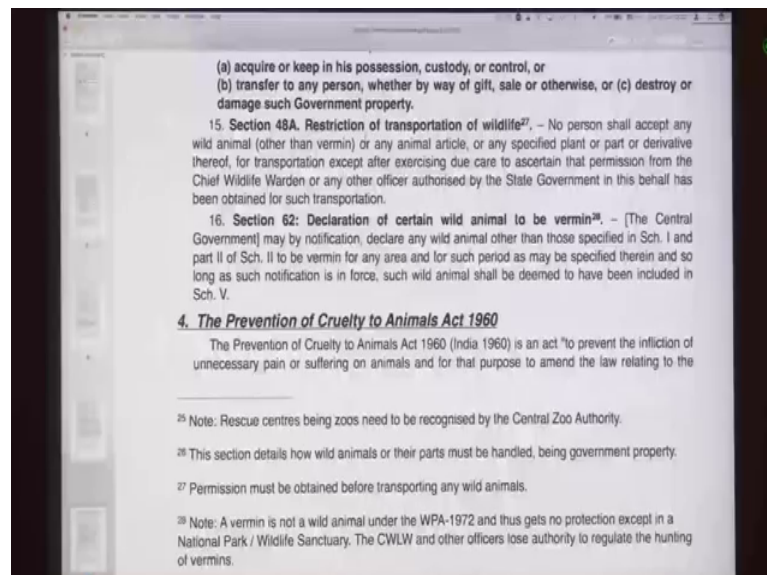
And then hunting is prohibited and then permission of hunting can be had through section 11. And in the case of section 12, so this talks about who grants the permits and then there are different situations for which permits can be granted.

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Schedule 1 animals and schedule 2 animals are given more preference. So, schedule 1 and part 2 of schedule 2 and other animals I given a less preference. Then you have restriction on entries destruction etcetera is prohibited and so on. Declaration of national parks wild life etcetera, are government property.

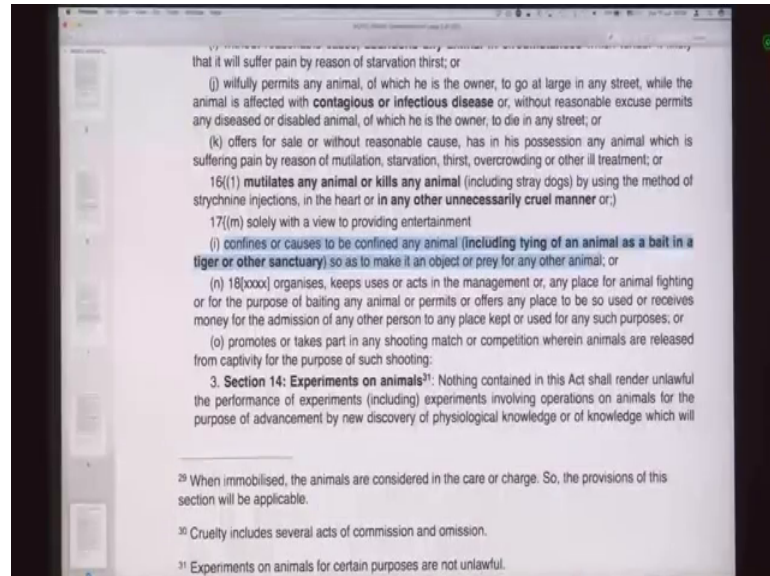
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And then section 62 is a very important section it talks about the declaration of certain wild animals to be vermin's. And here also animals it says declare any wild animal other than those specified and schedule 1 and part 2 of schedule 2. Now, the next important act

is the Prevention of Cruelty to Animals Act of 1960. Now in this case treating animals cruelly is defined very clearly.

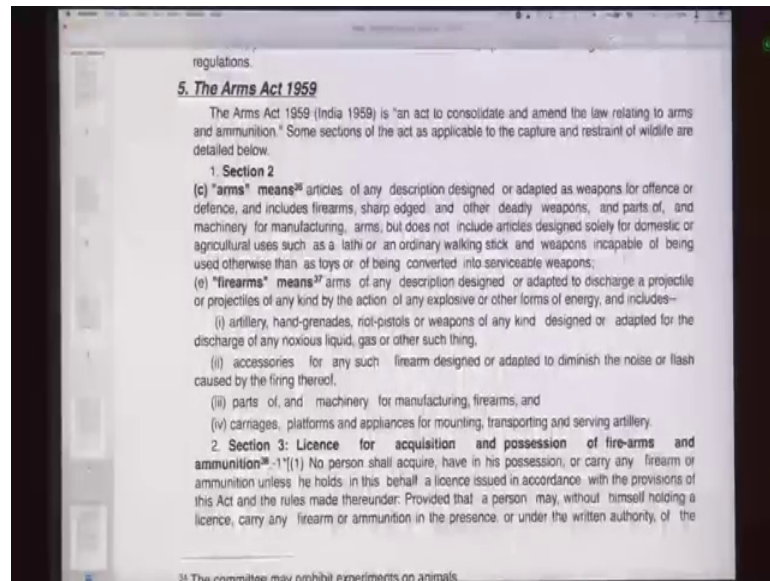
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Now in the case of our situations so it is says 17 m is solely with the view of providing to providing entertainment confines, or causes any animal to be confined. Including tying of an animal as a bait or in the in tiger or other sanctuary.

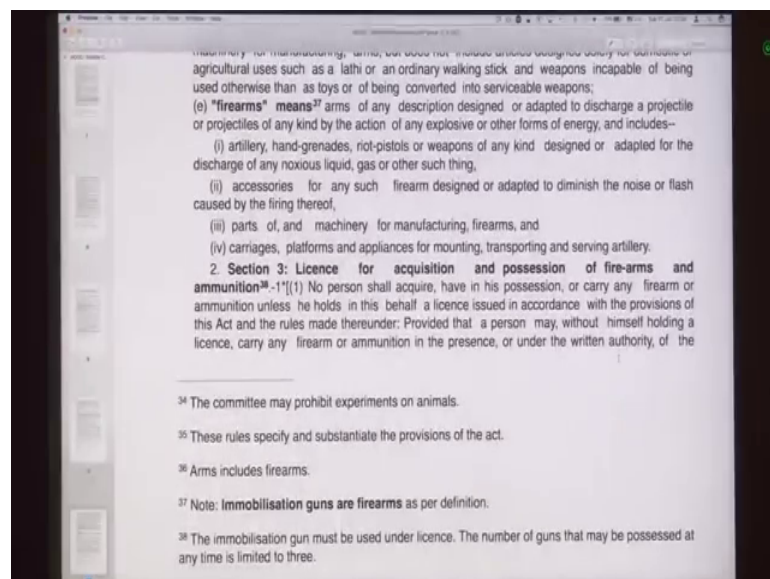
Now, the point here to note is that if you are using an animal as a bait that is not explicitly prohibited, but only when you are using it as a bait for the purpose of entertainment and entertainment alone. Then it also regulates experimentation of animals, there is a committee; the duties are defined and so on.

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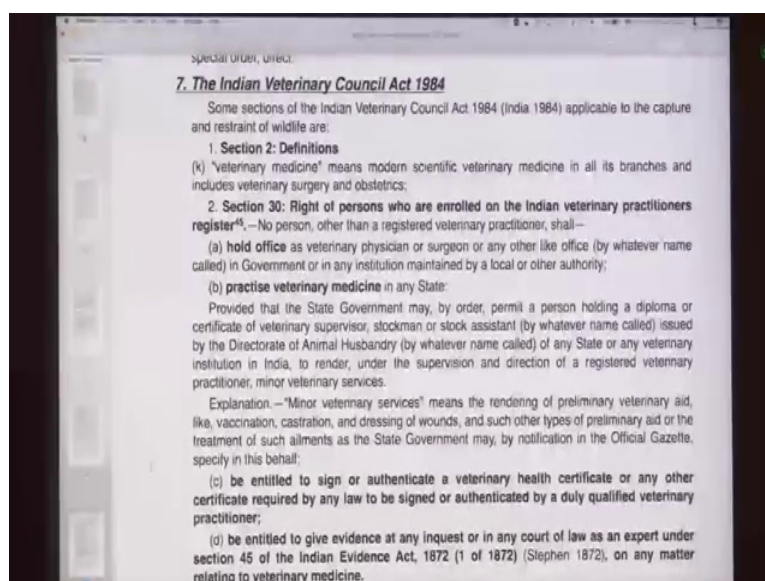
The next important act is the Arms Act of 1959. So, here it defines arms and firearms.

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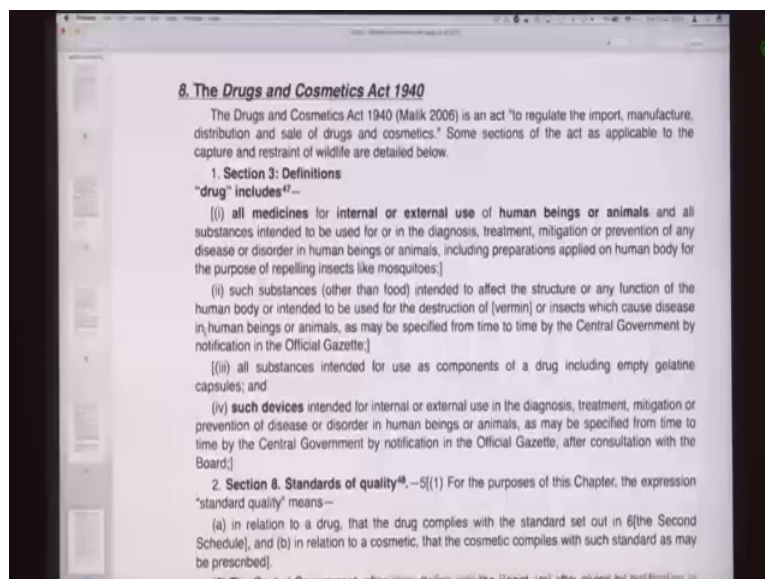
Now, in this case these two points are important. Immobilization, guns are firearms as per the definition, and arms also includes firearms. So, basically the immobilization guns are firearms and as well as they are arms.

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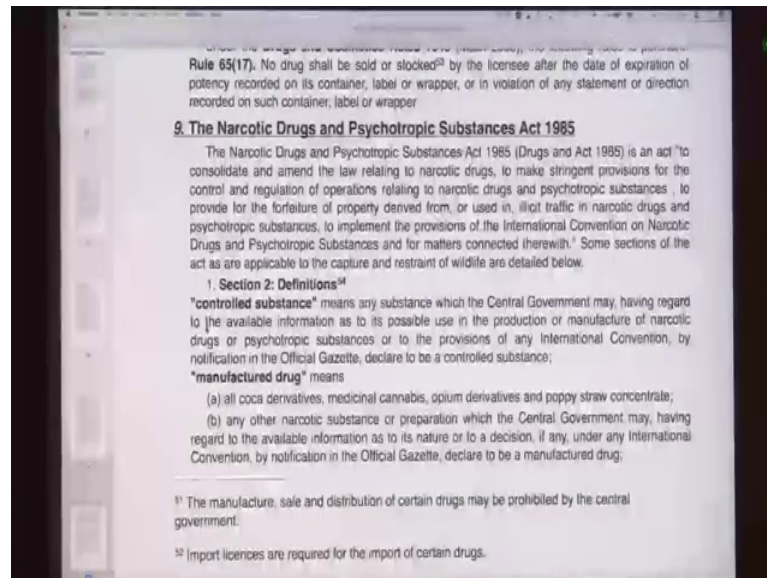
Next is the Indian Electricity Act, the Indian Veterinary Council Act. Now Indian Veterinary Council Act very clearly mentions that if you are giving any drug to and to a wild animal. You need to have a registration with the veterinary council, and which also means that you need to have a degree in veterinary science and medicine.

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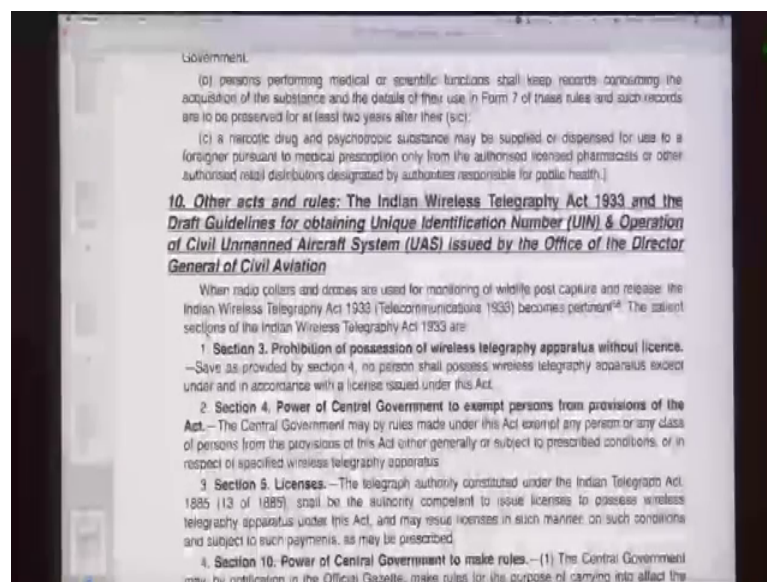
Then you have the Drugs and Cosmetics Act, so whenever we are importing, or manufacturing, or transporting any of our drugs mostly our. So, they are regulated under this act and also under the Narcotics and the Psychotropic Substances Act.

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So, especially when we are talking about immobilizing drugs a number of them are narcotics. So, the provisions of this act also applied to them. So, the important sections are already highlighted.

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And next is the Indian Wireless Telegraphy Act the draft guidelines for the use of drones. So, these are the important acts and regulations that are required here. So, next we looked at other topics in capture and restraint.

(Refer Slide Time: 04:28)

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Module 8: Management of changes

Preliminaries
Mechanical capture
Chemical capture
Capture myopathy
Care of immobilised animal
Legal aspects of capture and restraint
Other topics in capture and restraint

Design of trap cages I

Annexure-I¹⁷¹

1. Trap cages should be completely enclosed (new designs use fiberglass) with holes for ventilation.
2. Iron rods should not be used (thick chain link is preferable) anywhere in the trap cage as leopards struggle to escape by pulling at the bars which results in canines being broken.
3. Old rusty, iron cages should be discarded, and not used to house leopards.
4. There should be a gap of 1.5 inches between the cage floor and the lower edge of the trap door to prevent tails getting slammed.
5. Trap cages should be well ventilated.

Dr. Ankur Awa observation

So, when we are designing trap cages; how should they be designed. Then transport of captive animals and all of these are governed by the CZA guidelines.

(Refer Slide Time: 04:38)

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Preliminaries
Mechanical capture
Chemical capture
Capture myopathy
Care of immobilised animal
Legal aspects of capture and restraint
Other topics in capture and restraint

Human safety concerns during wildlife capture I

- 1 Environmental risks
 - 1 inclement or extreme weather
 - 2 need to carry sufficient protective clothing
 - 3 ropes or harness in dangerous locations
 - 4 adequate food and water supply
 - 5 communication systems and backup
- 2 Disease risks
 - 1 zoonotic diseases
 - 2 malaria
 - 3 ticks and fleas
 - 4 need for prophylactic medicines and protection
- 3 Equipment related risks

Dr. Ankur Awa observation

(Refer Slide Time: 04:51)

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Legal aspects of capture and restraint
Other topics in capture and restraint

Human safety concerns during wildlife capture II

- ① rifles and pistols are firearms, may cause severe trauma if misused
- ② need for appropriate training
- ③ need to follow firearms safety rules
- ④ traps, snares, nets may not function as desired
- ⑤ Drug related risks
 - ① protective gear: gloves, apron / coverall, goggles, boots
 - ② cover dart before pressurising
 - ③ dart filling should not be done on moving vehicle or elephant back
 - ④ use of spill-proof containers
 - ⑤ keep human antidote ready before starting to fill the dart
- ⑥ Animal-related risks

Dr. Ankur Awa observation

And next we have the human safety concerns. So, whenever you are capturing a wild animal, or whenever you are immobilizing a wild animal or whether you are working with a wild animal you need to take care of environmental risk, disease risk, equipment related risk. Drug related risk, animal related risk, and evacuation protocols.

(Refer Slide Time: 04:52)

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Preliminaries
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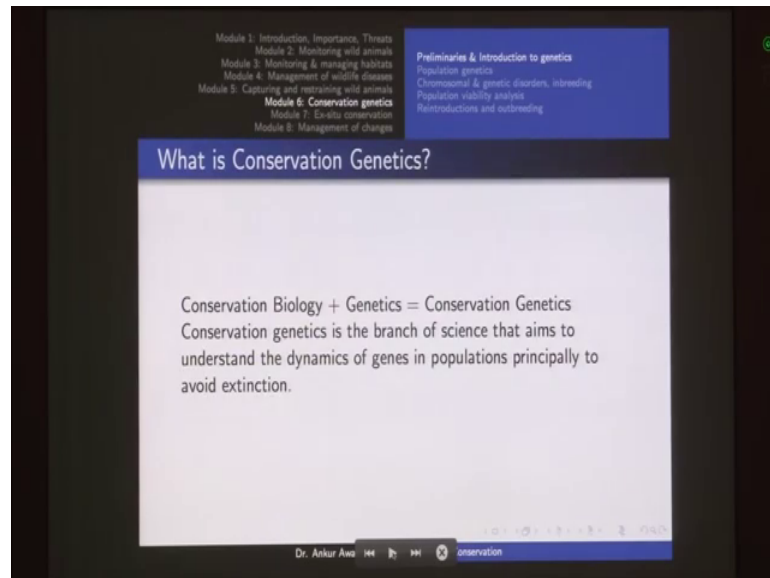
Human safety concerns during wildlife capture III

- ① firearm backup
- ② pepper spray
- ③ chances of misjudging the anaesthetic depth
- ④ involuntary muscular responses of the immobilised animal
- ⑤ trauma by bites, horns, weight of animal, etc.
- ⑥ evacuation protocol and treatment options are a must
 - ① if narcotics are used, naloxone, naltrexone, hydrocortisone, diazepam, atropine and adrenaline must be a part of the first aid kit
 - ② emergency response: HAD-ABC
 - ③ Help: Call for help
 - ④ Absorption / Antidote: Limit absorption, give antidote
 - ⑤ Drip: Establish drip if indicated

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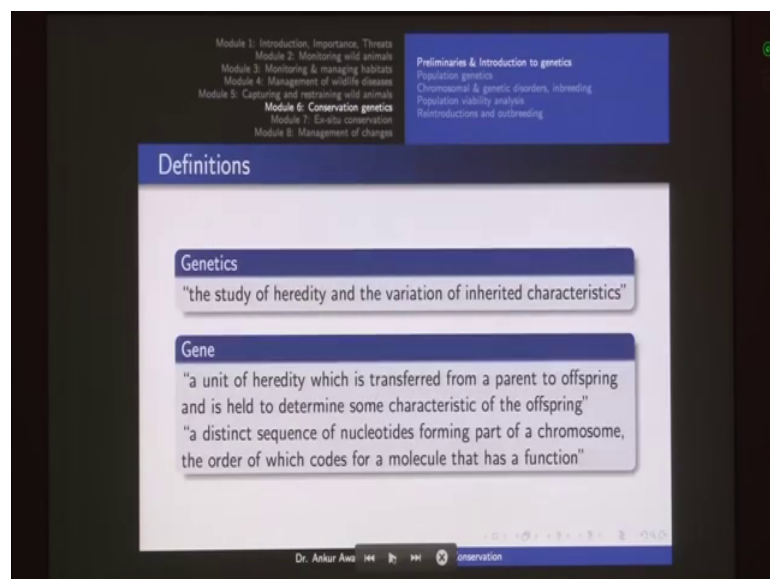
So, the next module was Conservation Genetics.

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So, we began with what is conservation genetics? What is conservation biology plus genetics or a branch of science that aims to understand the dynamics of genes in populations principally to avoid extinction.

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Then we looked at what is genetics? What is a gene?

(Refer Slide Time: 05:11)

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Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Definitions

Chromosome

"a thread-like structure of nucleic acids and protein found in the nucleus of most living cells, carrying genetic information in the form of genes"

Dr. Ankur Awasthi | Conservation

(Refer Slide Time: 05:12)

Genes are in chromosomes

5 μ m

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What is a chromosome?

(Refer Slide Time: 05:15)

The slide is titled 'Definitions' and is part of a presentation on conservation genetics. It includes a table of contents on the left and a list of topics on the right. The main content defines 'Allele' and 'Trait'.

Allele
"each of two or more alternative forms of a gene that arise by mutation and are found at the same place on a chromosome."
e.g. P and p represent flower colour alleles for a pea plant

Trait
"a genetically determined characteristic caused due to the presence of some allele"
e.g. colour of flower of a pea plant

Dr. Ankur Awa | observation

What is allele? What is a trait?

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The slide is titled 'Mendel's laws of genetics' and is part of a presentation on conservation genetics. It includes a table of contents on the left and a list of topics on the right. The main content describes the 'Law of dominance' and the 'Law of segregation'.

Law of dominance
Recessive alleles will always be masked by dominant alleles.
e.g. Purple (P) flower trait is dominant over white (p) flower trait.

Law of segregation
"The two alleles of a gene separate (segregate) during gamete formation, so that a sperm or an egg carries only one allele of each pair."
Explains the 3:1 F₂ ratio.

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What is genotype? What is phenotype? Then we had the law of a I mean genetics, law of dominance, law of segregation, law of independent assortment.

(Refer Slide Time: 05:23)

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Example case: PP × pp

F1: PP × pp

	p	p
P	Pp	Pp
P	Pp	Pp

Genotype: Pp (all)
Phenotype: Purple flowered (all)

Dr. Ankur Awa observation

(Refer Slide Time: 05:25)

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Example case: PPGG × ppGG

F2: PpGg × PpGg

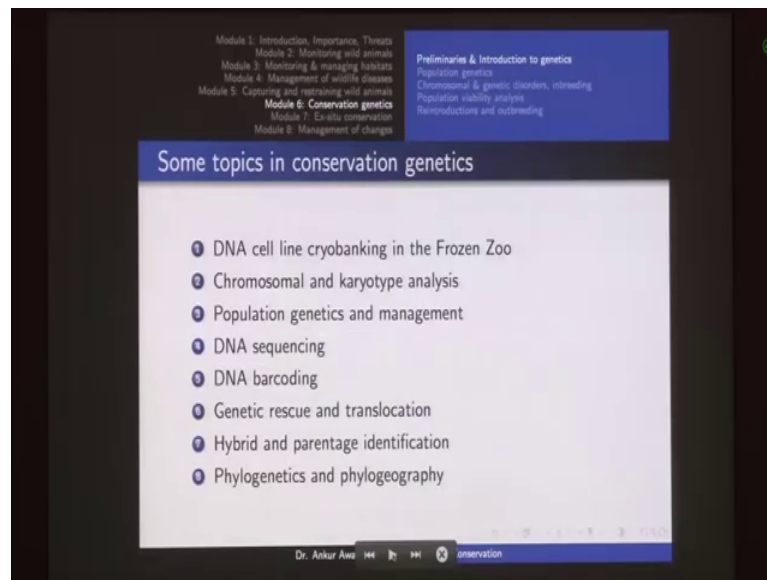
	PG	Pg	pG	pg
PG	PPGG	PPGg	PpGG	PpGg
Pg	PPGg	PPgg	PpGg	Ppgg
pG	PpGG	PpGg	ppGG	ppGg
pg	PpGg	Ppgg	ppGg	ppgg

Genotype: PPGG (1) : PpGG (2) : PPGg (2) : PpGg (4) : ppGG (2) : Ppgg (2) : PPgg (1) : ppGG (1) : ppGg (1)
Phenotype: Purple flowered, Green pod (9) : white flowered, Green pod (3) : Purple flowered, yellow pod (3) : white flowered, yellow pod (1)

Dr. Ankur Awa observation

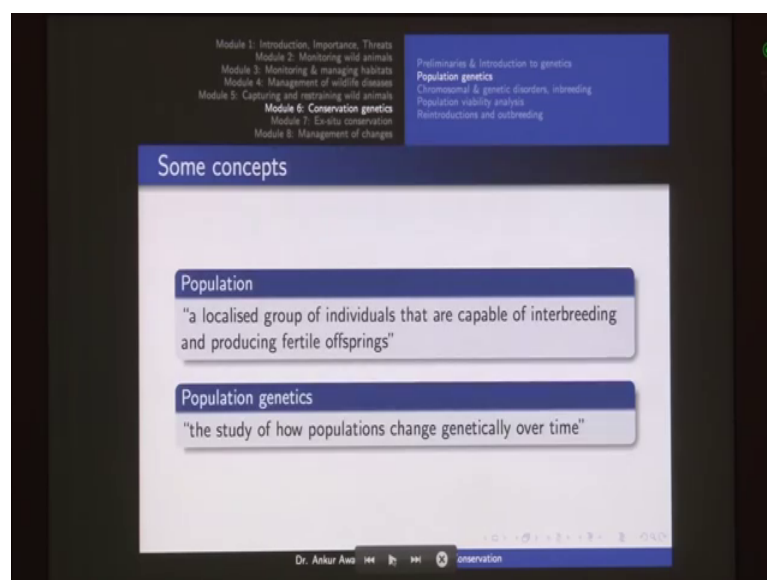
Then we looked at all different finite squares.

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Then we looked at co dominance and incomplete dominance and then some topics in conservation genetics. So, conservation in genetics is important because we are doing things such as DNA cell line, cryobanking, then chromosomal analysis, karyotype analysis, population genetics, DNA sequencing, bar-coding and so on. Next we had a look at population genetics.

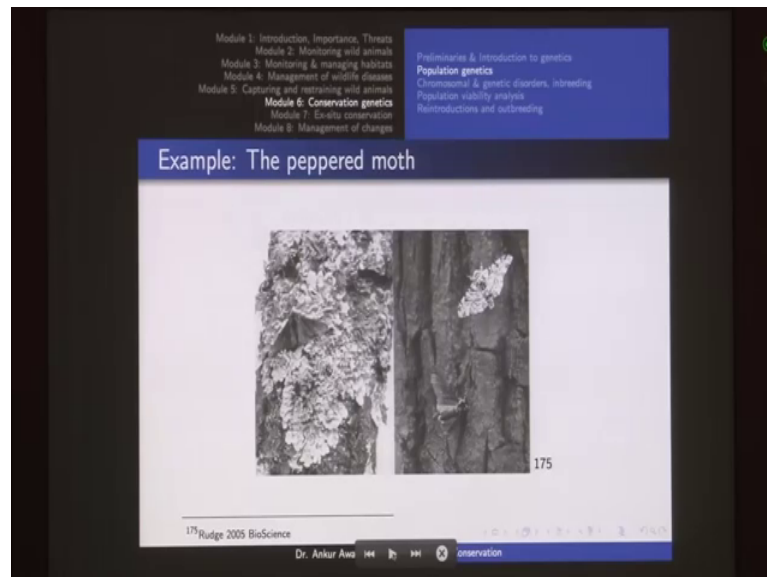
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So, what is a population? A population is a localized group of individuals that are capable of interbreeding and producing fertile offspring. So, we looked at different

populations giving the examples of tigers from Madhya Pradesh and tigers from Sundarbans or say tigers from Mudumalai. So, all of these are different populations of tigers and population genetics ask the question how populations are changing genetically over time.

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So, we looked at this example of the peppered moth. So, in this example earlier when there was less amount of population so, the barks of the trees were light in color. And so out of these two varieties peppered moth, the melanistic variety was very clearly visible, but the whitish variety, or the lighter colored variety it became very easily camouflaged. So, both of these traits were present both of these phenotypes were present in the population, but then this one was more dominant.

Now, later on when the area became more populated and soot covered all of these tree barks. So, the lighter variety became more conspicuous and the darker variety became less conspicuous. So, this is how population genetics works in response to the environment. Then it is related with evolution.

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The slide is titled "Relation with evolution". It features a table of contents on the left and a sidebar on the right. The main content area defines evolution.

Module 1: Introduction, Importance, Threats	Preliminaries & Introduction to genetics
Module 2: Monitoring wild animals	Population genetics
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Module 8: Management of changes	

Evolution
Evolution is the *genetic adaptation of organisms to their environment*.

Dr. Ankur Awa | observation

(Refer Slide Time: 06:59)

The slide is titled "Definitions". It features a table of contents on the left and a sidebar on the right. The main content area defines three key terms.

Module 1: Introduction, Importance, Threats	Preliminaries & Introduction to genetics
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Adaptation
Any alteration in the structure or function of an organism by which the organism becomes better able to survive and multiply in its environment.

Genetic
Relating to genes (informational sequences regarding traits or functions) or heredity (passing of traits across generations).

Genetic Adaptation
Inheritable fitness.

Dr. Ankur Awa | observation

Then we looked at adaptation, and genetic adaptation. So, genetic adaptation is an inheritable fitness.

(Refer Slide Time: 07:06)

The slide is titled "Fitness" and is part of a presentation on conservation genetics. It includes a table of contents on the left and a sidebar on the right. The main content area contains a "Definition" box.

Table of Contents:

- Module 1: Introduction, Importance, Threats
- Module 2: Monitoring wild animals
- Module 3: Monitoring & managing habitats
- Module 4: Management of wildlife diseases
- Module 5: Capturing and restraining wild animals
- Module 6: Conservation genetics**
- Module 7: Ex-situ conservation
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Sidebar:

- Preliminaries & Introduction to genetics
- Population genetics**
- Chromosomal & genetic disorders, inbreeding
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- Reintroductions and outbreeding

Definition:

The ability of a particular organism to leave descendants in future generations, relative to other organisms.
Evolution acts to maximise fitness through the process of natural selection.

Dr. Ankur Awasthi | observation

Then we defined fitness as the ability of a particular organism to leave descendants in future generations, relative to other organisms. So, evolution tends to maximize the fitness.

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The slide is titled "Fitness" and is part of a presentation on conservation genetics. It includes a table of contents on the left and a sidebar on the right. The main content area contains a "Characteristics of 'fitness'" box.

Table of Contents:

- Module 1: Introduction, Importance, Threats
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Sidebar:

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- Chromosomal & genetic disorders, inbreeding
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Characteristics of 'fitness':

- 1 Fitness is environment-specific.
- 2 Fitness is species-specific.
- 3 High reproductive rate alone does not mean higher fitness; but higher survival of more progeny does.
- 4 Fitness should be measured across several generations; it is a long-term measure.
- 5 Fitness works at the level of complete organism, not on individual traits such as size or speed.

Dr. Ankur Awasthi | observation

So, fitness we looked at different characteristics of fitness. And then we defined natural selection.

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The slide is titled "Natural Selection". It features a table of contents on the left and a definition box in the center. The table of contents lists modules from 1 to 8, with Module 6: Conservation genetics highlighted. The definition box contains the following text:

Definition

The process in nature by which only those organisms best adapted to their environment tend to survive and transmit their genetic characteristics to the succeeding generations; while those less adapted tend to be eliminated.

At the bottom of the slide, there is a navigation bar with the text "Dr. Ankur Awasthi" and "conservation".

The process in nature by which only those organisms best adapted to the environment tend to survive and transmit their genetic characteristics to the succeeding generations; while those less adapted tend to be eliminated.

(Refer Slide Time: 07:35)

The slide is titled "Natural Selection". It features a table of contents on the left and a list of five steps in a box in the center. The table of contents lists modules from 1 to 8, with Module 6: Conservation genetics highlighted. The list of steps is as follows:

The five steps in Natural Selection

- 1 Variation: All individuals are not identical; they have different characteristics.
- 2 Overpopulation: Organisms tend to produce excess offsprings. e.g. Female mosquitos may lay 500 to 1,000 eggs.
- 3 Struggle for existence: Resources are limited, so not all offsprings will be accommodated.
- 4 Survival of the fittest: Only those individuals best able to obtain and use resources will survive and reproduce.
- 5 Changes in the gene pool: Inherited characters increase the frequency of favoured traits in the population.

At the bottom of the slide, there is a navigation bar with the text "Dr. Ankur Awasthi" and "conservation".

So, this is natural selection and it occurs in five steps; one is variation. So, all the individuals are not identical they have different characteristics. So for instance the dark variety of peppered moth and the light variety of peppered moth, then we had over population.

So, organisms tend to produce excess number of offspring's. And then there is a struggle for existence because the resources are limited, but then we have excess number of offspring's that need to be accommodated. So, then because of this is struggle only a few organism are able to survive.

So, it says survival of the fitness, and then because of this survival of the fittest these organisms are able to pass on their genes to the next generations. So, there is a change in the gene pool. And so this is how the natural selection occurs.

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The slide is titled 'Definitions' and contains two definitions:

- Gene pool**
"the total aggregate of genes in a population at any one time"
- Allele frequency**
"the proportion of an allele in the population"

The slide also features a table of contents on the left and a list of topics on the right.

Module	Topic
Module 1	Introduction, Importance, Threats
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Topics on the right:

- Preliminaries & Introduction to genetics
- Population genetics
- Chromosomal & genetic disorders, inbreeding
- Population viability analysis
- Reintroductions and outbreeding

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Next we defined gene pool as the total aggregate of genes in a population at any one time; and allele frequency as the proportion of an allele in the population.

(Refer Slide Time: 08:28)

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Example

Consider a population with 640 plants with red flowers (RR), 320 plants with pink flowers (Rr) and 40 plants with white flowers (rr). This gene shows an incomplete dominance phenotype.

In this case,
Number of R alleles = $640 \times 2 + 320 \times 1 + 40 \times 0 = 1280 + 320 = 1600$
Number of r alleles = $640 \times 0 + 320 \times 1 + 40 \times 2 = 320 + 80 = 400$
Allele frequency of R = $\frac{1600}{1600+400} \times 100\% = 80\%$
Allele frequency of r = $\frac{400}{1600+400} \times 100\% = 20\%$

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So, we looked at how allele frequencies are calculated.

(Refer Slide Time: 08:30)

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Hardy-Weinberg principle

"allele and genotype frequencies in a population will remain constant from generation to generation in the absence of other evolutionary influences"

Dr. Ankur Awadhya, IFS Wildlife Conservation

Hardy-Weinberg principle is a very important principle. It says "allele and genotypic frequencies in a population will remain constant from generation to generation in the absence of other evolutionary influences". So, basically if evolution has not taking place then allele frequencies and genotype frequencies will remain constant for every generation.

(Refer Slide Time: 08:50)

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Example

In our example,
Allele frequency of R = 80% $\Rightarrow f(R), p = 0.8$
Allele frequency of r = 20% $\Rightarrow f(r), q = 0.2$
In the absence of evolutionary influences, not only will p and q remain constant, but also the proportions of individuals.
Proportion of RR individuals = $0.8 \times 0.8 = 0.64$
Proportion of rr individuals = $0.2 \times 0.2 = 0.04$
Proportion of Rr individuals = $1 - (0.64 + 0.04) = 0.32$

Dr. Ankur Awadhiya, IFS Wildlife Conservation

(Refer Slide Time: 08:54)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

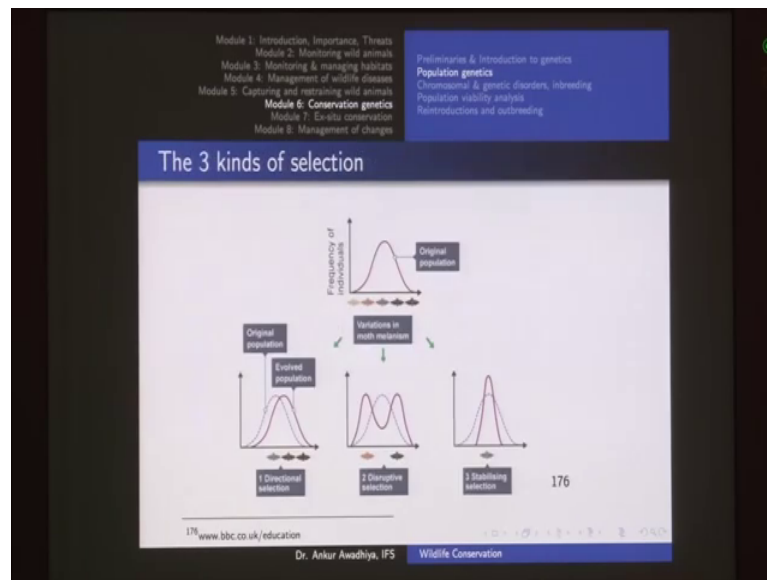
Evolution: Violations of Hardy-Weinberg equilibrium

- 1 Non-random mating, e.g. inbreeding
- 2 Selection

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Then we looked at how evolution occurs. So, evolution occurs if there is a nonrandom mating, if there is a selection of mates, if there is mutation, if there is selection of individuals.

(Refer Slide Time: 08:59)



(Refer Slide Time: 09:05)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

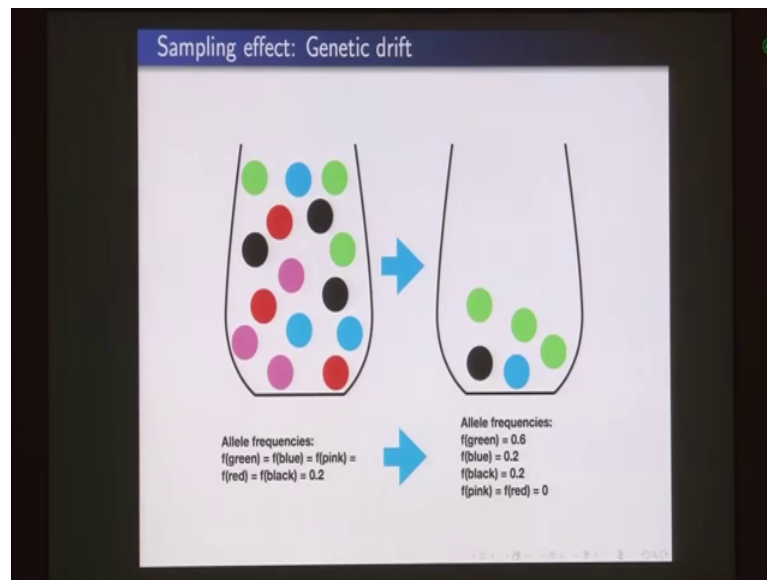
Evolution: Violations of Hardy-Weinberg equilibrium

- 1 Non-random mating, e.g. inbreeding
- 2 Selection
- 3 Mutation: Generation of new alleles
- 4 Migration: Addition of new alleles or changes in frequencies
- 5 Small population effect: Random changes due to sampling

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If there is a mutation, if there is migration, and if there is a small effect.

(Refer Slide Time: 09:09)



So, we just shown here in the in the example of genetic drift; so, here you have all these different varieties that are available in your gene pool, but then if you take only these ones for the next generation. So, the allelic frequency changes in the gene pool. So, this is an example of genetic drift.

(Refer Slide Time: 09:32)

The slide is titled "Chromosomal disorders". It contains a definition: "A chromosome disorder is a missing, extra, or irregular portion of chromosomal DNA, caused by an atypical number of chromosomes or a structural abnormality in one or more chromosomes". In the top right corner, there is a table of contents with the following items:

Module 1: Introduction, Importance, Threats	Preliminaries & Introduction to genetics
Module 2: Monitoring wild animals	Population genetics
Module 3: Monitoring & managing habitats	Chromosomal & genetic disorders, inbreeding
Module 4: Management of wildlife diseases	Population viability analysis
Module 5: Capturing and restraining wild animals	Reintroductions and outbreeding
Module 6: Conservation genetics	
Module 7: Ex-situ conservation	
Module 8: Management of changes	

At the bottom of the slide, it says "Dr. Ankur Awadhiya, IFS" and "Wildlife Conservation".

Next we looked at chromosomal and genetic disorders in inbreeding. So, we had defined chromosome in the last lecture here we looked chromosomal disorders.

(Refer Slide Time: 09:39)

The slide is titled "Kinds of chromosomal disorders". It lists two main categories: Numerical disorders and Structural abnormalities. Numerical disorders include Monosomy (one chromosome instead of a pair), Trisomy (three chromosomes instead of a pair), and Tetrasomy (four chromosomes instead of a pair). Structural abnormalities include Deletion (a part of a chromosome missing), Duplication (a part of a chromosome in two or more copies), Translocation (a part of a chromosome shifted to another chromosome), and Inversion (a part of a chromosome turned upside down). The slide also includes a table of contents on the left and a sidebar on the right with the text "Preliminaries & Introduction to genetics", "Population genetics", "Chromosomal & genetic disorders, inbreeding", "Population viability analysis", and "Reintroductions and outbreeding". The footer of the slide reads "Dr. Ankur Awadhiya, IFS Wildlife Conservation".

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
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Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Kinds of chromosomal disorders

- 1 Numerical disorders
 - 1 Monosomy: One chromosome in place of a pair
 - 2 Trisomy: Three chromosomes in place of a pair
 - 3 Tetrasomy: Four chromosomes in place of a pair
- 2 Structural abnormalities
 - 1 Deletion: A part of a chromosome missing
 - 2 Duplication: A part of a chromosome in two or multiple copies
 - 3 Translocation: A part of a chromosome shifted to another chromosome
 - 4 Inversion: A part of a chromosome turned upside down

etc.

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So, we have numerical disorders and structural abnormalities. So, these are the varieties.

(Refer Slide Time: 09:44)

The slide is titled "Kinds of genetic disorders". It lists three types of genetic disorders: a gene that does not work (due to deletion or inactivation), a gene that works extra (due to duplication or extra activation), and a gene that does different work (due to mutation that changes the structure of protein made). The slide also includes a table of contents on the left and a sidebar on the right with the text "Preliminaries & Introduction to genetics", "Population genetics", "Chromosomal & genetic disorders, inbreeding", "Population viability analysis", and "Reintroductions and outbreeding". The footer of the slide reads "Dr. Ankur Awadhiya, IFS Wildlife Conservation".

Module 1: Introduction, Importance, Threats
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Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Kinds of genetic disorders

- 1 a gene that does not work, say, due to deletion or inactivation
- 2 a gene that works extra, say, due to duplication or extra activation
- 3 a gene that does different work, say, due to mutation that changes the structure of protein made

Dr. Ankur Awadhiya, IFS Wildlife Conservation

Then genetic disorders you have a gene that does not work, a gene that does a extra work, or a gene that does a different work.

(Refer Slide Time: 09:51)

The slide is titled "Inbreeding". It defines inbreeding as "mating of individuals that are genetically related" and states that it "increases homozygosity, causing expression of recessive traits, and reduces variations between individuals in the population." The slide is part of a presentation on Wildlife Conservation, with a table of contents on the left and a list of topics on the right.

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Inbreeding

"mating of individuals that are genetically related"
It increases homozygosity, causing expression of recessive traits,
and reduces variations between individuals in the population.

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Now, inbreeding is mating of individual that are genetically related. Now, this becomes very important in the case of smaller populations where most of the individuals are already related.

(Refer Slide Time: 10:01)

The slide is titled "Causes of inbreeding in animals". It lists two causes: 1) Some animals naturally prefer mating with relative, e.g. *Drosophila melanogaster* and banded mongoose. 2) Some animal populations are forced into inbreeding when the population is so small or isolated that most individuals are already genetically related. The slide is part of a presentation on Wildlife Conservation, with a table of contents on the left and a list of topics on the right.

Module 1: Introduction, Importance, Threats
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Module 3: Monitoring & managing habitats
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Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Causes of inbreeding in animals

- 1 Some animals naturally prefer mating with relative, e.g. *Drosophila melanogaster* and banded mongoose.
- 2 Some animal populations are forced into inbreeding when the population is so small or isolated that most individuals are already genetically related.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

So, some organisms prefer mating with their relatives, and some are force into in breeding.

(Refer Slide Time: 10:08)

Juvenile mortality in cheetahs

Table 1. Juvenile mortality in captive-bred cheetahs. Juvenile mortality includes all deaths at 6 months of age or less, including stillbirths, premature births, and cases of maternal neglect, cannibalism, infection and so forth.

Population	Period	Infant mortality (%)
4. Unrelated, North American regional studbook†	1956 to 1982	26.3
5. Related, North American regional studbook†	1956 to 1982	44.2

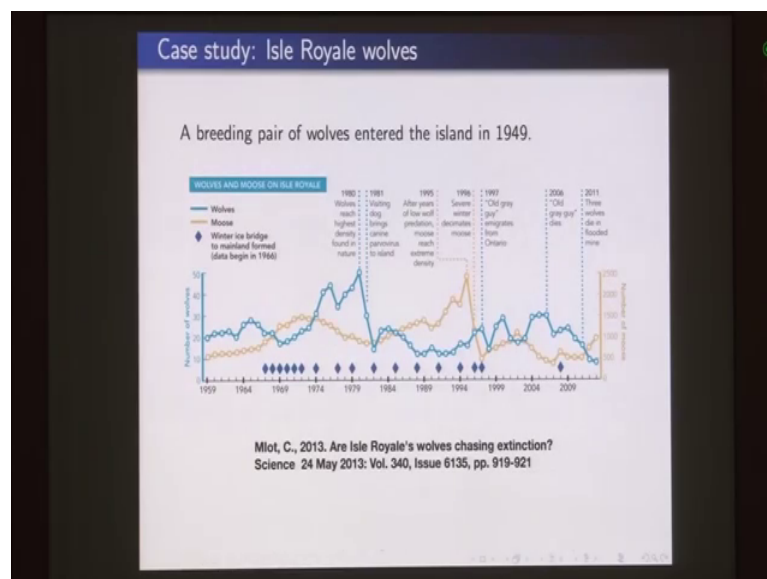
†Data were compiled by L. M. (16). The data represent a composite of pedigree analysis of successful breeding programs in 18 zoos. †Pedigree data for each of the offspring produced by groups 1 and 3 was available. The entire (in Wild) population was the result of matings of wild-caught or semiwild animals. Within the survey of the studbook, 10% of offspring were either one or two generations removed from the wild. These offspring resulting from matings of related parents (group 5) were compared to those arising from apparently unrelated parents (group 4).

177

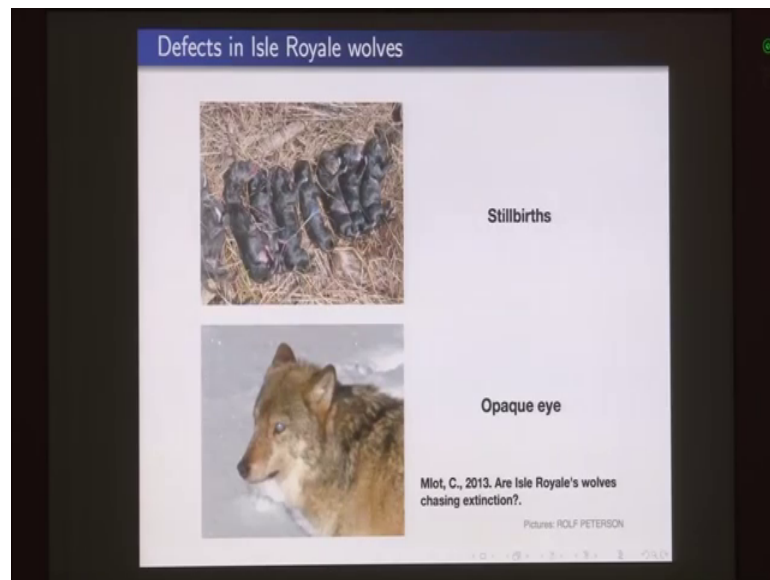
¹⁷⁷O'Brien, S.J., Roelke, M.E., Marker, L., Newman, A., Winkler, C.A., Meltzer, D., Colly, L., Evermann, J.F., Bush, M., and Wildt, D.E., 1985. Genetic basis for species vulnerability in the cheetah. *Science*, 227(4693), pp.1428-1434.

Now, what are the impacts of inbreeding? So, this paper showed us that in the case of cheetahs if you have unrelated individuals then there is 26 percent infant mortality. For the related organisms there is 44 percent infant mortality. So, infant mortality goes up.

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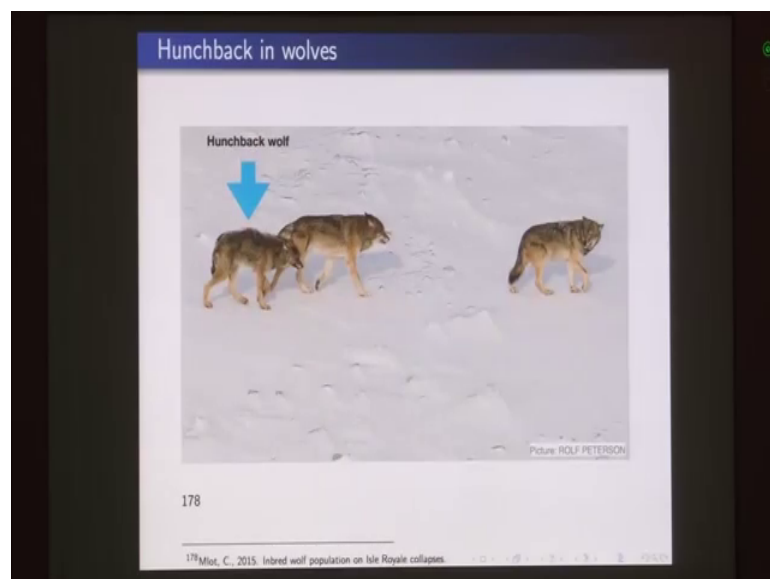


(Refer Slide Time: 10:28)



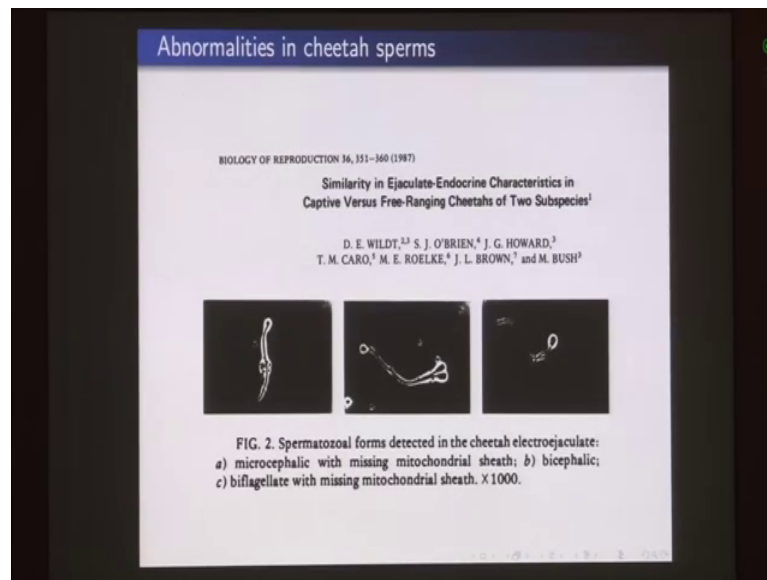
Next we had this case study of Isle Royale wolves which because of their smaller population and inbreeding; and now seeing a number of abnormalities such as still births, or abortions.

(Refer Slide Time: 10:36)



Opaque eyes, hunchback because: of which they are not able to hunt properly.

(Refer Slide Time: 10:38)



In the case of other small population such as cheetahs, so we are observing things such as micro cephalic sperms, bi cephalic sperms, biflagellate sperms.

(Refer Slide Time: 10:50)

Abnormalities in lion sperms

NATURE VOL. 322 24 SEPTEMBER 1987 LETTERS TO NATURE 309

Table 1 Ejaculate characteristics of lions from the Serengeti Plains, the Ngorongoro Crater and the Sabikarung Zoo

	Serengeti National Park n=11	Ngorongoro Crater n=9	Sabikarung Zoo n=8
Lions tested	9.4 ± 1.4 ^a	8.5 ± 0.9 ^a	5.9 ± 0.7 ^a
Ejaculate volume (ml)	91.0 ± 4.2 ^a	131.0 ± 4.4 ^a	111.0 ± 3.7 ^a
Spermatozoal motility (%)	34.4 ± 12.8	75.8 ± 10.0	13.3 ± 2.8
Sperm per ejaculate (x10 ⁶)	228.5 ± 65.5 ^a	286.8 ± 93.0 ^a	45.3 ± 9.9 ^b
Total sperm abnormalities (%)	24.3 ± 4.0 ^a	50.5 ± 6.4 ^a	66.2 ± 1.6 ^b
Types:			
(1) Macrocephalic	8.6 ± 0.2	0.3 ± 0.1	0.0 ± 0.0
(2) Microcephalic	0.2 ± 0.04	0.2 ± 0.06	0.1 ± 0.05
(3) Biflagellate	0.04 ± 0.03	0.03 ± 0.02	0.0 ± 0.0
(4) Bipectinate	0.2 ± 0.04	0.8 ± 0.6	0.4 ± 0.2
(5) Abnormal acrosome	1.1 ± 0.3 ^a	0.9 ± 0.1 ^a	3.6 ± 0.7 ^a
(6) Abnormal midpiece	1.9 ± 0.4 ^a	1.5 ± 0.3 ^a	0.6 ± 0.2 ^a
(7) Tightly coiled flagellum	2.3 ± 0.3 ^a	8.5 ± 3.3 ^a	13.7 ± 2.4 ^a
(8) Detached head	0.0 ± 0.0 ^a	0.0 ± 0.0 ^a	6.6 ± 1.8 ^a
(9) Bent midpiece with droplet	2.3 ± 0.4 ^a	12.4 ± 1.0 ^a	5.2 ± 1.0 ^a
(10) Bent midpiece	2.1 ± 0.4 ^a	4.2 ± 1.0 ^a	5.0 ± 0.8 ^a
(11) Cytoplasmic droplet	12.5 ± 2.2	17.2 ± 2.9	69.9 ± 3.3
(12) Bent flagellum	9.9 ± 0.3 ^a	1.5 ± 0.3 ^a	11.5 ± 2.7 ^a
(13) Bent neck	0.7 ± 0.1	1.1 ± 0.2	2.8 ± 1.1

Each ejaculate was collected in a warmed (37°C) plastic container. Sperm motility and concentration values were evaluated immediately in the field² using a phase-contrast microscope powered by a portable generator. These values as well as semen volume were used to provide the index of viable sperm per ejaculate. Fig. 1 legend describes general methodology for morphological assessment. Within each row, values with different superscripts are significantly different ($P < 0.05$); values within rows with no superscripts are similar ($P > 0.05$).

And even in the case of lions we are observing very similar things. So, there are a number of abnormalities seen in this sperms.

(Refer Slide Time: 10:56)

The slide is titled "Disease spread in genetically similar animals I". It contains a list of three numbered points:

- 1 May 1982: A clinically healthy, 8 year old female cheetah in the Cheetah breeding program at Wildlife Safari Oregon developed jaundice, fever, diarrhoea. Even with aggressive therapy, including diuretics, antibiotics, vitamins, steroids and forced feeding, the animal died in a week.
- 2 Diagnosis: Feline infectious peritonitis, caused by a coronavirus
- 3 By January 1983, all the cheetahs at the facility had developed antibodies, and during the year over 90% showed signs of the disease. 18 animals died.

At the top left, a table of contents lists modules 1 through 8. At the top right, a list of topics includes Preliminaries & Introduction to genetics, Population genetics, Chromosomal & genetic disorders, inbreeding, Population viability analysis, and Reintroductions and outbreeding. The footer identifies the speaker as Dr. Ankur Awadhiya, IFS, and the topic as Wildlife Conservation.

And then we looked at this case study in which diseases spread very quickly in the case genetically similar animals because, there is hardly any difference in the immune response. Next we had a look at the population viability analysis.

(Refer Slide Time: 11:09)

The slide is titled "What is Population viability?". It features a box labeled "Definition" containing the text: "Population viability is the ability of a population to persist, or to avoid extinction." The slide layout is consistent with the previous one, including the table of contents on the top left and the list of topics on the top right. The footer identifies the speaker as Dr. Ankur Awadhiya, IFS, and the topic as Wildlife Conservation.

So, we defined population viability as the ability of a population to persist, or to avoid extinction.

(Refer Slide Time: 11:15)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
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Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Why does a population become extinct?

2 kinds of factors operate at all times

- 1 deterministic factors (acting at large population sizes)
- 2 stochastic factors (more important when the population sizes are smaller)

Dr. Ankur Awadhiya, IFS Wildlife Conservation

So, we looked at population viability analysis, so two kinds of factors deterministic factors, and stochastic factors we have discussed this before.

(Refer Slide Time: 11:19)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Extinction factors

Deterministic factors (acting at large population sizes)

- 1 birth rate
- 2 death rate
- 3 population structure

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(Refer Slide Time: 11:38)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

3 ways of doing Population viability analysis

These are¹⁸⁰:

- 1 utilising empirical observations of the stability and long term fates of a number of populations of various sizes. An example is the study of viability of various population sizes of the bighorn sheep¹⁸¹.

¹⁸⁰Shaffer, M.L., 1981. Minimum population sizes for species conservation. *BioScience*, 31(2), pp.131-134.
¹⁸¹Berger, J., 1990. Persistence of different-sized populations: an empirical assessment of rapid extinctions in bighorn sheep. *Conservation Biology*, 4(1), pp.91-98.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

And next in the case of population viability analysis you will use any methodology to determine a minimum viable population, or the size at which the population has a 99 percent probability of persistence for 1000 years. And then these are different terms and there are 3 ways; one is using the field data, or empirical observations of what happens at different population sizes.

(Refer Slide Time: 11:44)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

3 ways of doing Population viability analysis

- 2 development of analytical models of the extinction process that permit calculation of the probability of extinction from measurements of a small number of measurable parameters. A good example would be Goodman's model of the demography of chance extinction¹⁸².

¹⁸²Goodman, D., 1987. The demography of chance extinction. *Viable populations for conservation*, 11(p.34).

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Second is using mathematical modules.

(Refer Slide Time: 11:47)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
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3 ways of doing Population viability analysis

1. utilisation of computer simulations and modelling to project the probability distribution of possible fates of a population. An example could be the software Vortex¹⁸³.

¹⁸³Lacy, R.C., 1993. VORTEX: a computer simulation model for population viability analysis. Wildlife research, 20(1), pp.45-65.

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And third is using computer simulations.

(Refer Slide Time: 11:49)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Use of computer simulations and modelling

Population viability analysis through this method has two defining pre-requisite characteristics:

1. an explicit model of the extinction process
2. the quantification of threats to extinction

Dr. Ankur Awadhiya, IFS Wildlife Conservation

Now, in the case of computer simulation, so you also recover a mathematical model to work in the background and you also require a quantification of the threats to extinction. So, we have looked at the software called vortex and also it is another version called eddy that can be used for population viability analysis.

(Refer Slide Time: 12:02)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Newer frontiers

Of late, population viability analyses have also started incorporating, besides the probability of extinction, other measures of the health of the population, such as the mean and the variance in the population growth¹⁸⁴, changes in the range, distribution, and habitat occupancy¹⁸⁵, and losses of genetic variability¹⁸⁶.

¹⁸⁴Lindemayer, D.B., Burgman, M.A., Akakaya, H.R., Lacy, R.C. and Possingham, H.P., 1995. A review of the generic computer programs ALEX, RAMAS/space and VORTEX for modelling the viability of wildlife metapopulations. *Ecological modelling*, 82(2), pp.161-174.
¹⁸⁵Hanski, I. and Gilpin, M., 1991. Metapopulation dynamics: brief history and conceptual domain. *Biological journal of the Linnean Society*, 42(1/2), pp.3-16.
¹⁸⁶Lande, R. and Barrowclough, G.F., 1987. Effective population size, genetic variation, and their use in population management. *Viable populations for conservation*, 87, p.124.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

And now this is being used for a number of other studies as well. Next we looked at reintroductions and out breeding.

(Refer Slide Time: 12:10)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Some definitions

Translocation
"deliberate and mediated movement of wild individuals or populations from one part of their range to another"
e.g. movement of tiger from Kanha Tiger Reserve to Satkosia Tiger Reserve

Reintroduction
"an attempt to establish a species in an area which was once part of its historical range, but from which it has become extinct"
e.g. movement of tiger from Ranthambore Tiger Reserve to Sariska Tiger Reserve following the Sariska debacle

188

Dr. Ankur Awadhiya, IFS Wildlife Conservation

So, translocation is the movement of animals from one place to another. Reintroduction is reestablishment of a species into an area that where it was earlier present, but is now not present.

(Refer Slide Time: 12:21)

The slide is titled "Some definitions" and is part of a presentation on Wildlife Conservation. It features a table of contents on the left and a list of topics on the right. The main content area contains two definitions:

- Reinforcement / Supplementation**
"addition of individuals to an existing population of conspecifics"
e.g. movement of tigers from Pench Tiger Reserve to Panna Tiger Reserve
- Introduction**
"an attempt to establish a species, often for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco- geographical area"
Often used when there is no remaining area left within a species' historical range.

At the bottom, it shows the slide number 189 and the presenter's name, Dr. Ankur Awadhiya, IFS.

Reinforcement is when you are trying to increase the number of animals in a certain area. Introduction is when you are trying introducing a species into an area where it was never found before.

(Refer Slide Time: 12:31)

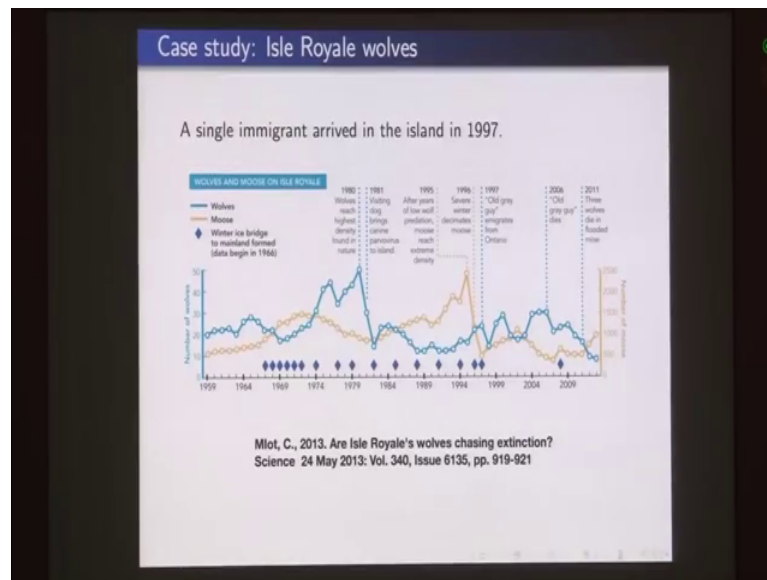
The slide is titled "Genetic rescue" and is part of a presentation on Wildlife Conservation. It features a table of contents on the left and a list of topics on the right. The main content area contains a definition:

Restoration of genetic diversity and reduction of extinction risks in small, isolated, inbred populations, often through natural or artificial movement of individuals that bring new alleles to the gene pool.

At the bottom, it shows the slide number 190 and the presenter's name, Dr. Ankur Awadhiya, IFS.

So, next we talked about genetic rescue.

(Refer Slide Time: 12:33)



So, this was the example from the Isle Royale wolves when a single individual came in into this very inbred population. So, there was some amount of genetics bigger that was observed.

(Refer Slide Time: 12:44)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring and managing habitats
Module 3: Management of wildlife diseases
Module 4: Capturing and restraining wild animals
Module 5: Conservation genetics
Module 6: Wildlife conservation
Module 7: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

But how diverse should the rescuer be?

Outbreeding
"the practice of introducing unrelated genetic material into a breeding line"

Outbreeding enhancement
"improved biological quality in a hybrid offspring"

Outbreeding depression
"decreased fitness in a hybrid offspring, when compared to parents or to offsprings from crosses between more related individuals"

Dr. Ankur Awasthiya, IFS Wildlife Conservation

Now, next we asked this question how diverse should a rescuer be. So, in the case of out breeding, so we are bringing in individuals that are having unrelated genetic material. So, you can have out breeding enhancement, or out breeding depreciation. So, we are always looking for out breeding enhancement, but out-breeding dispersion needs to be reduced.

(Refer Slide Time: 13:06)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
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Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Case study of ibex I

- 1 By the 1850s, Alpine Ibex (*Capra ibex*) was extinct in the High Tatra mountain range at the Slovakia-Poland border.
- 2 The species was re-introduced in 1901 from Austria.
- 3 To increase genetic diversity, *Capra hircus* and *Capra nubiana* were also introduced. In those days, they were considered sub-species of *Capra ibex*.
- 4 In a short while, all the animals died again.
- 5 Reason: *Capra ibex* is adapted to cold climates. It ruts in winters and fawns in spring. *Capra hircus* and *Capra nubiana* are adapted to warmer climates. They rut in autumn and fawn in winter.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

Now, we looked at two examples through which we can have out-breeding depression. So, in the case of Ibex it is a goat. And we looked at this goat that was living in very cold areas and when it was outbred with other goats that were coming from warmer areas. So, it gave birth in very cold seasons because of which the offspring's died.

(Refer Slide Time: 13:25)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & Introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Case study of roebuck

- 1 Before World War 1, Siberian race of roebuck *Capreolus capreolus pygargus* was introduced in Slovakia.
- 2 The Siberian race is much larger than the Slovakian race.
- 3 When males of Siberian race mated with females of Slovakian race, the foetus was so large that fawning was made impossible, and the females died.¹⁹¹

¹⁹¹Turcek, F.J. and Hickey, J.J., 1951. Effect of introductions on two game populations in Czechoslovakia. The Journal of Wildlife Management, 15(1), pp.113-114.

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And in the case of roebuck we had a case in which the Siberian race was introduced. The Siberian race was much bigger, so when the females got impregnated the fetuses were so

large that they that they were not able to come out. And so the fetus died and the mother also died.

(Refer Slide Time: 13:41)

Module 1: Introduction, Importance, Threats
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Preliminaries & introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Planning, preparation and release stage activities I

- 1 approvals from government agencies, landowners, etc. as required
- 2 construction of multidisciplinary team of experts
- 3 identification of success indicators
- 4 securing adequate funding
- 5 design of pre- and post-release monitoring programmes
- 6 health and genetic screening of release stock
- 7 vaccination of release stock, as required
- 8 quarantine arrangements
- 9 development of transport plans

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So, these are two examples of out breeding. Then we looked at different planning preparation and release stage activities, post release activities.

(Refer Slide Time: 13:47)

Module 1: Introduction, Importance, Threats
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Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Preliminaries & introduction to genetics
Population genetics
Chromosomal & genetic disorders, inbreeding
Population viability analysis
Reintroductions and outbreeding

Post-release activities II

- 1 public relations activities, including education and mass media coverage
- 2 evaluation of success and cost-effectiveness of techniques used
- 3 regular publications in scientific and popular literature

193

¹⁹³IUCN/SSC Re-introduction Specialist Group, 1998. IUCN Guidelines for Re-introductions: IUCN. 9. 13/1/2018

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The next module was ex-situ conservation.

(Refer Slide Time: 13:50)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

In-situ and ex-situ conservation

In-situ conservation
In situ = on site
Conservation within natural habitat.

Ex-situ conservation
Ex situ = off site
Conservation outside natural habitat.

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So, we defined what is in situ conservation. In situ is on the site ex situ is off the site. So, conservation within a national habitat is in situ conservation, outside the national habitat is ex situ.

(Refer Slide Time: 14:01)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
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Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

In-situ conservation

Process
Areas in the natural habitat are designated as reserves, national parks or protected areas.
In these areas, ecological monitoring and interventions (active management) are done. Legislations are required to maintain these areas as protected areas.

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Now, in the process of in situ conservation we have things like reserves, national parks, so protected areas.

(Refer Slide Time: 14:08)

The slide is titled 'In-situ conservation'. It features a table of contents on the left and a 'Fundamentals' box on the right. The main content is a list of advantages for in-situ conservation.

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
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Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

In-situ conservation

Advantages

- 1 Species continue to live in their natural environment.
- 2 Less disruptive, less costly.
- 3 Natural behaviours are maintained.
- 4 Protection of natural habitat provides protection to other species as well.
- 5 Even in case of ex-situ conservation, the animal will need to be released somewhere. In-situ conservation sites provide suitable areas for such releases.
- 6 Reserves double as places for scientific studies and public awareness.

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Then we looked at their advantages and disadvantages.

(Refer Slide Time: 14:09)

The slide is titled 'In-situ conservation'. It features a table of contents on the left and a 'Fundamentals' box on the right. The main content is a list of disadvantages for in-situ conservation.

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

In-situ conservation

Disadvantages

- 1 Requires very large areas.
- 2 Less intensive protection and management: areas may be encroached upon or animals poached.
- 3 Threat of diseases and disasters.
- 4 Large establishment required in each case.

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(Refer Slide Time: 14:10)

The slide is titled 'Ex-situ conservation'. It features a table of contents at the top left listing modules 1 through 8, with 'Module 7: Ex-situ conservation' highlighted. To the right, a 'Fundamentals' box lists 'Zoo and their management', 'Botanical gardens', and 'Other aspects: cryopreservation, seed banks, etc.'. The main content is divided into two sections: 'Requirement' and 'Process'. The 'Requirement' section lists two points: '1 required for critically endangered species' and '2 provides urgent intervention'. The 'Process' section lists three points: '1 Designated areas with suitable conditions and facilities are created.', '2 Species are moved into these designated areas for their survival and breeding.', and '3 (Optional) The species are later released into their natural habitats.' The footer includes 'Dr. Ankur Awadhiya, IFS' and 'Wildlife Conservation'.

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Ex-situ conservation

Requirement

- 1 required for critically endangered species
- 2 provides urgent intervention

Process

- 1 Designated areas with suitable conditions and facilities are created.
- 2 Species are moved into these designated areas for their survival and breeding.
- 3 (Optional) The species are later released into their natural habitats.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

In the case of ex situ conservation they are required when you have very few number of individuals. So, they are critically endangered and you need to provide an urgent intervention and a very focused an intensive intervention. Then we create the ex situ observation facilities. So, it allows a better control of variables, there are also a number of disadvantages.

(Refer Slide Time: 14:30)

This slide is also titled 'Ex-situ conservation'. It follows the same layout as the previous slide, with the same table of contents and 'Fundamentals' box. The main content section is titled 'Examples' and lists six items: '1 Zoos', '2 Aquaria', '3 Captive breeding facilities', '4 Botanical gardens, bambuseta, arboreta, etc.', '5 Seed banks', and '6 Cryopreservation facilities: tissue cultures, sperm banks, ova banks, etc.' The footer remains the same: 'Dr. Ankur Awadhiya, IFS Wildlife Conservation'.

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Ex-situ conservation

Examples

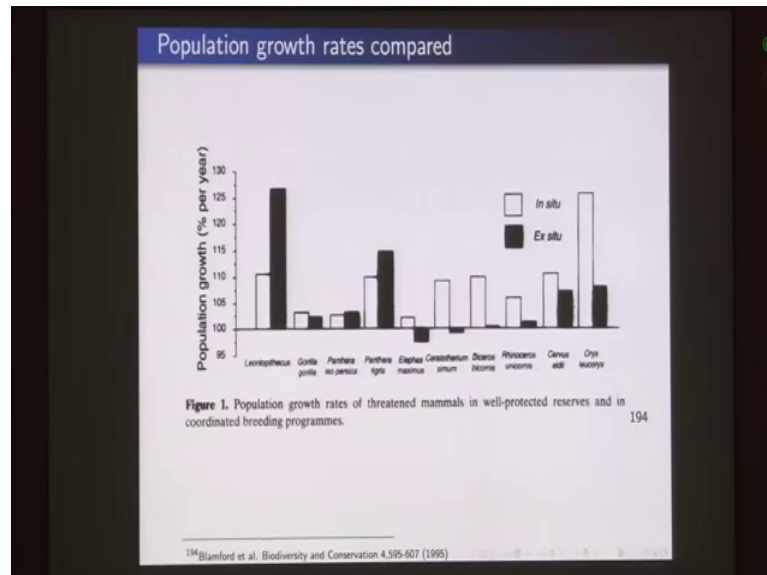
- 1 Zoos
- 2 Aquaria
- 3 Captive breeding facilities
- 4 Botanical gardens, bambuseta, arboreta, etc.
- 5 Seed banks
- 6 Cryopreservation facilities: tissue cultures, sperm banks, ova banks, etc.

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So these are the examples of ex situ conservation, zoo, aquaria, captive breeding facilities, botanical gardens, bambuseta which are which are places where bamboos are

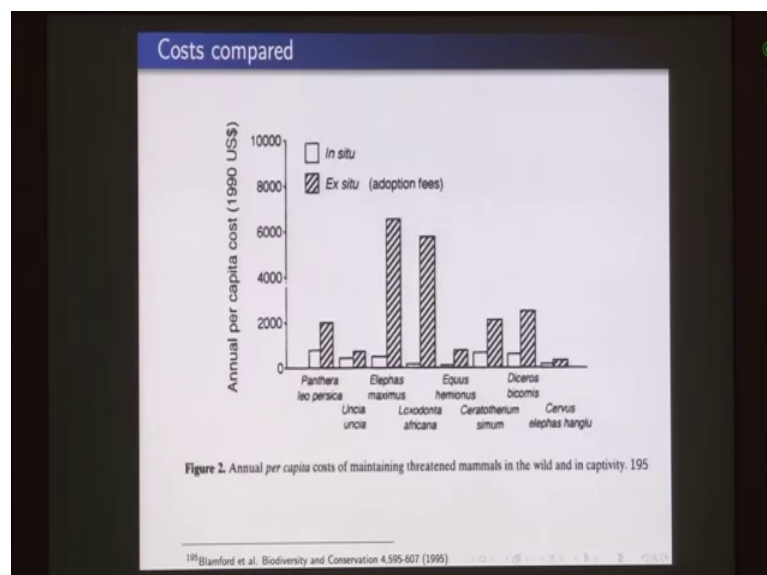
grown, arboreta where trees are grown together, seed banks cryo preservation facilities tissue cultures sperm bank ova bank so on.

(Refer Slide Time: 14:47)



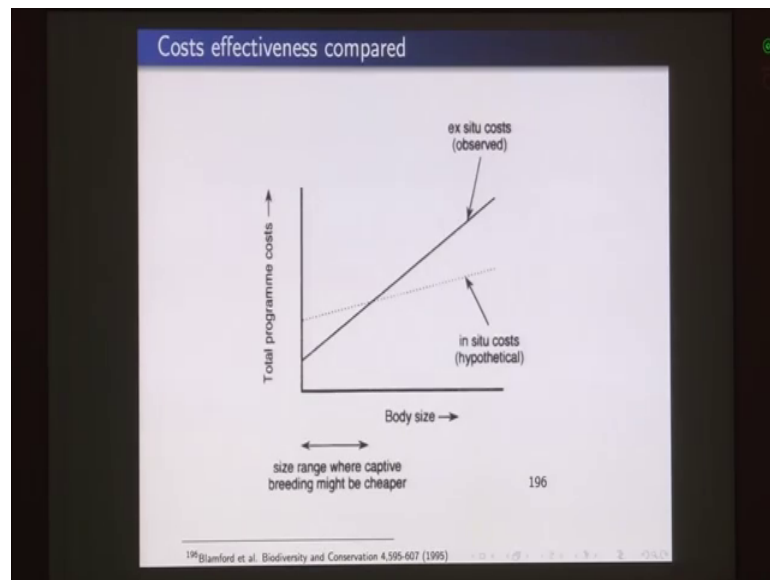
Now, the population growth rate tells us that in certain situations in situ is better, in certain situations a ex situ is better, and in certain situations ex situ just does not work.

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Next we looked at the cost. So, ex situ is in most cases much more costlier.

(Refer Slide Time: 15:04)



But in certain organisms that are having a smaller body size, then your ex situ cost may be the lesser than the in situ cost. So, this gives us a cost benefit analysis of what to prefer in which situation.

(Refer Slide Time: 15:16)

The slide, titled "Creation of ex-situ conservation stands", lists six steps in a numbered list:

- 1 Sampling of source population
- 2 Site selection
- 3 Deciding the plantation size
- 4 Establishment of plantation
- 5 Management operations, including weeding, irrigation, fertilisation, etc.
- 6 Regeneration and collection of seeds

The slide number "197" is in the bottom left corner. At the bottom, a citation reads: "197 T. Skropps in Conservation and Management of Forest Genetic Resources in Europe". The footer includes "Dr. Ankur Awadhiya, IFS" and "Wildlife Conservation".

Now, we looked at creation of ex situ conservation stands, and the genetic implications.

(Refer Slide Time: 15:21)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
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Module 5: Capturing and restraining wild animals
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Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Genetic implications of ex-situ conservation I

- 1 Stochastic sampling of alleles: When samples are taken for a seed bank, the sampling may select some alleles, while discard some other alleles in a stochastic manner. Thus, some amount of natural variation will get lost in the sampling process. This needs to be compensated by extensive sampling from different geographical locations and meticulous collection of natural variations in the form of alleles.
- 2 Erosion of genetic variation in the absence of natural selection.

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So, genetic implications are stochastic sampling of allele. So, you are just keeping a small subset of the population. So, a number of alleles might be lost, a number of variations may be lost. Next there is erosion of genetic variation in the absence of natural selection in your ex situ facility.

(Refer Slide Time: 15:38)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
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Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Genetic implications of ex-situ conservation II

- 1 Genetic correlations / pleiotropy: e.g. same gene may increase cryopreservation stability but decrease number of seeds produced. Then selection of plants producing seeds with better cryopreservation stability will also result in selection of plants with less number of seeds, which would be antagonistic to the objectives of re-introduction.
- 2 Genotype-environment interactions: Those genotypes showing favourable phenotypes in the ex-situ conservation environment may not show favourable phenotypes when put back for re-introduction.

198

¹⁹⁸Hamilton, Conservation Biology, Vol. 8, No. 1 (Mar., 1994), pp. 39-49

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Next is genetic correlations and pleiotropy. So, when you are selecting for a certain characteristic then some other characteristic may also get selected at the same time which may or may not be useful for you, and forces the genotype environment interactions. So,

the organisms that are able to survive best in the ex situ conservation environment may not be able to survive that will when they are reintroduced back in to the natural environment.

(Refer Slide Time: 16:05)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoos and their management
Bioscience gardens
Other aspects: cryopreservation, seed banks, etc.

Zoo

Definition

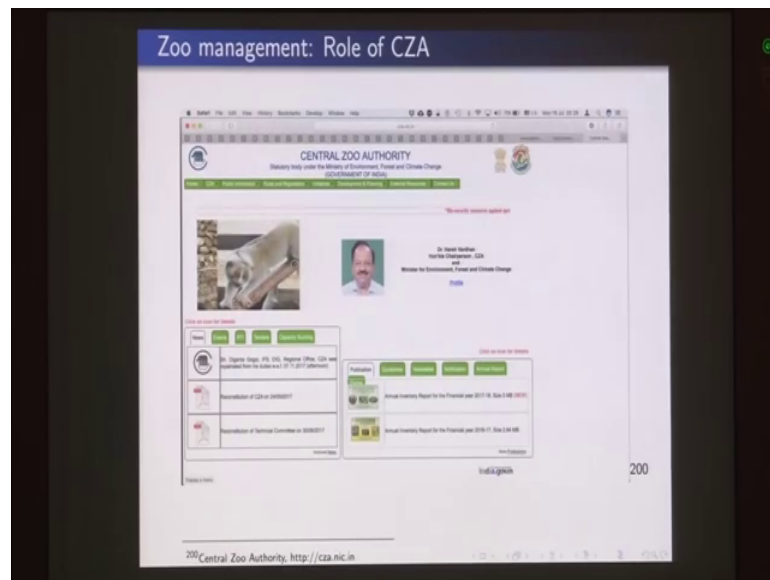
"Zoo" means an establishment, whether stationary or mobile, where captive animals are kept for exhibition to the public and includes a circus and rescue centres but does not include an establishment of a licensed dealer in captive animals^a.

^aWildlife Protection Act 1972

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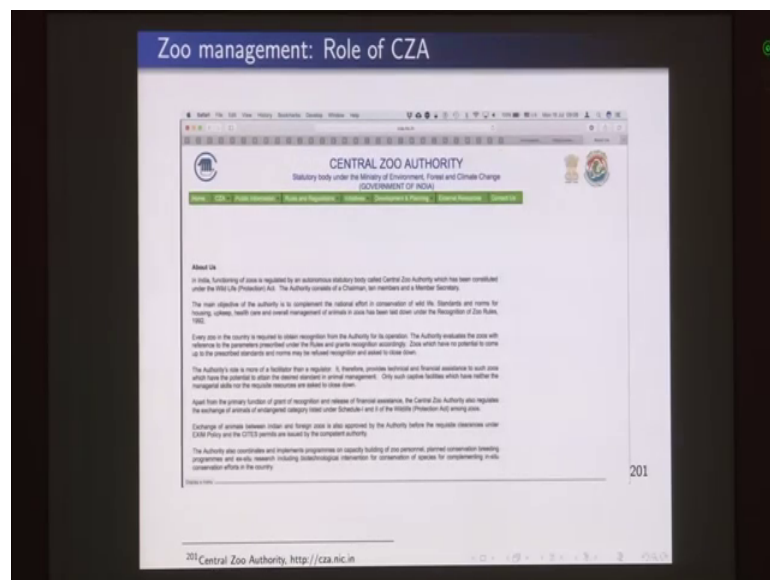
Next we looked at zoos and their management. So, the definition of zoo it is an establishment, where is whether stationary, or mobile, where captive animals are kept for exhibition to the public. And it also includes circus and rescue centers, but it does not include an establishment of a licensed dealer in captive animals. So, this comes from our Wild Life Protection Act 1972.

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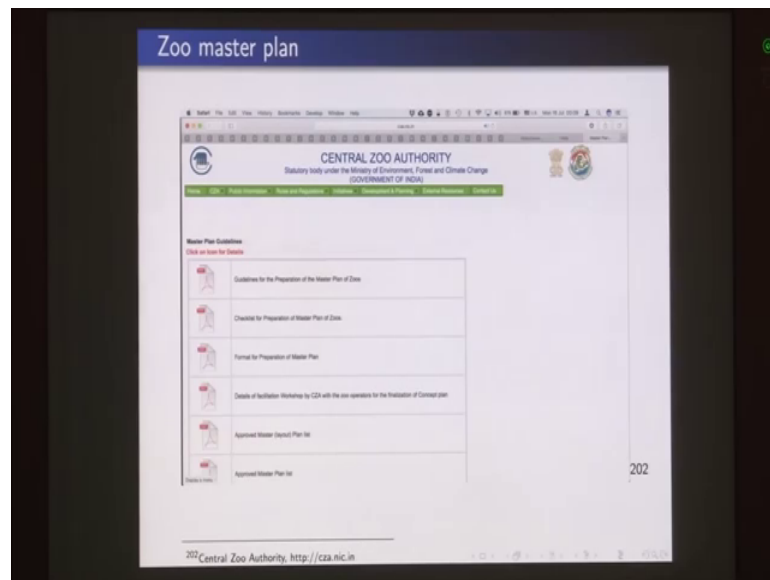


We looked at different kinds of zoos, central zoo authority maintenance an administrative control, regulatory control.

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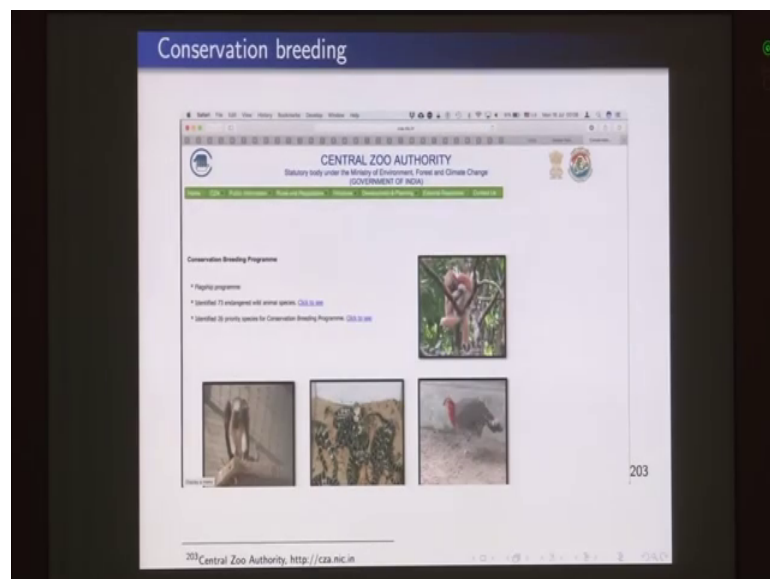


(Refer Slide Time: 16:34)



And also a role of a facilitator of these different zoos comes up with guidelines.

(Refer Slide Time: 16:37)



And then these are master plan guidelines.

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Studbook

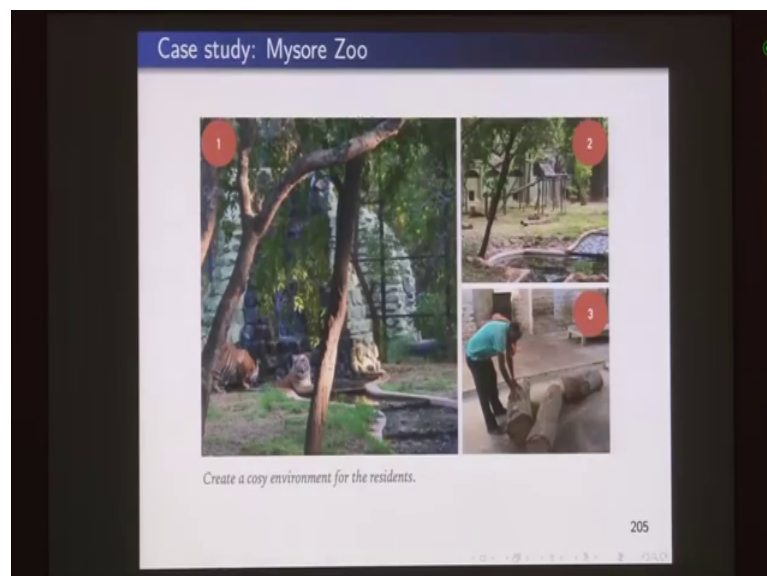
204 Central Zoo Authority, <http://czaa.nic.in>

204

Stud #	Sex	Birth Date	Stir	Location	Date	Location	Event	Name	Transfer#	Old Reg.	New Reg.	Sub#
1	M	Aug 1950	WOL	WOL	WOL	WOL	1951	WOL	WOL	1	1	1
2	F	Aug 1950	WOL	WOL	WOL	WOL	1951	WOL	WOL	2	2	2
3	M	7 Sep 1951	1	2	WOL	WOL	1951	WOL	WOL	3	3	3
4	M	7 Sep 1951	1	2	WOL	WOL	1951	WOL	WOL	4	4	4
5	M	10 Apr 1951	1	2	WOL	WOL	1951	WOL	WOL	5	5	5
6	M	10 Apr 1951	1	2	WOL	WOL	1951	WOL	WOL	6	6	6
7	F	10 Apr 1951	1	2	WOL	WOL	1951	WOL	WOL	7	7	7
8	F	10 Apr 1951	1	2	WOL	WOL	1951	WOL	WOL	8	8	8
9	M	10 Jul 1951	1	2	WOL	WOL	1951	WOL	WOL	9	9	9
10	F	10 Jul 1951	1	2	WOL	WOL	1951	WOL	WOL	10	10	10

It also facilitates conservation breeding.

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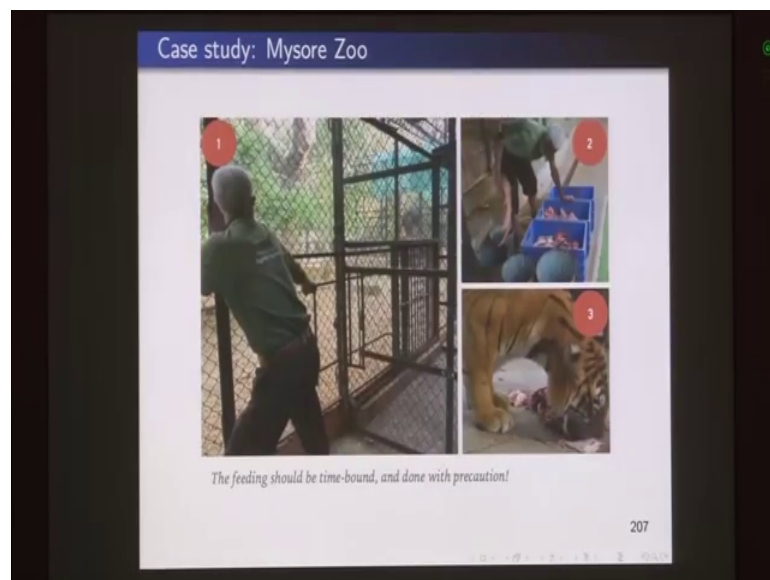
It helps in the maintenance of studbook for various animals. And then we looked at the case study of Mysore zoo to look at what goes on in a zoo.

(Refer Slide Time: 16:50)

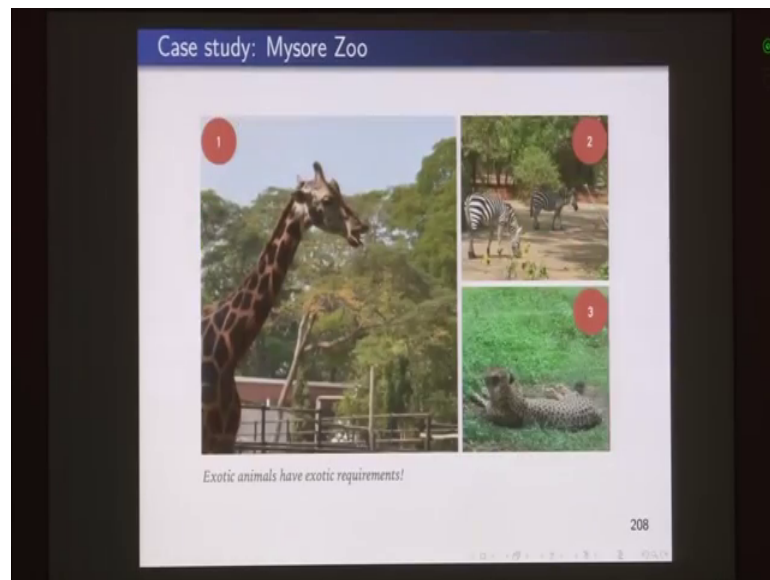


So, there is a cozy environment provided for the animals, feeding, then timing of feeding exotic animals if you are keeping them.

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(Refer Slide Time: 16:53)



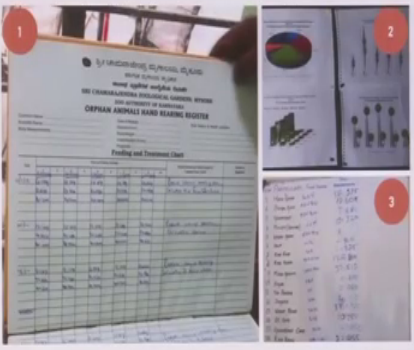
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Then they have exotic requirements, that needs to be full filled.

(Refer Slide Time: 17:00)

Case study: Mysore Zoo




What cannot be measured cannot be managed! Need for proper documentation.

210

Landscape needs to be planned properly.

(Refer Slide Time: 17:02)

Case study: Mysore Zoo



Capacity and infrastructure building for the beasts.

211

You need proper documentation; capacity, and infrastructure building including veterinary facilities; research and enrich activities, eco friendly activities.

(Refer Slide Time: 17:06)


Case study: Mysore Zoo

1


List of In-Reach Programme 2015

No	Date of Visit	Name of the Institution	Visit Purpose
01	28-10-2015	Dr. C. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
02	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
03	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
04	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
05	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
06	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
07	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
08	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
09	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
10	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
11	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
12	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
13	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
14	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
15	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
16	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
17	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
18	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
19	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure
20	28-10-2015	Dr. M. S. Venkatesh, Officer-in-Charge, P. W. D. Mysore	Infrastructure

2



3




Research and in-reach activities are essential for management.

212

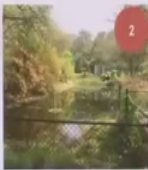
(Refer Slide Time: 17:08)

Case study: Mysore Zoo

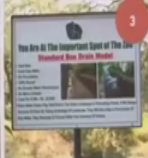
1



2



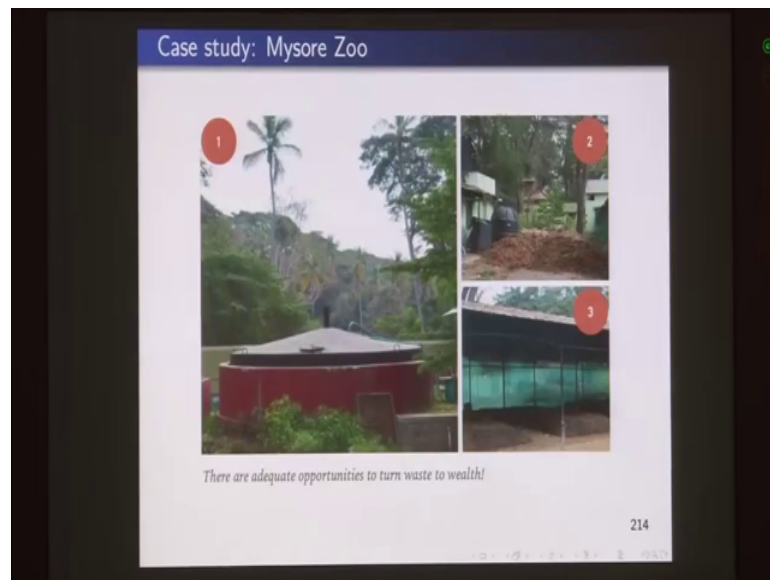
3



Keep a look-out for eco-friendly alternatives!

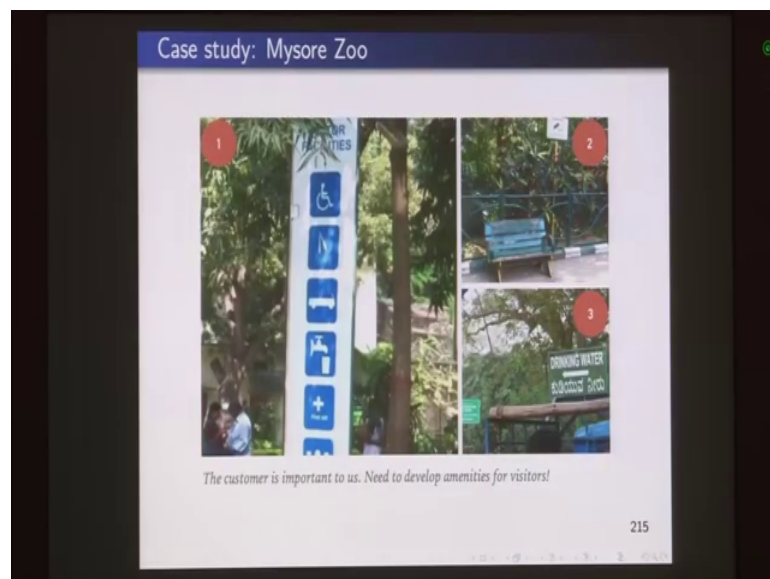
213

(Refer Slide Time: 17:10)



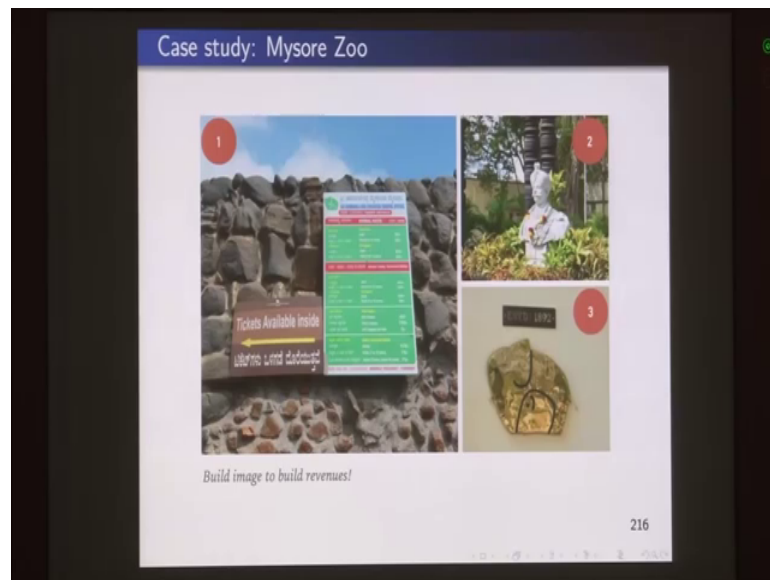
Then waste management what to do with the waste?

(Refer Slide Time: 17:14)



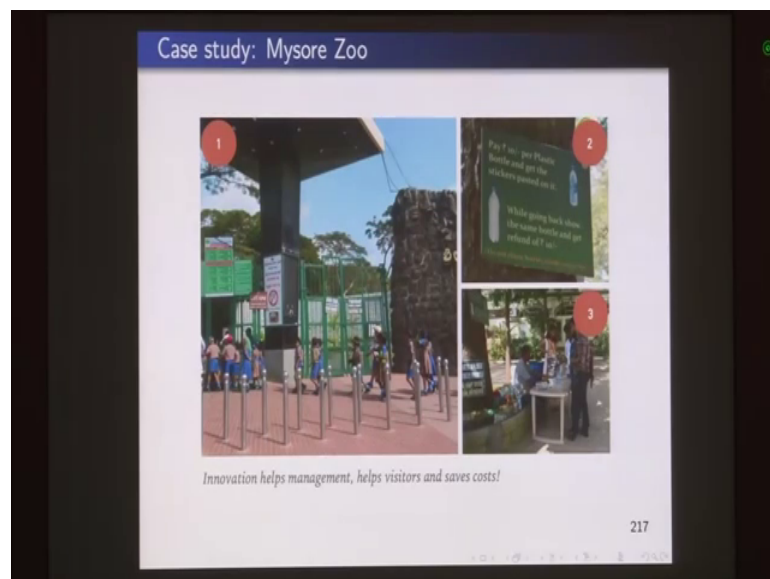
What to do with the dung? Then management of tourist.

(Refer Slide Time: 17:18)



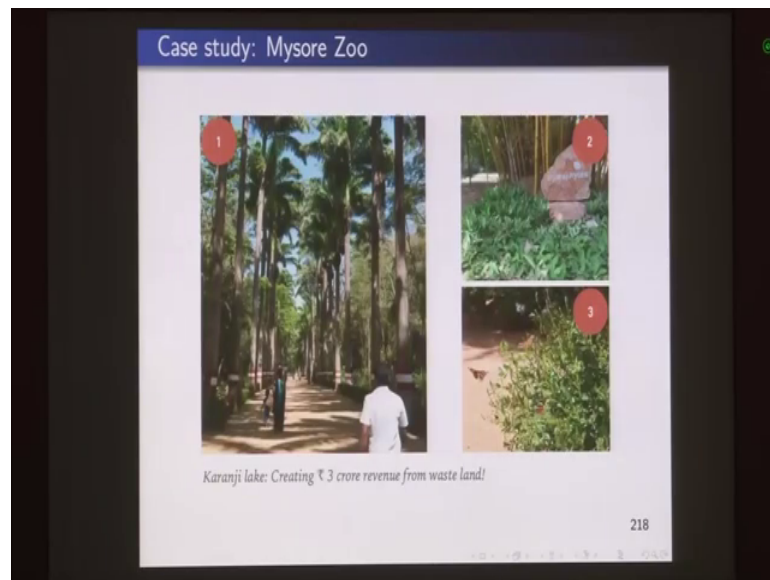
Then building of images.

(Refer Slide Time: 17:20)



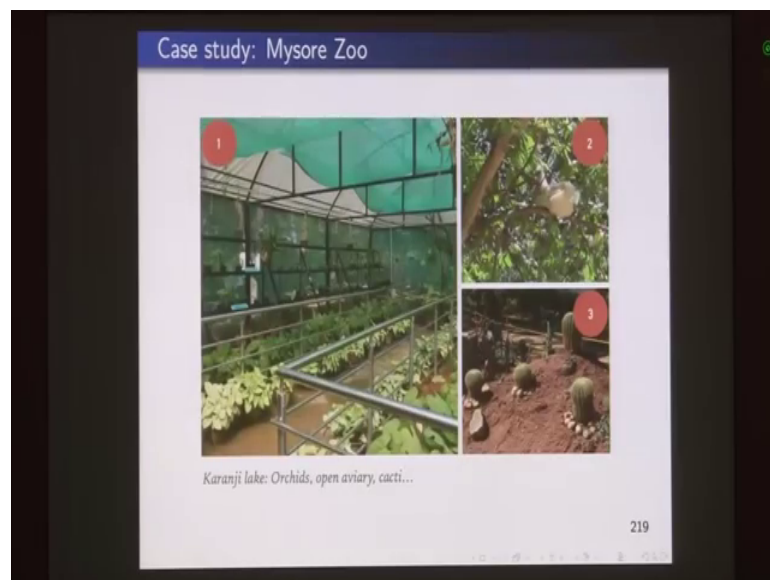
Creating a very nice ecosystem, for the visitors to roam around.

(Refer Slide Time: 17:27)

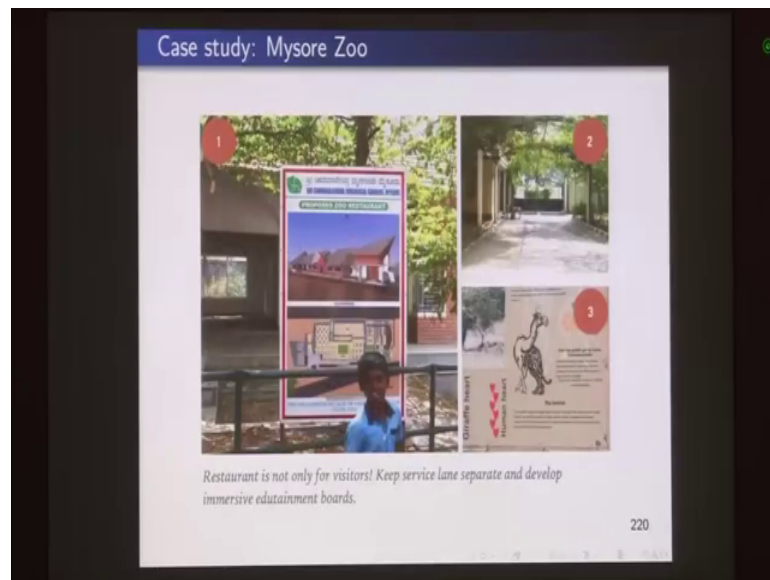


Then puts of innovation, and then also display of plants. Butterflies, orchids, birds and so on.

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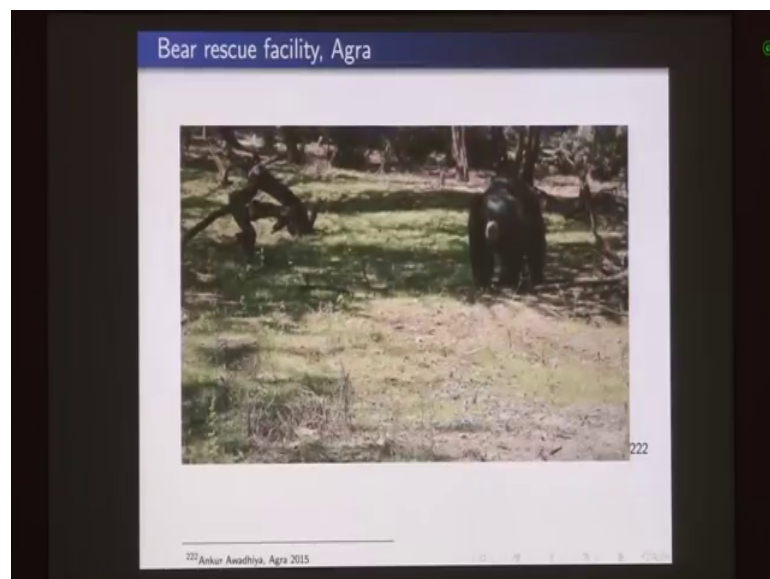


(Refer Slide Time: 17:32)



And we also had a look at the Bear rescue facility in Agra.

(Refer Slide Time: 17:37)



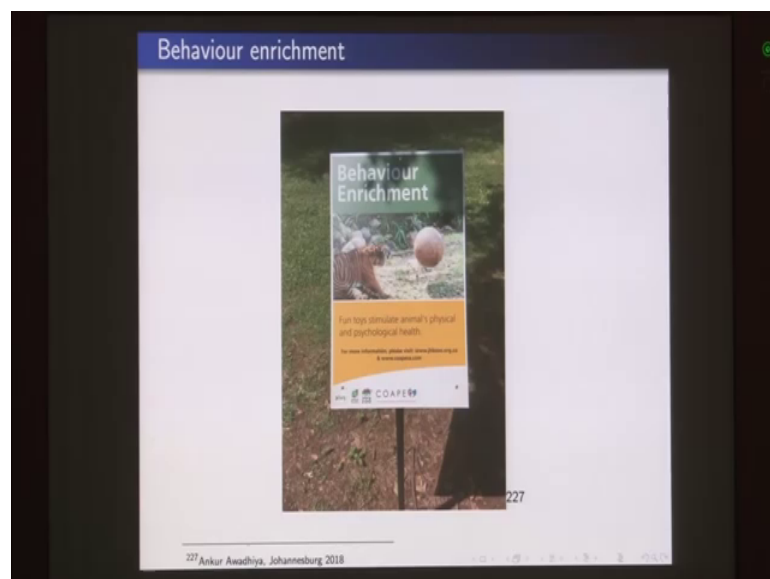
Lion rescue facility, Bhopal.

(Refer Slide Time: 17:41)



Turtle rescue facility in which case the turtle eggs are brought and then raised in an enclosure. So, that dogs are not able to feed on them. Then we also looked at the need to prevent stereotype.

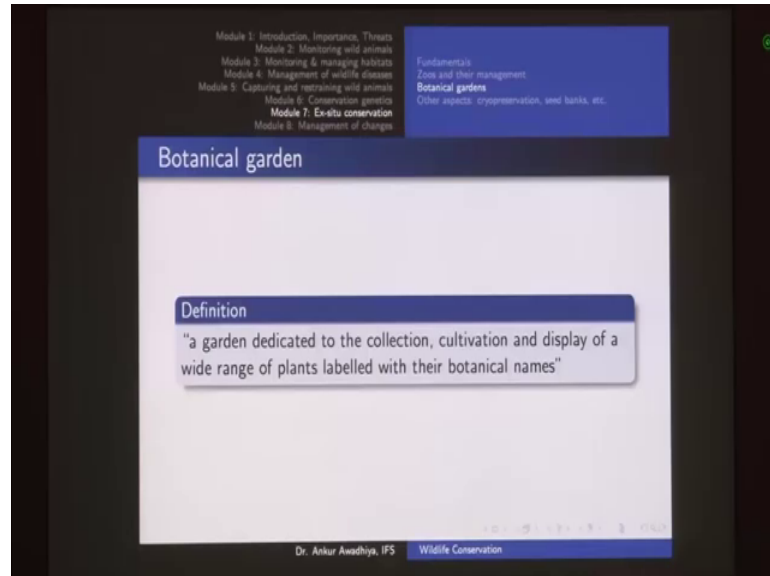
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So, there is stereotype behavior that is present if there is no environment enrichment or behavioral enrichment in the zoos. So, the animals get bored and then they show behaviors that are extreme repetitive. So, for instance they may just go on moving like

this and this or they may just pace around in their small enclosures. So, these are examples of stereotypes and these needs to be prevented.

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Next we had a look at the botanical gardens. So, botanical gardens are similar to our normal gardens, but then in this case we have a lot of scientific information that is also put in.

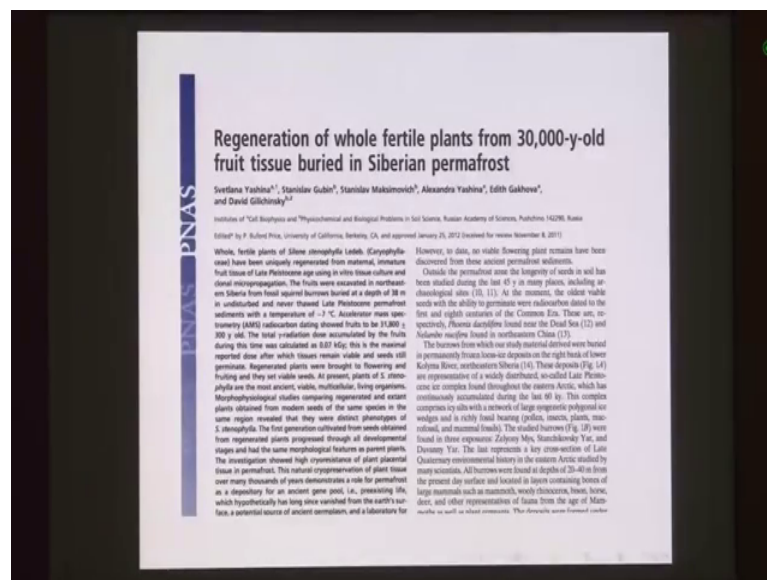
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So, we looked at hanging gardens of Babylon, Nishat gardens of Srinagar which are examples of normal gardens. And then we had a look at Kirstenbosch botanical garden in Cape Town as a case study. What will things are done in this kirstenbosch gardens?

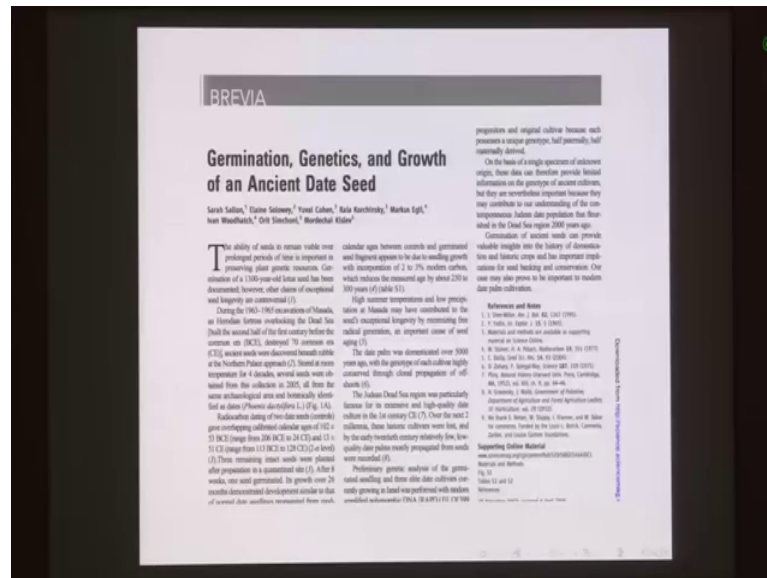
So, we had different plants and then different kinds of experiences, different kinds of learning's that are provided to people. So, that they become more tune to the cause of conservation. Next we will looked at seed banks and cryoperseveration.

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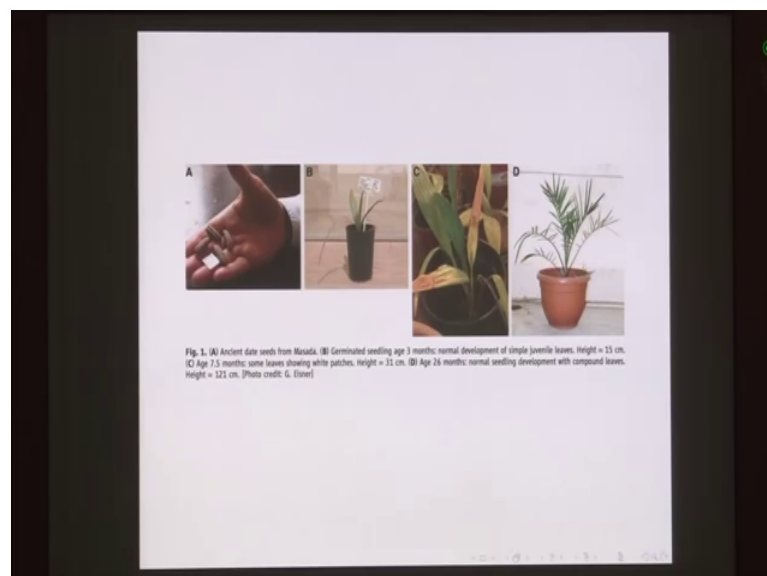
So, we started with these two cases in which a plant was raised back after 30000 years, when it was there in the Siberian permafrost.

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And another in which there was a seed that was germinated.

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After a span of 2000 years when it was kept in a dry condition; so, keeping things in cool conditions and keeping things in a dry condition both are things that are used to preserve.

So, we began with what is a seed? What is the structure of a seed? What is the characteristic of a good seed? When do you collect seed? Which trees you collect seeds from?

(Refer Slide Time: 19:30)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Requirements for proper seed collection

- 1 organisation of collecting teams
- 2 organisation of transport
- 3 organisation of equipment
- 4 organisation of records
- 5 organisation of permits
- 6 organisation of seed extraction from fruits

237

237 A Guide to Forest Seed Handling - FAQ

Dr. Ankur Awadhiya, IFS Wildlife Conservation

Then how do you collect specifically for conversation? What are the requirements for proper seed collection? What are the ways of collecting seeds? And then what are the other operations that are done?

(Refer Slide Time: 19:28)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Natural longevity of tree seeds

- 1 Microbiotic: seed life span not exceeding 3 years
- 2 Mesobiotic: seed life span from 3 to 15 years
- 3 Macrobiotic: seed life span from 15 to over 100 years.

240

240 A Guide to Forest Seed Handling - FAQ

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Next we looked at longevity of various seeds. So, these are divided into 3 categories micro biotic; so this is small life, mesobiotic middle life, macro biotic is large life.

So, microbiotic is less than 3 years, mesobiotic is 3 to 15 years. And macrobiotic is 15 to 100 years, or more than 1000 years. So, these are 3 longevity classifications.

(Refer Slide Time: 20:04)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of zoos

Fundamentals
Zoos and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Two main seed classes (Roberts 1973)

- 1 Orthodox: Seeds which can be dried down to a low moisture content of around 5% and successfully stored at low or sub-freezing temperatures for long periods. e.g. grass seeds
- 2 Recalcitrant: Seeds which cannot survive drying below a relatively high moisture content (often in the range 20-50%) and which cannot be successfully stored for long periods. e.g. sal seeds

241

²⁴¹A Guide to Forest Seed Handling - FAQ

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And then there are two kinds of seeds that are defined they are orthodox seeds, and recalcitrant seeds. Orthodox seeds are those seeds that do not have a very large amount of oil in them, they are able to tolerate very low moisture content.

So, they can be dried to a moisture content of less than 5 percent, and then they can be also stored at low, or sub freezing temperatures for very long periods. So, example includes are grass seeds, or grain seeds, or bamboo seeds, and so on.

Now, in the case of recalcitrant seeds these are seeds that cannot survive drying below a relatively high moisture content; often in the range of 20 to 50 percent and which cannot be successfully stored for long periods. Specially because they have a high concentration of oils in them example includes sal seeds.

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Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Factors affecting longevity in storage

- 1 seed condition
 - 1 seed maturity
 - 2 mechanical damage
 - 3 fungi and insects
 - 4 initial viability
- 2 age of seeds
- 3 storage conditions
 - 1 atmosphere: level of oxygen should be low
 - 2 moisture: should be low
 - 3 temperature: should be low
 - 4 light: should be absent

242
242 A Guide to Forest Seed Handling - FAQ
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Now, these were the natural variations, but longevity also depends on the seed condition, the age of seeds and the storage conditions. So, these are things that we play with when we are creating a seed bank.

(Refer Slide Time: 21:00)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Fundamentals
Zoo and their management
Botanical gardens
Other aspects: cryopreservation, seed banks, etc.

Underlying principles of seed banking

- 1 identity of accessions should be clear: use of passport data, together with a herbarium voucher specimen for identification
- 2 maintenance of viability and propagability
- 3 maintenance of genetic integrity
- 4 maintenance of germplasm health: ensure seeds are free from diseases and pests
- 5 physical security of collections, including safety from earthquakes, floods, fires and global warming
- 6 availability and use of germplasm
- 7 availability of information

243
243 FAQ, 2014. Genebank Standards for Plant Genetic Resources for Food and Agriculture. Rev. ed. Rome
Dr. Ankur Awadhiya, IFS Wildlife Conservation

Next we looked at various principles of seed banking ah. So, it should be everything should be identifiable, maintenance of viability and propagability, genetic integrity, germplasm health, physical security. So, this includes safety from a earthquakes, floods,

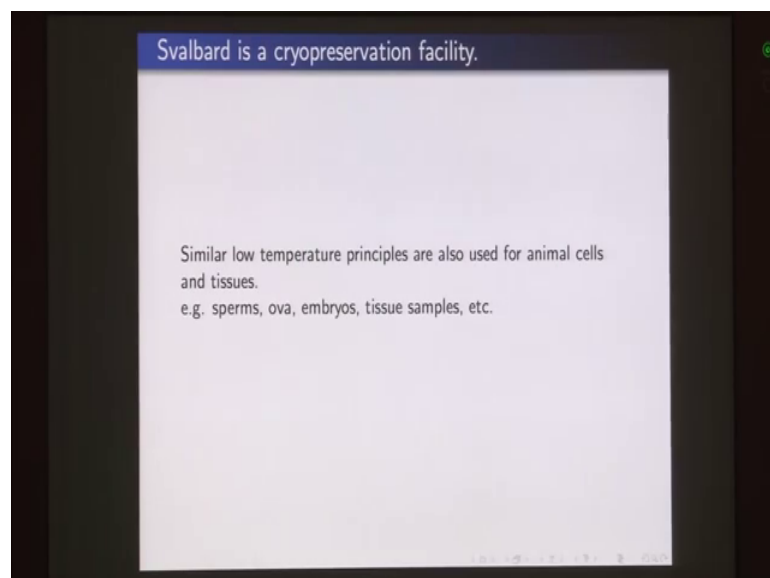
fires, global warming, terrorism and so on; then availability and use of germplasm for others and availability of information.

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So, we looked at Svalbard global seed vault in Norway that is a good example of one such seed bank.

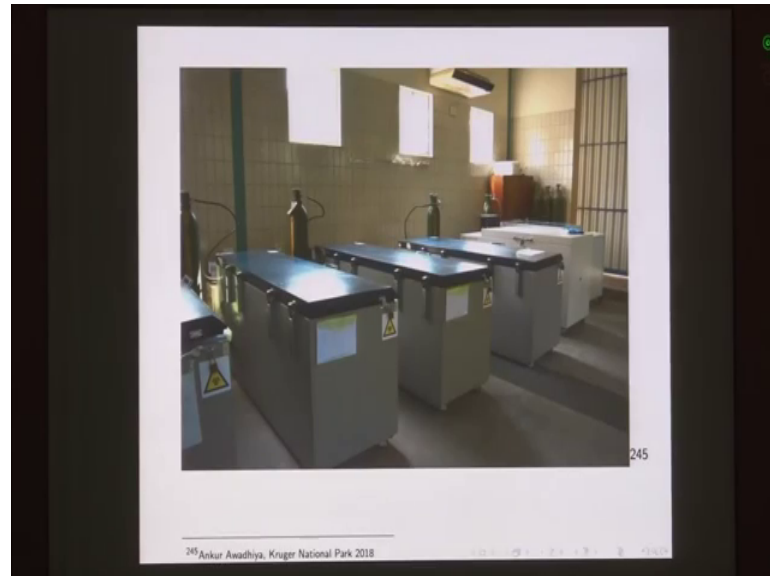
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And then such cryopreservation, so cryo is low temperature preservation.

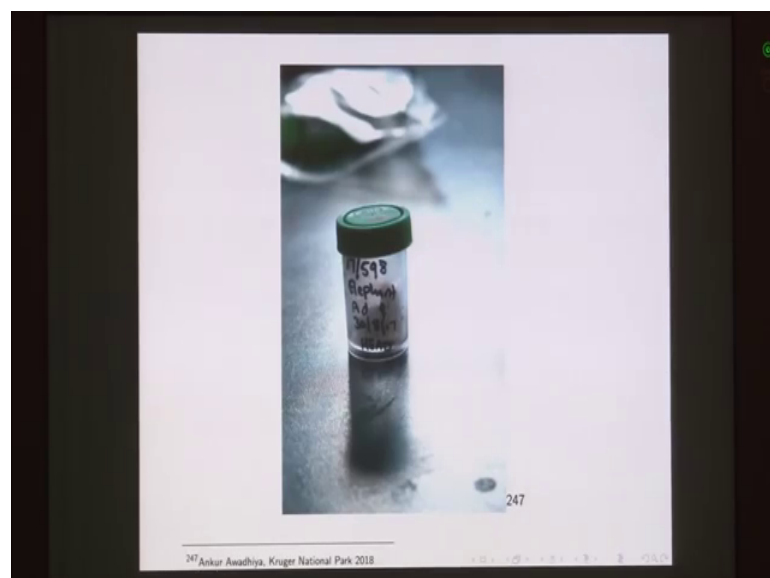
So, preservation at low temperature this can also be done for animal samples such as sperm, ova, embryos, and tissues.

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So, we looked at this example from Kruger national park in which we have these chest freezers in which various samples are kept. And this can be used later on.

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Now, in the last module we had a look at the management of changes. So, we looked at four different things we looked at climate change, plastics, oil spills. And then we had a

Sariska of case study of what of how crisis manifest itself and then how this crisis is overcome in the field situations.

(Refer Slide Time: 22:10)

The slide is titled "Climate" and is part of a presentation on "Wildlife Conservation" by Dr. Ankur Awadhiya, IFS. It includes a table of contents at the top left and a list of "Impacts of climate change" at the top right. The main content is divided into two sections: "Definition" and "Timing".

Definition
"A broad composite of the average conditions of a region, measured in terms of such things as temperature, amount of rainfall or snowfall, snow and ice cover, and winds"^a

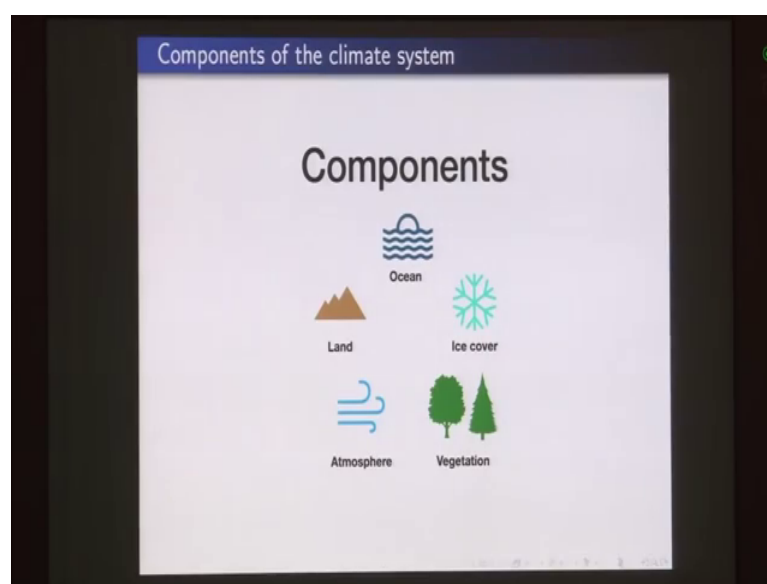
^aRuddiman, W. F. (2001). Earth's Climate: past and future, Macmillan.

Timing
The classical period for taking averages is 30 years.

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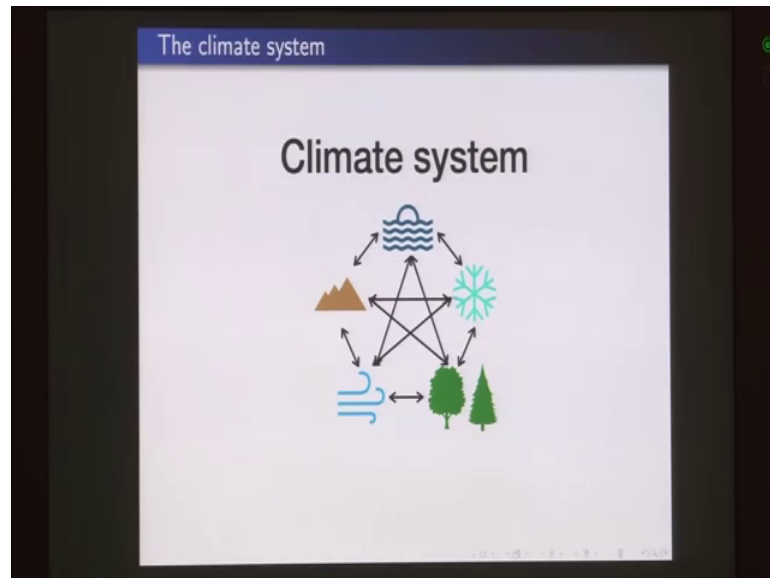
So, in the case of climate change we looked at what is the climate? Then classical period of taking average is just 30 years. So, we differentiate between climate and weather; whether is at this particular time point or at any particular time point and climate is an averaged out value over multiple years typically 30 years.

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So, there are 5 components of climate land, ocean, ice cover, vegetation, and atmosphere. These interact with each other to form the climatic system.

(Refer Slide Time: 22:34)



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Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastic and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

What is climate change?

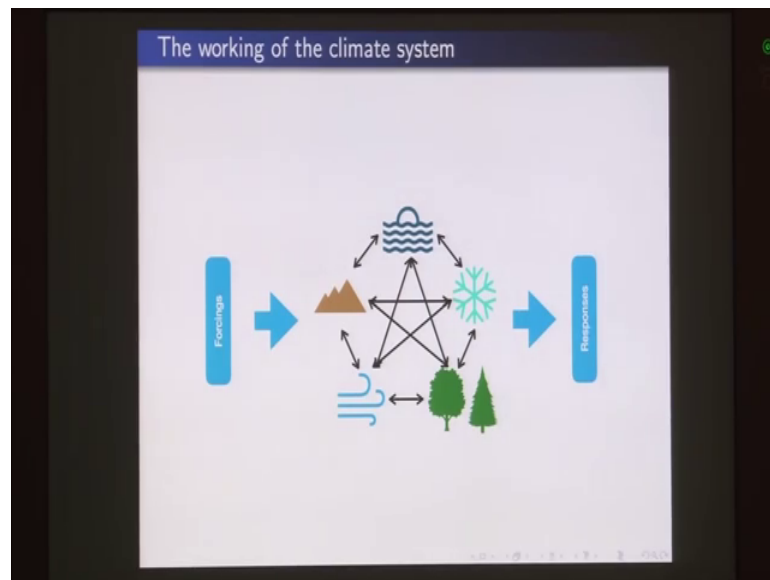
"Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use."²⁴⁸

²⁴⁸Baede, A. (2007). "Annex 1 IPCC Glossary." Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

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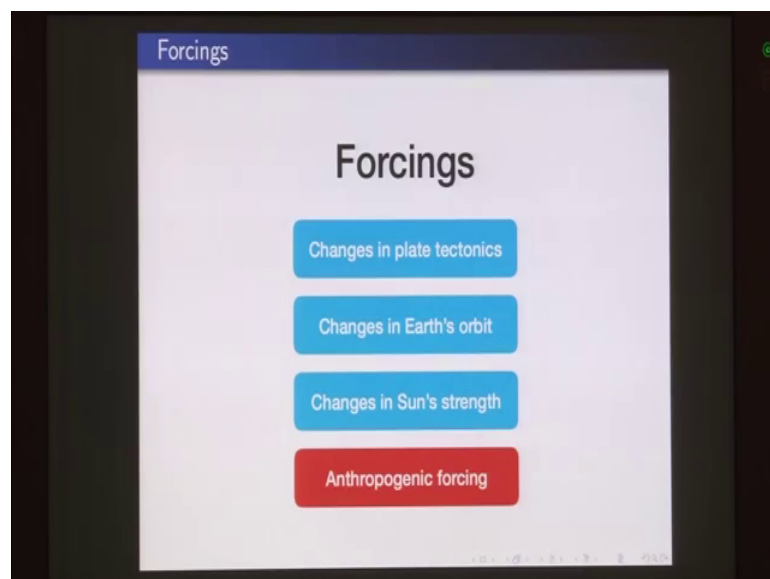
And then climate change is statistically significant variation in the mean state, or the variability persisting for an extended period.

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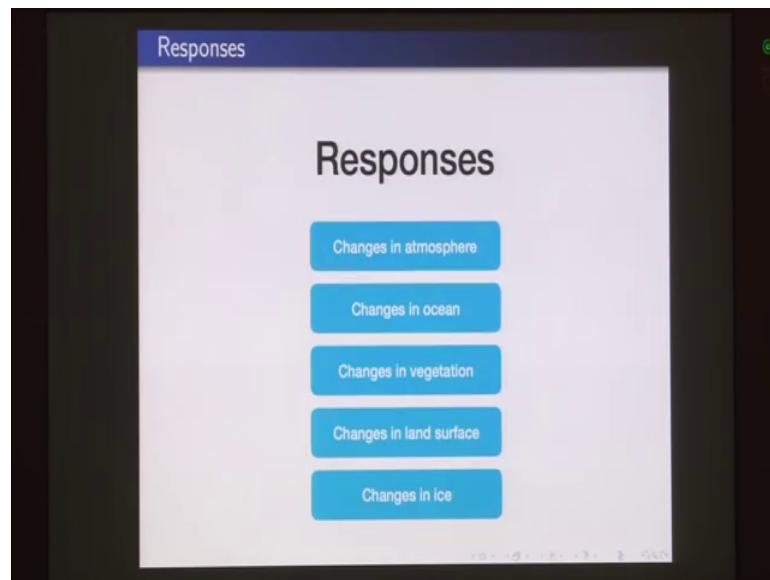
So, we next look it at the working of the climatic system. So, you have the climate system. And then if you have any forcings or any inputs that are given to this system. There would be some sort of output which we call as response.

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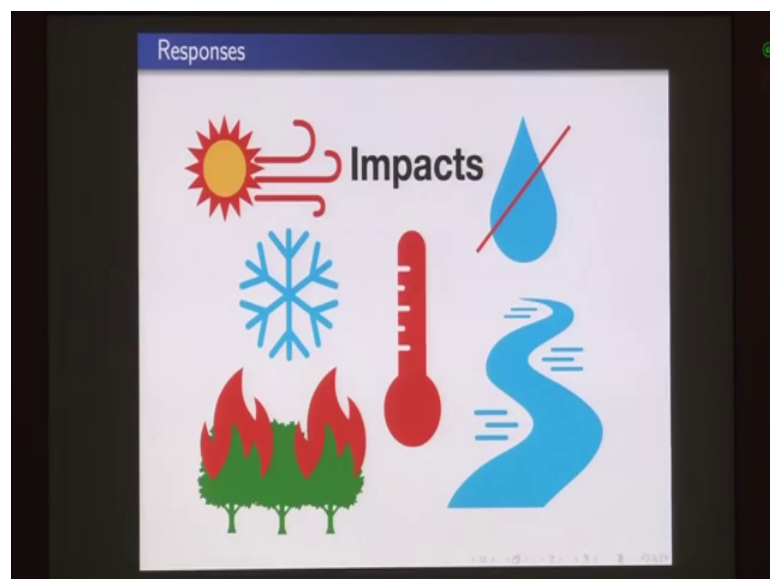
Now, this inputs and outputs are important to understand climate change. So, the inputs or the forcings include changes in the plate tectonics, changes in the earth's orbit, changes in the suns strength, and the anthropogenic forcings. So, essentially these are all four different things that can bring about a change in the climatic system.

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And when this change occurs what are the responses? So, there can be changes in all the 5 components of the climate. So, changes in atmosphere, ocean, vegetation, land surface and in ice. So, all these 5 different things are the responses of climate change.

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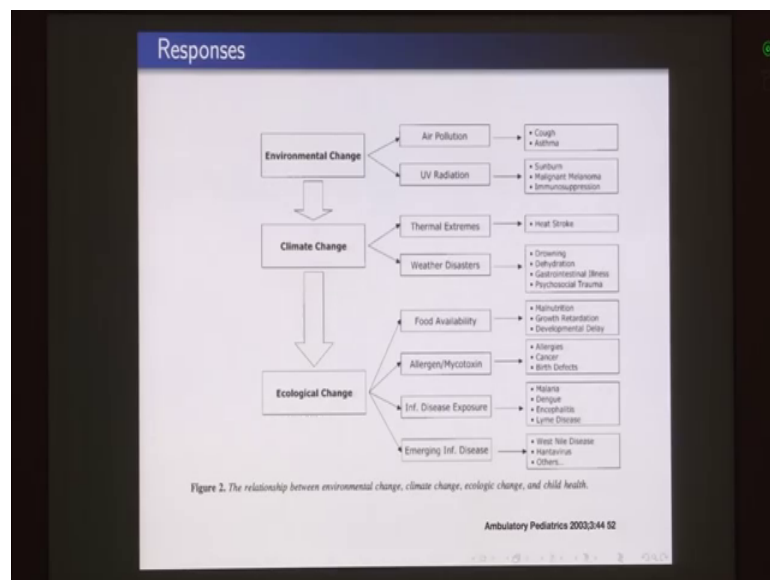
Then we looked at various impacts. So, things may become dry, things may become hot, things may become cold things may become wet. In the case of floods you can have more amount of forest fires, if they you can have more occurrence of diseases, new disease and so on.

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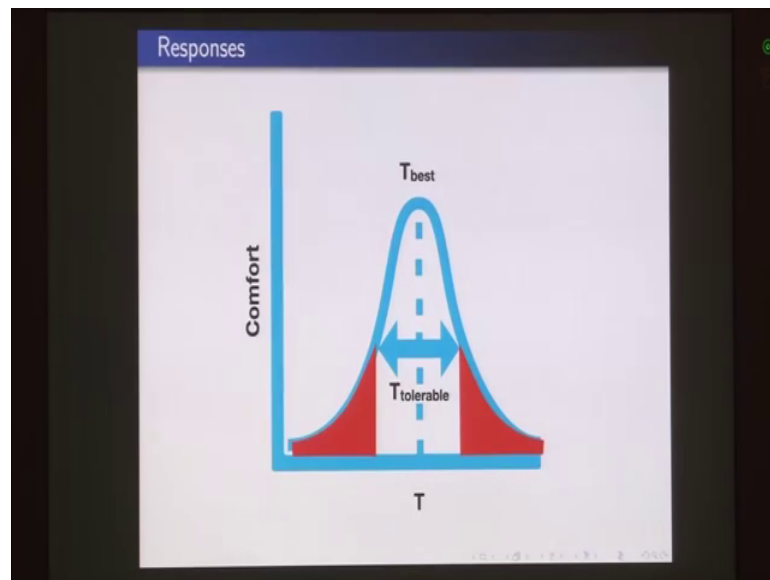
Then we looked at this example of how computer simulations can tell us about various responses.

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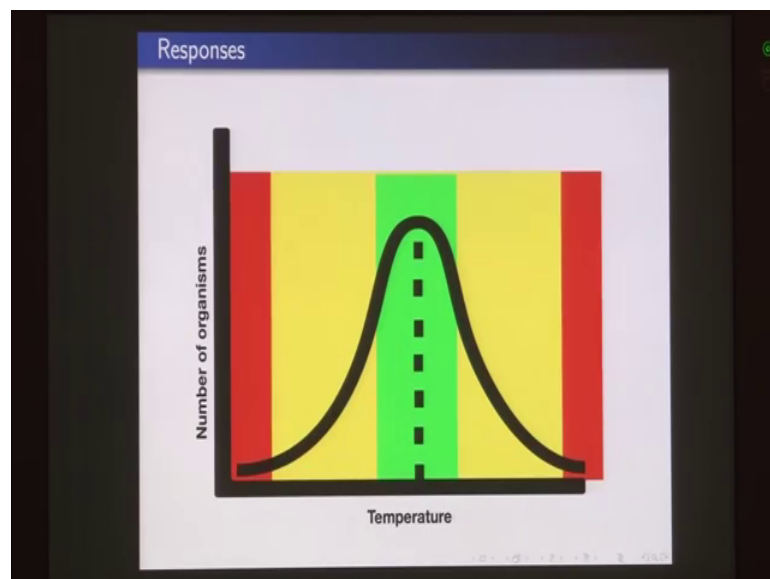
Different kinds of responses that we can have in our animals as well, different kinds of diseases, thermal extremes, weather disasters, food availability, allergens then more infectious disease, exposure emerging infectious diseases. All these things can show up in our conservation ah.

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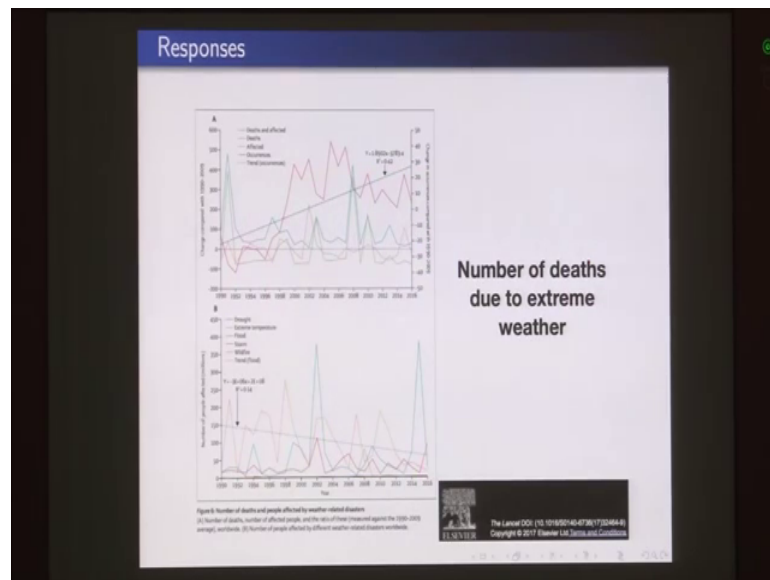
Now, next we will look at responses.

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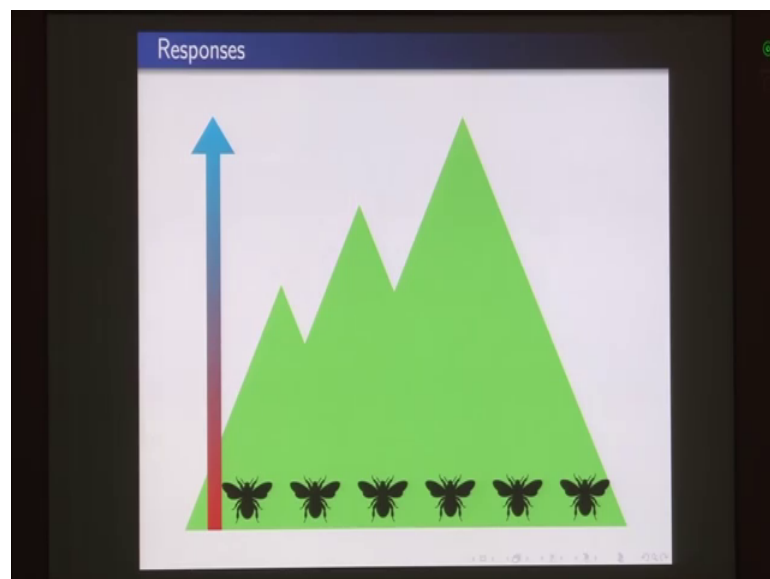
So, every animal has a tolerable range in which it can survive well. So, in when you provided with the most optimum situations you have a greater density of animals. When situations are not that optimum then there is a less density of animals, and then you go to the extremes then you will not find any organisms living permanently in those areas.

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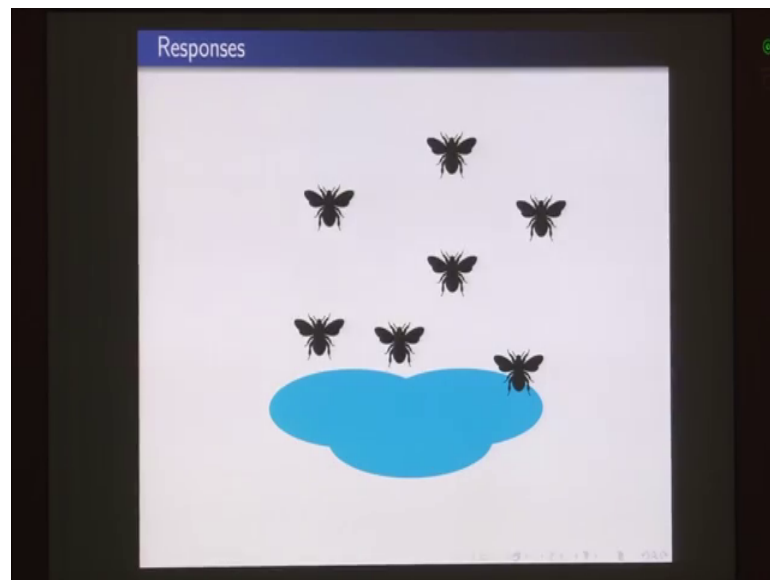
Then we looked at these studies of number of deaths due to extreme weather.

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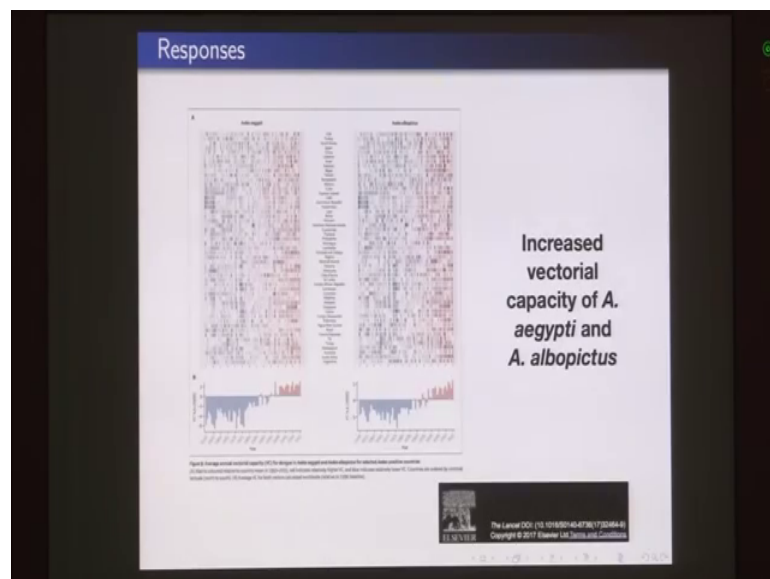
Another response is that in case temperatures increase. So, all the animals like these insects that are living at the bottom of the mountains when it is warmer, will start moving to the top which is cooler norm that will become warmer when they have a situation of climate change.

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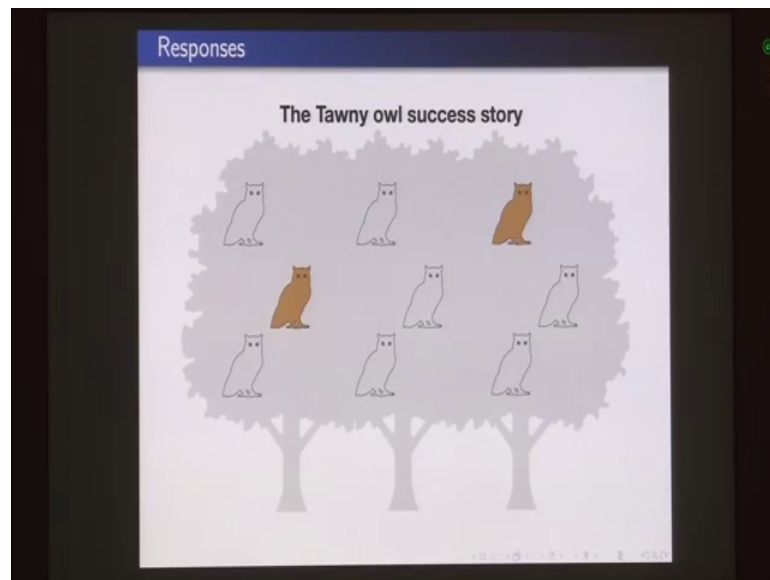
Also some insects may breed better because situations will be more hot, and more moist.

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Then we looked at actual fields scenarios. There is an increased vectorial capacity of it is mosquitoes because of climate change.

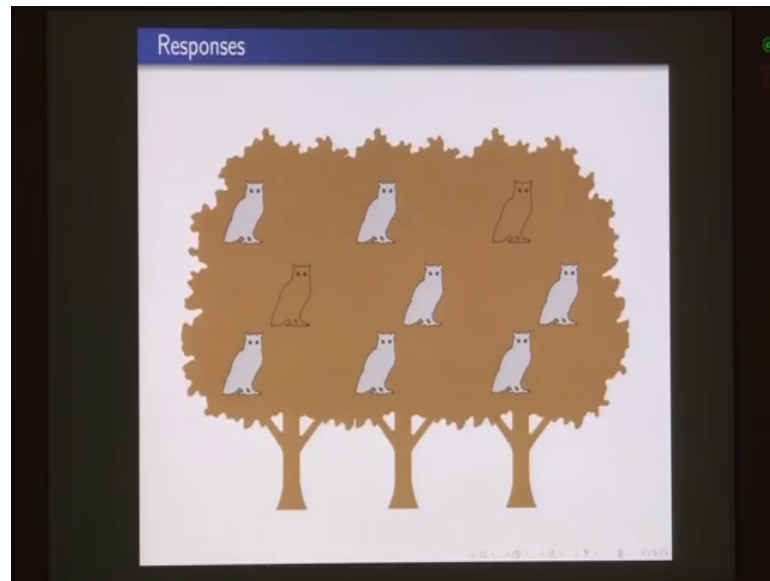
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Then we had a look at how our organism in the forest would response? So, this is a tawny owl success story, so this is an owl that is present in two variants in the grey color and the brown color. Now, in case you have quite a lot of snow in the trees, so the white or the grey colored owls they become camouflage. And so in the in the prey enables like mice, or rats, or hares are not able to see these owls. So, they become better at hunting.

Whereas, in the case of these brown colored owls the prey animals are able to see them and so they run away. So, generally or say a few decades back we were observing that in the forest we had quite a large number of grey colored owls, and very less number of brown colored owls.

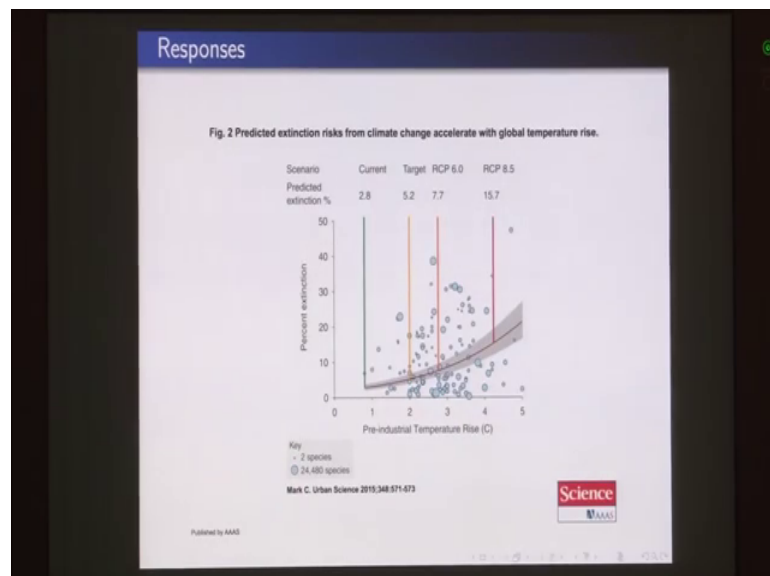
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But then because of climate change now there is less amount of snow, and in those scenarios the grey colored owl becomes more conspicuous, and the brown colored owl is able to camouflage better.

So, now we are saying a change in the genetic frequencies or the allele frequencies. Now in place of more number of grey colored owls, now we have less number of grey colored owls, and the number of brown colored owls has gone up. So, these are the responses that we will see even in the animal kingdom.

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Next response would be the increased level of extinctions that we will observe.

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The slide is titled "Mitigation & adaptation" and is part of a larger presentation. At the top, there is a navigation menu with the following items:

- Module 1: Introduction, Importance, Threats
- Module 2: Monitoring wild animals
- Module 3: Monitoring & managing habitats
- Module 4: Management of wildlife diseases
- Module 5: Capturing and restoring wild animals
- Module 6: Conservation genetics
- Module 7: Ex-situ conservation
- Module 8: Management of changes

On the right side of the menu, there is a section titled "Impacts of climate change" with the following sub-items:

- Plants and biodiversity
- Disasters
- Crisis and learnings: The Sarsika case-study
- Revision - I
- Revision - II
- Revision - III

The main content of the slide is divided into two sections:

Mitigation
"A human intervention to reduce the sources or enhance the sinks of greenhouse gases."^a
^aBaede, A. (2007). "Annex 1 IPCC Glossary". Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

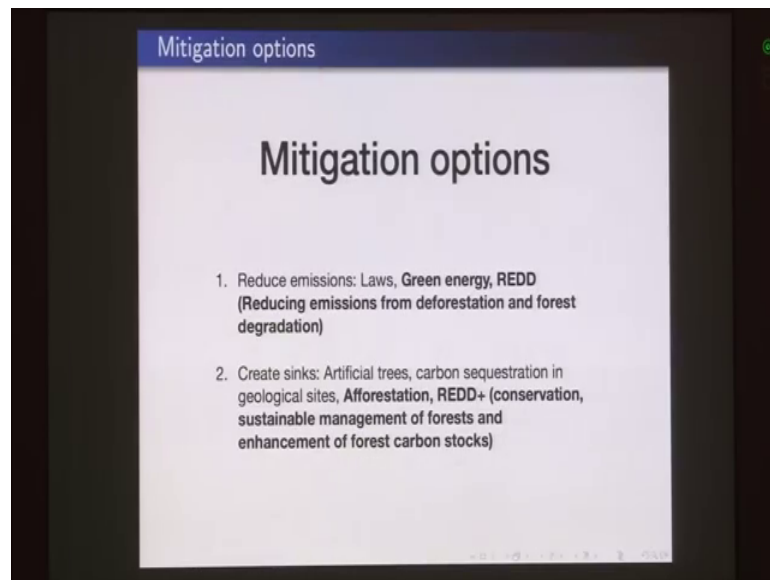
Adaptation
"Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."^a
^aUNFCCC. (2014). "Focus: Adaptation." Retrieved 2017-08-06, 2017, from <http://unfccc.int/focus/adaptation/items/6999.php>.

At the bottom of the slide, there is a footer that reads: "Dr. Ankur Awadhiya, IFS Wildlife Conservation".

So, this is a paper from science now what can we do? We can do two things; one is mitigation, the other is adaptation. Mitigation is a human intervention to reduce the sources or enhance the sinks, so of greenhouse gases.

So, you want to reduce the amount of emission and any emission that is there in the atmosphere you want to take it away that is mitigation. Adaptation in a natural or human system is the response to actual or expected climatic stimuli, or their effects which moderates harm, or exploits beneficial opportunities. So, in the case of adaptation you are providing your system a capability to able to resist, or respond to climate change.

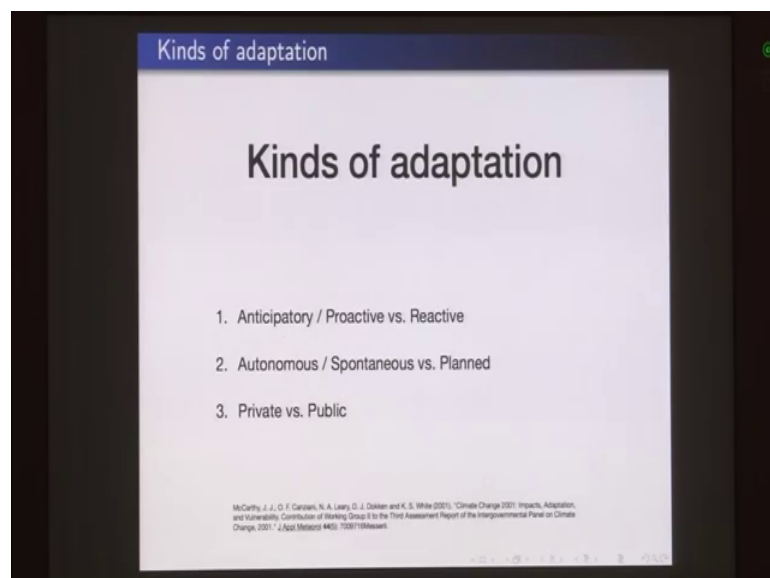
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So, both of these things can go on together; then we looked at mitigation options. So, mitigation options are reduce emissions and create sinks. Reduce emissions through green energy say use of led light bulbs red that is reducing emissions from deforestation and forest degradation and so on.

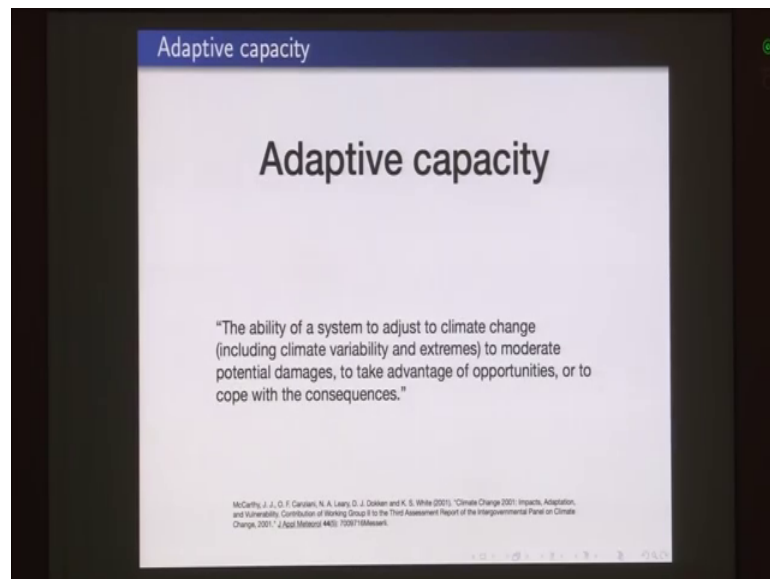
Creation of things includes things like afforestation, grow more trees, REDD plus which includes conversation, sustainable management of forest, and enhancement of forest carbon stocks. Besides these a number other technological things can also be thought of.

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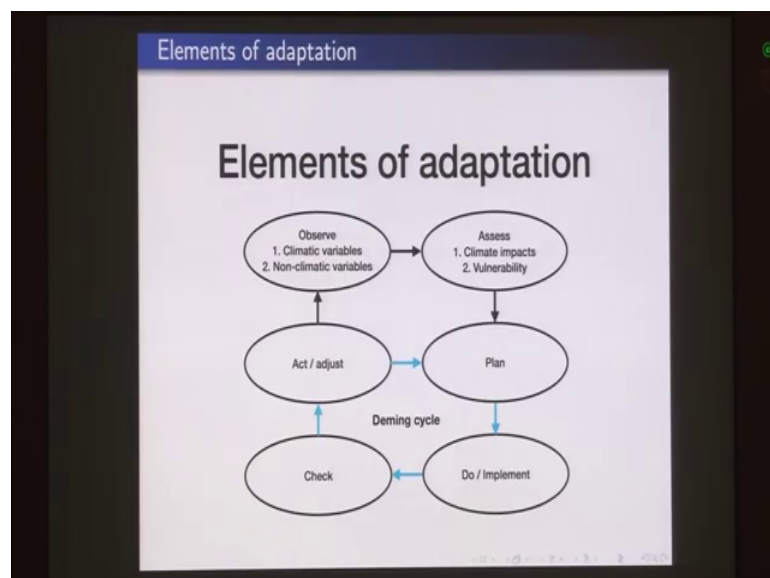
Now, there are 3 kinds of adaptation.

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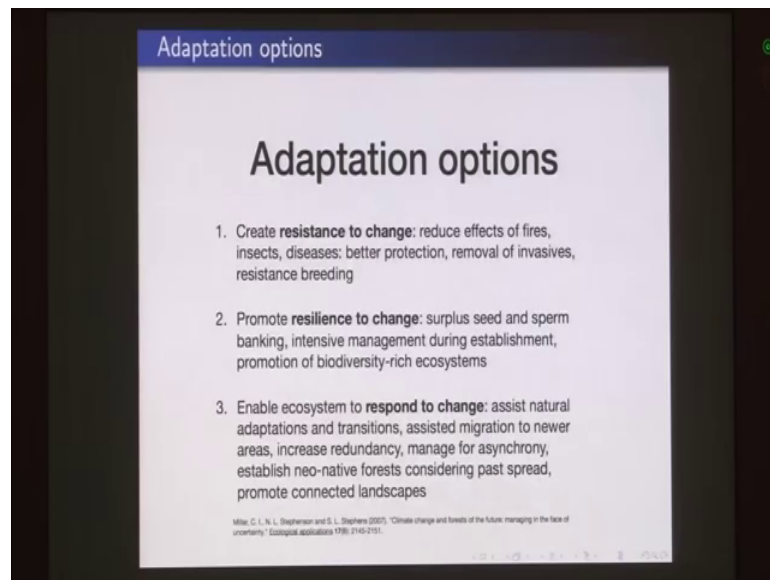
Then we also talked about adaptive capacity. The ability of a system to adjust to climate change to moderate potential damages to take advantage of opportunities, or to cope with the consequences is adaptive capacity.

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Then we looked at elements of adaptation. So, we have the Deming cycle, PDCA cycle plan do check and act and then we add these two things observe and assess. So, they become the elements of adaptation in the longer run.

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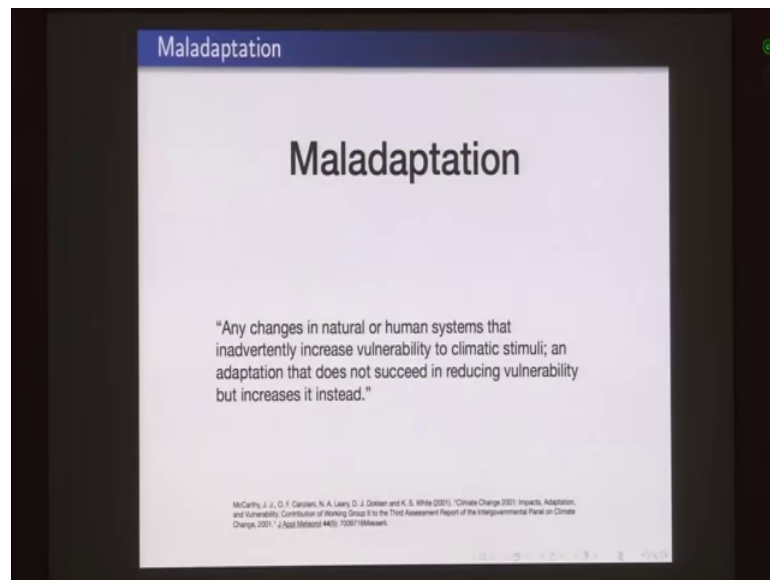


Then adaptation options are create a resistance to change, create a resilience to change, and create response to change. So, resistance to change is that if you expect that areas will become warmer. So, you can create situations in which the number of forest fires that would have gone up is more controlled.

So, in this case you forest will be able to resist the change. So, it reduce the effects of fires, or reduce the incidences of fires through better protection for instance. Resilience to change is that when impacts of climate change come in the systems productivity will go down, but then after a while it should be able to come back, so that is resilience.

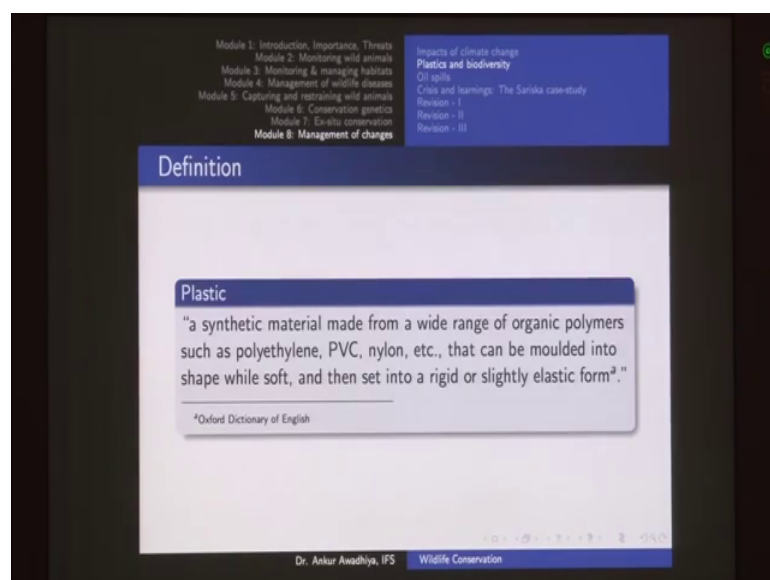
So, for this we also go for things like surplus seed and sperm banking. So, when we talk about seed banking if there is climate change and if a forest is completely obliterated we can use these seeds to reestablish that forest. So, that is a resilience to change and third is response to change. So, you can assist natural adaptations and transitions. You can go for assisted migration of species and so on, so that is the response to change.

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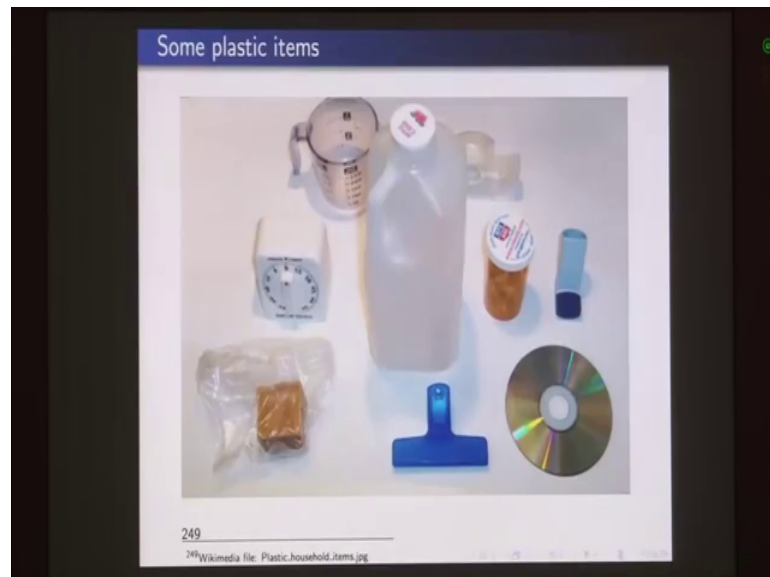
Next we looked at maladaptation. So, maladaptation is an adaptation that is not working properly or that is that has gone wrong. Any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; or an adaptation that does not succeed in reducing vulnerability, but increases it instead is a maladaptation. Next we looked at plastics in biodiversity.

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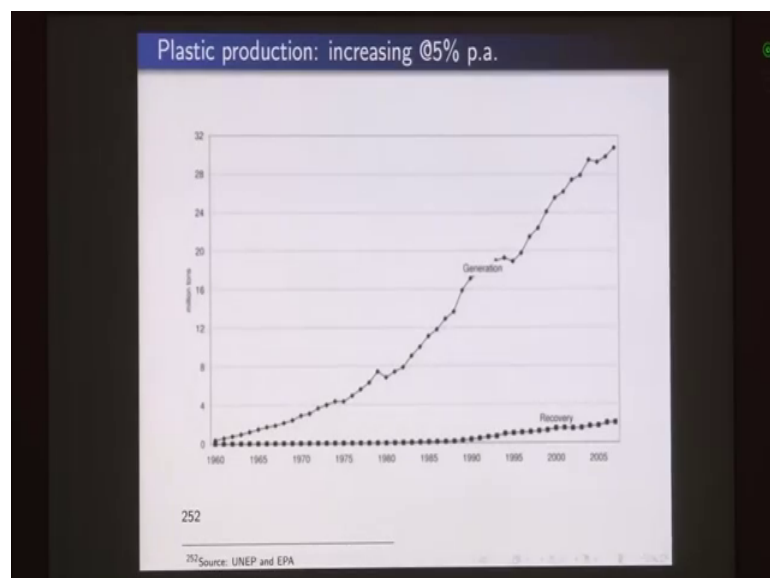
What is a plastic? So, it is a synthetic material made from a wide range of organic polymers. That can be molded into shape when soft and then set into a rigid or slightly elastic form.

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So, we are surrounded by plastics they have a very long history.

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Then plastic production has been increasing, but the amount of plastics that has been recovered that is that has been recycled, or reused is very less.

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Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Srinika case-study
Revision - I
Revision - II
Revision - III

Where does all this plastic go?

- 1 Reused and recycled: a small fraction
- 2 Burnt: releases dioxins and CO₂
- 3 Landfills: and we're running short of space!
- 4 Environment: both terrestrial and (ultimately) marine

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So, what are the options available for these plastics? Reuse and recycle is a very small fraction, otherwise they can be burnt in which case they release greenhouse gases and also toxins such as dioxins.

Then you can put them in to landfills, but we are already running out of space. And then the rest of the plastics will go into is the environment which should be terrestrial as well as marine environment.

(Refer Slide Time: 30:13)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
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Impacts of climate change
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Revision - I
Revision - II
Revision - III

Size classification of plastic debris

Macrodebris
> 20 mm in size
Ghost nets are the main concern.

Mesodebris
5 - 20 mm in size
Dominated by 'nurdles': resin granules that are intermediates in plastic production.

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Next we looked at size classification of plastic debris. So, plastic debris that is greater than 2 centimeters in size is macro debris. So, this is greater than 20, 20 millimeter or greater than 2 centimeters meso debris is middle size. So, this is 5 to 20 millimeters, and micro debris is less than 5 millimeters.

(Refer Slide Time: 30:33)

The slide is titled "Decomposition of plastic debris". It lists the following factors: $h\nu$, O_2 , microbes and worms. Below this, it states: "light absorption, photolytic reaction, formation of radicals, enzymatic degradation". The final outcome is: "Oxidation and scission reactions causing discolouration, loss of mechanical integrity, strength and impact properties".

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

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Next we looked at decomposition of plastic debris fate of marine plastics.

(Refer Slide Time: 30:37)

The slide is titled "How does this impact wildlife?". It features a blue circle with a white 'i' icon and the word "Ingestion". Below this, the number "258" is displayed.

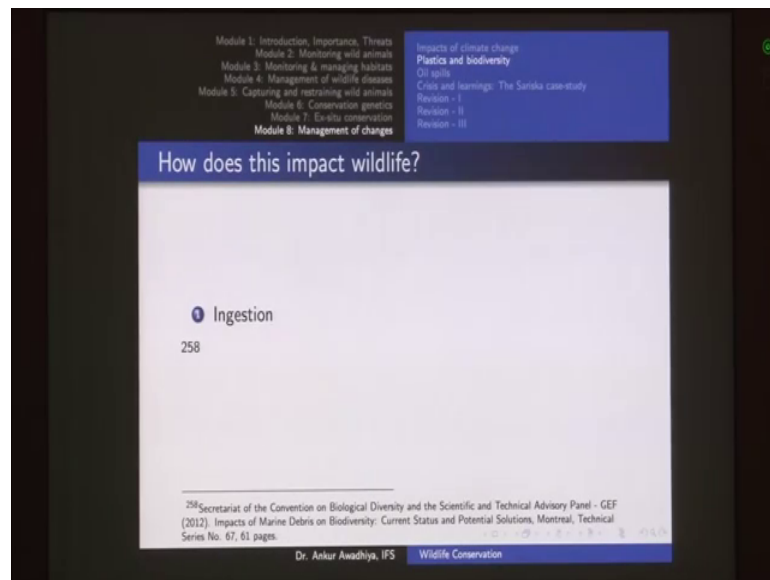
Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

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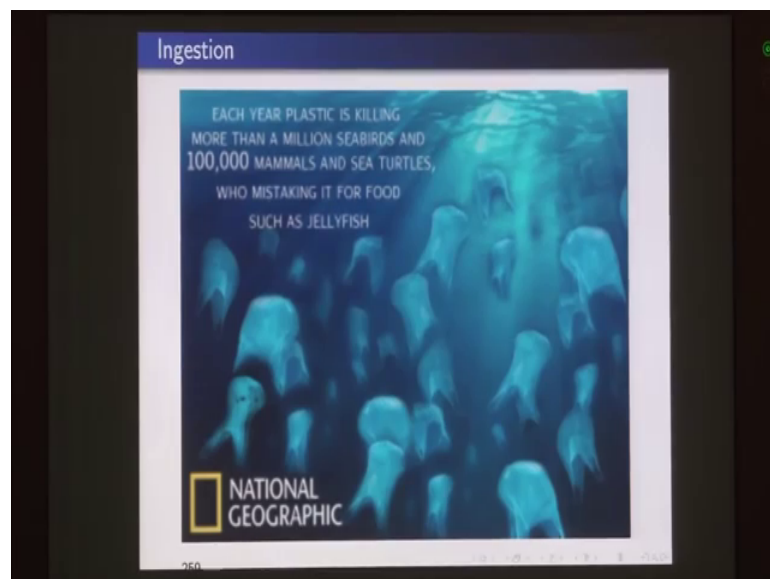
So, you have floating plastics, you have plastic that what ashore, and you have plastics that come on the sea beds.

(Refer Slide Time: 30:42)



Now, does it impact wild life?

(Refer Slide Time: 30:45)



You can have situations of ingestion in which animals confuse plastics for food.

(Refer Slide Time: 30:50)



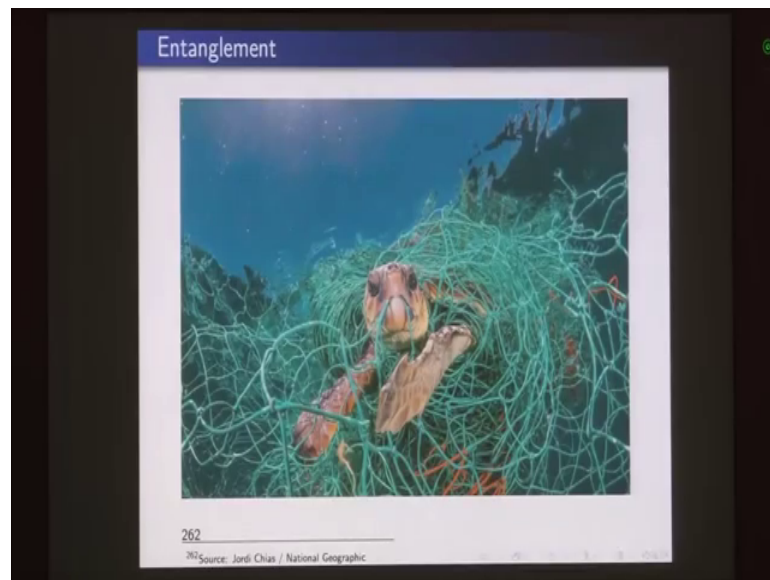
And then this plastic completely blocks up the elementary canal. And the animal dies because it is not able to get any nutrition.

(Refer Slide Time: 30:58)

The image is a presentation slide with a blue header. The header contains a list of modules on the left and a box on the right titled 'Impacts of climate change' with sub-points: 'Plastics and biodiversity', 'Oil spills', 'Crisis and learnings: The Sanku case-study', 'Revision - I', 'Revision - II', and 'Revision - III'. The main title of the slide is 'How does this impact wildlife?'. Below the title, there is a list of two points: '1 Ingestion' and '2 Entanglement, even smothering'. The slide number '261' is visible in the bottom left corner. At the bottom, there is a footer with the text 'Dr. Ankur Awasthiya, IFS' and 'Wildlife Conservation'. A small footnote at the bottom left reads: '281 Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel - GEF (2012). Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions, Montreal, Technical Series No. 67, 61 pages.'

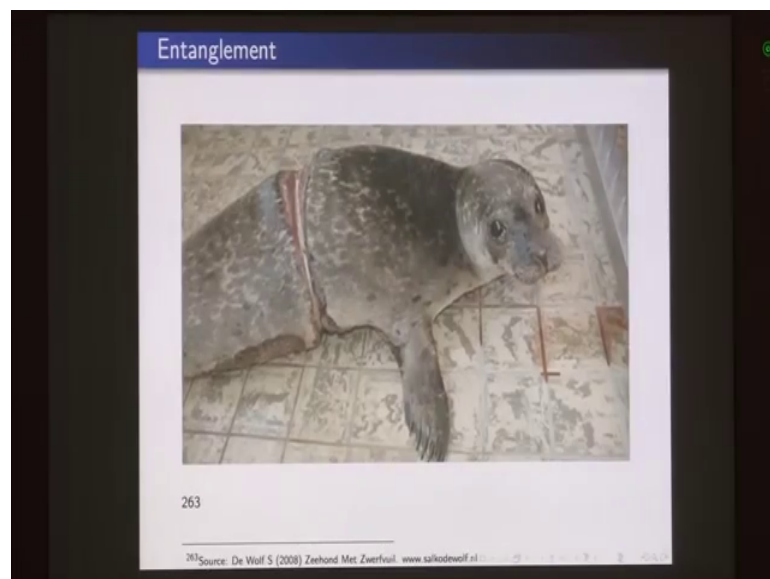
Next is entanglement or smothering of animals.

(Refer Slide Time: 31:00)



So, this is a turtle that has got entangled in a net.

(Refer Slide Time: 31:04)



Here you have a seal that is whose body is being cut because of this plastic.

(Refer Slide Time: 31:09)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sarsua case-study
Revision - I
Revision - II
Revision - III

How does this impact wildlife?

- 1 Ingestion
- 2 Entanglement, even smothering
- 3 Persistent, bio-accumulative, toxic substances

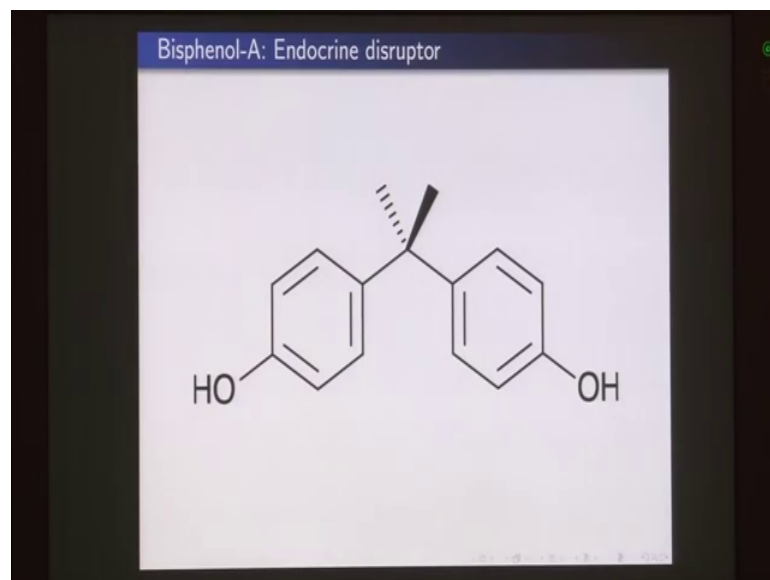
264

²⁶⁴Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel - GEF (2012). Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions, Montreal, Technical Series No. 67, 61 pages.

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Then you can have persistent, bio accumulative, toxic substances like bisphenol A, and brominated flame retardants.

(Refer Slide Time: 31:12)



(Refer Slide Time: 31:17)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sarsua case study
Revision - I
Revision - II
Revision - III

How does this impact wildlife?

- 1 Ingestion
- 2 Entanglement, even smothering
- 3 Persistent, bio-accumulative, toxic substances
- 4 Accumulation and concentration of hydrophobic toxins

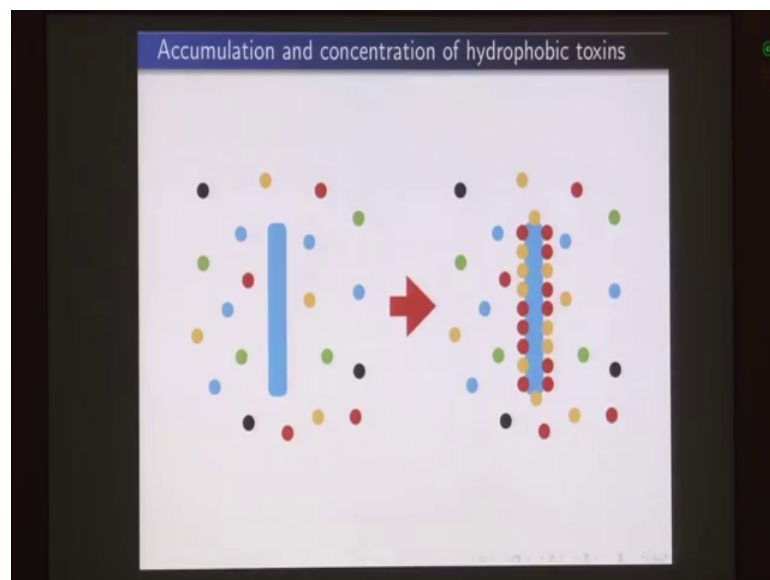
266

²⁶⁶Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel - GEF (2012). Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions, Montreal, Technical Series No. 67, 61 pages.

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Then you can have accumulation and concentration of hydrophobic toxins, because plastics provide a hydrophobic substance.

(Refer Slide Time: 31:20)



So, different hydrophobic substances would come together. And so the concentration of various toxins will increase on the surface of plastic and when an animal eats it then it will get a very high dose of the toxins.

(Refer Slide Time: 31:35)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sarsika case-study
Revision - I
Revision - II
Revision - III

How does this impact wildlife?

- 1 Ingestion
- 2 Entanglement, even smothering
- 3 Persistent, bio-accumulative, toxic substances
- 4 Accumulation of hydrophobic toxins
- 5 Potential to alter habitats and behaviours

267


²⁶⁷Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel - GEF (2012). Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions, Montreal, Technical Series No. 67, 61 pages.

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Next it has a potential to alter habitats and behaviors. So, here we looked at different examples.

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Rhinoceros dung

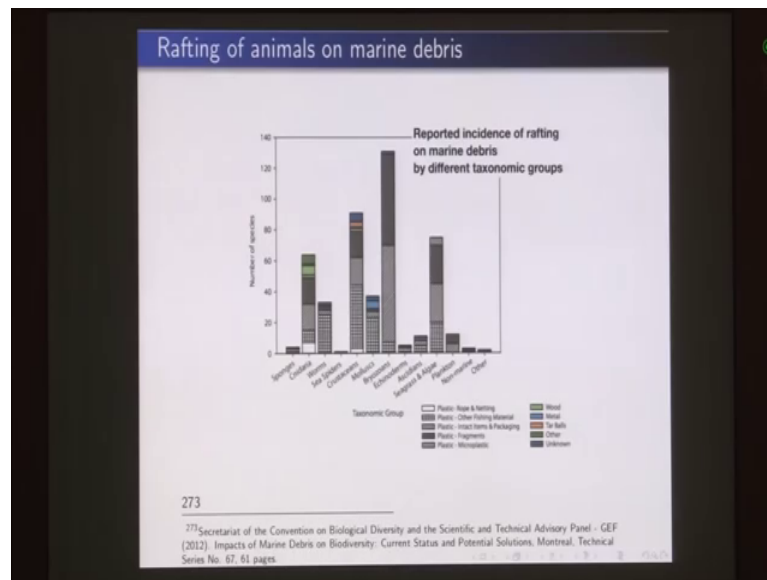


271

²⁷¹Ankur Awadhiya, Manas 2018

And even in the case of our protected areas even in the case of Manas Tiger Reserve we are seeing plastic in the rhinoceros dung. Then need also alters the dispersion of organisms.

(Refer Slide Time: 31:51)



So, these days a number organisms are able to move because of these plastics and not because of the natural amount of dispersal. Dispersal agents that were available before.

(Refer Slide Time: 32:04)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

How can we help?

1 Reduce, reuse, recycle

Dr. Ankur Awasthiya, IFS Wildlife Conservation

And some of these could even be invasive species. So, what can we do? We do to help reduce, reuse, recycle, life style changes or an alternative material such as bioplastics.

(Refer Slide Time: 32:10)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

How can we help?

- 1 Reduce, reuse, recycle
- 2 Lifestyle changes: e.g. glasses in place of straws
- 3 Alternative materials: Bioplastics

Dr. Ankur Awadhiya, IFS Wildlife Conservation

(Refer Slide Time: 32:14)

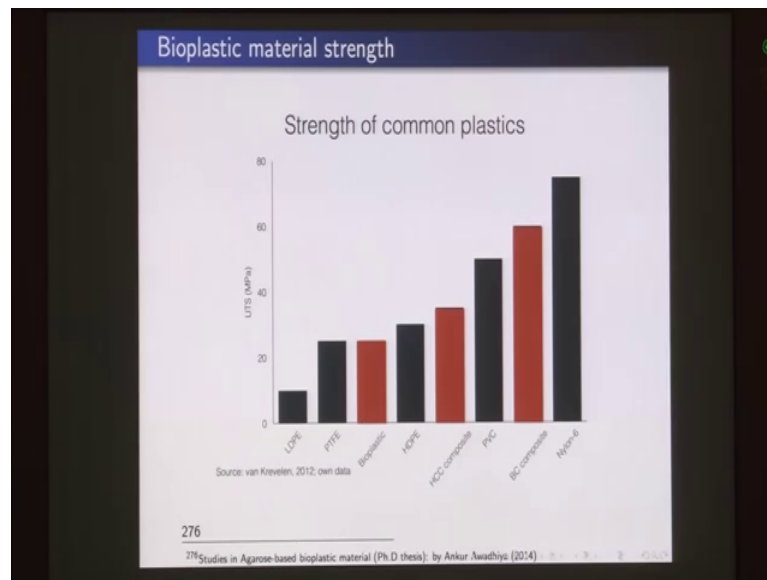
Bioplastic material

275

⁷⁷⁵Studies in Agarose-based bioplastic material (Ph.D thesis) by Ankur Awadhiya (2014)

So, here we looked at this bioplastic which has all the properties of or most of the properties of polyethylene. So, this is transparent, this is flexible.

(Refer Slide Time: 32:26)



And then it is a strength is also much greater than that of your lower density polyethylene. And with certain other ingredients should can also increase to more than the high density polyethylene. So, such kinds of plastics which are completely biodegradable which can be eaten by animals need to be promoted.

(Refer Slide Time: 32:43)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Case and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

Definition

Oil spill

"An oil spill is the release of a liquid petroleum hydrocarbon into the environment."

Dr. Ankur Awadhiya, IFS Wildlife Conservation

Next we had a look at oil spill. So, what is oil spill? It is a release of liquid petroleum hydrocarbon in to the environment, it can be terrestrial or marine.

(Refer Slide Time: 32:48)

The slide is titled "Location of oil spills". It is part of a presentation on Wildlife Conservation, as indicated by the footer. The slide content is organized into two main categories: Terrestrial and Marine. The Terrestrial category includes the example of Kuwaiti oil lakes formed during Iraq's invasion of Kuwait (1990 - 91). The Marine category includes the example of the Deepwater Horizon (2010). The slide also features a table of contents in the top left corner and a sidebar on the top right with additional topics like climate change, plastics, and biodiversity.

Location	Example
Terrestrial	e.g. Kuwaiti oil lakes formed during Iraq's invasion of Kuwait (1990 - 91).
Marine	e.g. Deepwater Horizon (2010).

Dr. Ankur Awadhya, IFS Wildlife Conservation

So, we looked at these Kuwaiti oil lakes that were created and this is a marine example.

(Refer Slide Time: 32:55)

The slide is titled "Kinds of oil spills". It is part of a presentation on Wildlife Conservation, as indicated by the footer. The slide content is organized into three main categories: Natural, Accidental, and Intentional. The Natural category includes the example of oil seeps in the Gulf of Mexico. The Accidental category includes the example of the Deepwater Horizon incident. The Intentional category includes the example of the Gulf war oil spill. The slide also features a table of contents in the top left corner and a sidebar on the top right with additional topics like climate change, plastics, and biodiversity.

Kind	Example
Natural	e.g. Oil seeps in Gulf of Mexico
Accidental	e.g. Deepwater Horizon incident
Intentional	e.g. Gulf war oil spill

Dr. Ankur Awadhya, IFS Wildlife Conservation

This can be natural accidental, or intentional.

(Refer Slide Time: 32:59)

The slide is titled "Definition" and defines "Hydrocarbon". It states: "A hydrocarbon is an organic compound consisting entirely of hydrogen and carbon." and "These form a major chunk of petroleum oil." The slide is part of a presentation on Wildlife Conservation, as indicated by the footer. The top navigation bar lists modules 1 through 8, with Module 8: Management of changes selected. The right sidebar lists topics: Impacts of climate change, Plastics and biodiversity, Oil spills, Crisis and learnings: The Sanku case-study, Revision - I, Revision - II, and Revision - III.

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

Definition

Hydrocarbon

"A hydrocarbon is an organic compound consisting entirely of hydrogen and carbon."
These form a major chunk of petroleum oil.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

So, this is a natural oil lake. And then next we looked at what is a hydrocarbon? It is an organic compound consisting entirely of hydrogen and carbon. So, there are various hydrocarbons.

(Refer Slide Time: 33:10)

The slide is titled "Classification of hydrocarbons" and shows "Group 1 to 5 oils". It states: "Based on specific gravity" and lists two groups: "Group 1: very low (< 0.8) specific gravity (e.g. kerosene)" and "Group 5: very high (≥ 1.0) specific gravity (e.g. bitumen)". It also states: "Useful when discussing the fate and persistence of oil spills." The slide is part of a presentation on Wildlife Conservation, as indicated by the footer. The top navigation bar lists modules 1 through 8, with Module 8: Management of changes selected. The right sidebar lists topics: Impacts of climate change, Plastics and biodiversity, Oil spills, Crisis and learnings: The Sanku case-study, Revision - I, Revision - II, and Revision - III.

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

Classification of hydrocarbons

Group 1 to 5 oils

Based on specific gravity

- Group 1: very low (< 0.8) specific gravity (e.g. kerosene)
- Group 5: very high (≥ 1.0) specific gravity (e.g. bitumen)

Useful when discussing the fate and persistence of oil spills.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

Next we defined or we classify hydrocarbons based on their specific gravity. So, you have group 1 hydrocarbons that are very low specific gravity. Group 5 hydrocarbons that have a very high specific gravity and others come in between why is this important? Because those with less specific gravity are going to float on water, those with higher

specific gravity are going to sink down. Also those with less specific gravity will be more volatile, those with higher specific gravity will be less volatile.

(Refer Slide Time: 33:35)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: In-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and bio-diversity
Oil spills
Crisis and learning: The Sanku case-study
Revision - I
Revision - II
Revision - III

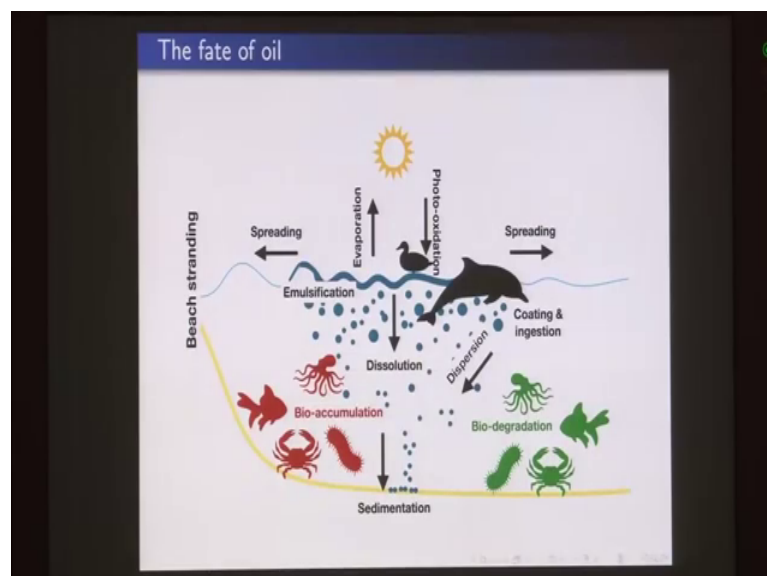
Classification of hydrocarbons

- Petrogenic hydrocarbons**
Derived directly from mineral oils.
- Pyrogenic hydrocarbons**
Derived from incomplete burning of mineral oils.
- Biogenic hydrocarbons**
Derived from biological processes acting on mineral oils.

Dr. Ankur Awadhya, IFS Wildlife Conservation

Next we looked at three different classifications based on the origin. So, you can have petrogenic which are directly derived from mineral oils. Then if these mineral oils are burnt then because of incomplete burning we will have pyrogenic pyro is heat. So, this is a heat formation this is rock formation and third is biogenic that is biological formation which is derived from biological processes acting on the mineral oils.

(Refer Slide Time: 34:02)



Next we looked at the fate of oil. So, if there is oil then it will spread that this may evaporate, there will be some photo oxidation there some will be emulsification some parts will dissolve, some parts we will dispose. And some parts will sediment down and then these will quote and these will be ingested by certain organisms. In certain cases there will be a bio accumulation in certain cases there will be a bio degradation of these oil components.

(Refer Slide Time: 34:28)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Case study: The Bunker case-study
Revision - I
Revision - II

Impact of oil spills

Upon coating

- 1 Physical smothering: reduced ability to move, feed, etc., loss of thermoregulation
- 2 Inhalation of volatile hydrocarbons: toxicity
- 3 Absorption through skin and mucosa: toxicity

Dissolved products

- 1 Absorption through skin and food: toxicity

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Next we looked at different impacts. So, impacts upon coating impacts of dissolve products.

(Refer Slide Time: 34:34)

The slide is titled "Factors influencing the impact". It features a table of contents on the left and a list of topics on the right. The main content area lists two factors:

- Seasonality**
e.g. breeding season, presence of eggs or juveniles
- Ecological functions of key species**
e.g. impact on keystone species like mangroves

At the bottom, it says "Dr. Ankur Awadhiya, IFS Wildlife Conservation".

And then factors influencing the impact the seasonality. So, if there is an organism in it is breeding season it is it will have a greater impact, then the ecological function. If there is a key stone species; then the impact on the ecosystem will be much greater.

(Refer Slide Time: 34:47)

The slide is titled "Factors influencing the impact". It features a table of contents on the left and a list of topics on the right. The main content area lists two factors:

- Lifestyle factors**
e.g. animals with long lifespan and *k*-selected reproductive strategy are more impacted
- Health and condition**
e.g. stressed animals such as diseased or migrating animals are more impacted

At the bottom, it says "Dr. Ankur Awadhiya, IFS Wildlife Conservation".

Life style factors animals with long life span and *k* selected reproductive strategy. So in this strategy there the animals go for less number of offspring's, and give much more attention. So, if those offspring's die then there is a very little chance that this a species

will be able to cope with this situation, and then health and other prevailing conditions in the animals.

(Refer Slide Time: 35:10)

The slide is titled "Some terms associated with impacts". It features a table of contents on the left and a sidebar on the right. The main content area contains two definitions:

- Vulnerability**
"Vulnerability describes the likelihood that a resource will be exposed to oil."
- Sensitivity**
"Sensitivity assumes that the resource is exposed to the oil, and describes the relative effect of that exposure. Thus, a deep water coral may be sensitive but not vulnerable to a surface oil spill, while a rocky shore seaweed may be vulnerable but not sensitive."

At the bottom, it says "Dr. Ankur Awadhiya, IFS Wildlife Conservation".

Next we had look at vulnerability and sensitivity. So, vulnerability is the likelihood that your resource or your animals will be exposed to oil. And sensitivity assumes that your resource or the animals are already exposed to oil and then it ask what is the relative effect of that exposure. So, there could be some species that will be highly sensitive and there could be some species that are more resistance to the impacts of oil.

(Refer Slide Time: 35:32)

The slide is titled "Some terms associated with impacts". It features a table of contents on the left and a sidebar on the right. The main content area contains two definitions:

- Toxicity**
"The potential or capacity of a material to have adverse effects on living organisms."
- Acute toxicity**
"Acute toxicity involves harmful effects in an organism through a single or short-term exposure."

At the bottom, it says "Dr. Ankur Awadhiya, IFS Wildlife Conservation".

Next we looked at toxicity; toxicity is divided into two parts acute and chronic toxicity acute toxicity occurs in a very short period of time. So, if there is an animal that is given say cyanide and this animal dies so, this would be a case of acute toxicity.

(Refer Slide Time: 35:49)

The slide is titled "Some terms associated with impacts". It contains two definitions:

- Chronic toxicity**: "Chronic toxicity is the ability of a substance or mixture of substances to have harmful effects over an extended period, usually upon repeated or continuous exposure, sometimes lasting for the entire life of the exposed organism."
- Exposure**: "The combination of duration of exposure to the chemical and concentration of the chemical."

At the top left, a list of modules is shown: Module 1: Introduction, Importance, Threats; Module 2: Monitoring wild animals; Module 3: Monitoring & managing habitats; Module 4: Management of wildlife diseases; Module 5: Capturing and restraining wild animals; Module 6: Conservation genetics; Module 7: Ex-situ conservation; Module 8: Management of changes. At the top right, a list of topics is shown: Impacts of climate change; Plastics and biodiversity; Oil spills; Crisis and learnings: The Sanku case-study; Revision - I; Revision - II; Revision - III. At the bottom, the text "Dr. Ankur Awadhiya, IFS Wildlife Conservation" is visible.

Chronic toxicity is something that occurs in a very long time span. So, if there is a person who is living in a house that has lead paint. So, this person is exposed to lead for a very long period of time and will show impacts of chronic toxicity.

(Refer Slide Time: 36:04)

The slide is titled "Some terms associated with impacts". It contains two definitions:

- Lethal effect**: "A lethal effect results in the death of an organism."
- Sub-lethal effect**: "A sublethal effect results in a reduction of biological function or health, e.g. its growth, ability to reproduce, or the condition of its skin."

At the top left, a list of modules is shown: Module 1: Introduction, Importance, Threats; Module 2: Monitoring wild animals; Module 3: Monitoring & managing habitats; Module 4: Management of wildlife diseases; Module 5: Capturing and restraining wild animals; Module 6: Conservation genetics; Module 7: Ex-situ conservation; Module 8: Management of changes. At the top right, a list of topics is shown: Impacts of climate change; Plastics and biodiversity; Oil spills; Crisis and learnings: The Sanku case-study; Revision - I; Revision - II; Revision - III. At the bottom, the text "Dr. Ankur Awadhiya, IFS Wildlife Conservation" is visible.

Next we looked at exposure root magnitude lethal and sub lethal effect. So, lethal effect is when an organism dies sub lethal effect is when an organism has a reduced biological function, or health.

(Refer Slide Time: 36:14)

The slide is titled "Some terms associated with impacts". It contains two definitions:

- Bioavailability**: "Bioavailability is the extent to which a chemical is available for uptake into an organism and, with respect to oil spills, is usually closely related to both the display of toxicity and the rate of biodegradation."
- Bioaccumulation**: "Bioaccumulation occurs when an organism absorbs a toxic substance into its tissues at a rate greater than that at which the substance is lost."

The slide also includes a table of contents on the left and a navigation bar at the bottom.

Next we looked at bioavailability, bioaccumulation.

(Refer Slide Time: 36:16)

The slide is titled "Impacts on different animals". It contains a list of impacts on Planktons:

- 1 Sensitive to exposure.
- 2 Acute, chronic and sublethal effects.
- 3 Recover quickly due to short generation times.

The slide also includes a table of contents on the left and a navigation bar at the bottom.

And impacts of on different animals like planktons, seabird life, fish, marine mammals, marine reptile's birds, shoreline and coastal habitats.

(Refer Slide Time: 36:25)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

Definitions

Cleaning
Clean, in the context of an oil spill, may be defined as the return to a level of petroleum hydrocarbons that has no detectable impact on the function of an ecosystem^a.

Recovery
Recovery of an ecosystem is characterised by the re-establishment of a biological community in which the plants and animals characteristic of that community are present and functioning normally^a.

^aKingston, P.F., 2002. Long-term environmental impact of oil spills. Spill Science & Technology Bulletin, 7(1-2), pp 53-61.

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When there is an oil spill we go for cleaning operations, and our aim is to recover the ecosystem back to its full productivity.

(Refer Slide Time: 36:35)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sanku case-study
Revision - I
Revision - II
Revision - III

Clean-up operations

Contain and scoop
Use booms to contain the spill, and skimmer to collect the oil from the surface.

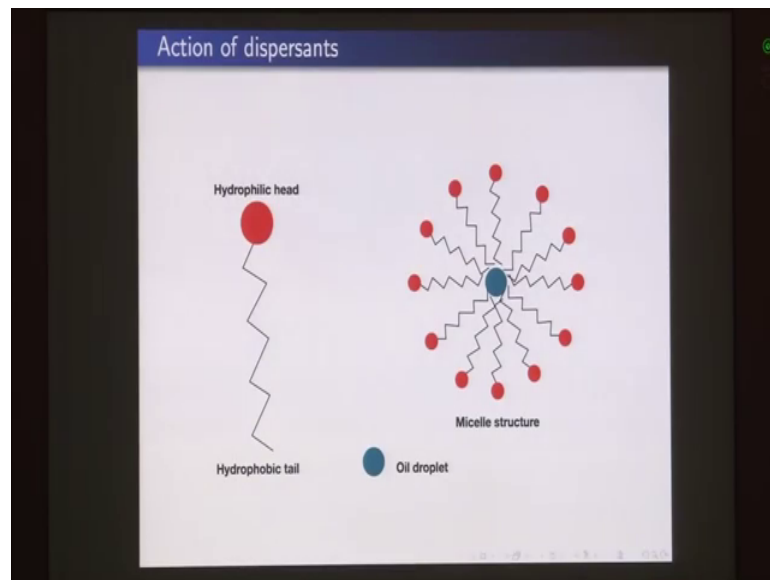
Burn
Burn the freshly ignited oil *in situ*.

Disperse
Use chemical dispersants to break oil into droplets, facilitating natural biodegradation.

Dr. Ankur Awadhya, IFS Wildlife Conservation

So, these cleaning operations could include clean and contain and scoop operations in which the oil is contained. And then it is taken away or you can burn this oil in on the site, or you can use dispersants to disperse the oil.

(Refer Slide Time: 36:45)



So, these dispersants are very similar to detergents they have a hydrophilic head, and hydrophobic tail. So, the tail attaches to the oil globule the head is able to move around in the water. And so this is able to break the oil into smaller pieces and then disperse the oil away. But then this could also have another unintended consequences on the habitat, or in certain situations if the impact is very less we can just nature act.

(Refer Slide Time: 37:04)

The slide is titled 'Clean-up operations'. It features a table of contents on the left and two main sections in the center. The table of contents lists modules 1 through 8, with 'Module 8: Management of changes' highlighted. The two main sections are 'Let nature act' and 'Use biological agents and fertilisers', each with a brief description of the approach.

Module 1: Introduction, Importance, Threats	Impacts of climate change
Module 2: Monitoring wild animals	Plastics and biodiversity
Module 3: Monitoring & managing habitats	Oil spills
Module 4: Management of wildlife diseases	Case and learnings: The Sanku case study
Module 5: Capturing and restraining wild animals	Revision - I
Module 6: Conservation genetics	Revision - II
Module 7: Ex-situ conservation	Revision - III
Module 8: Management of changes	

Clean-up operations

Let nature act

When there is little possibility of the oil impacting the ecosystem, it can be left as such for nature to take care of it.

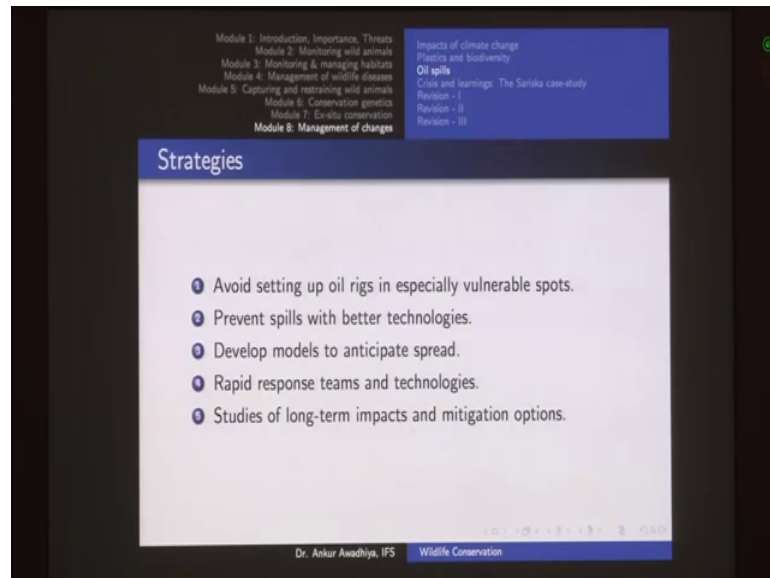
Use biological agents and fertilisers

The natural action can be speeded up by the addition of micro-organisms, or by the action of nitrogen and phosphorus that promote their growth.

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So, we will not do anything or we can just add some fertilizers. So, that the number of naturally acting microorganisms increase and so, the action of nature is expedited.

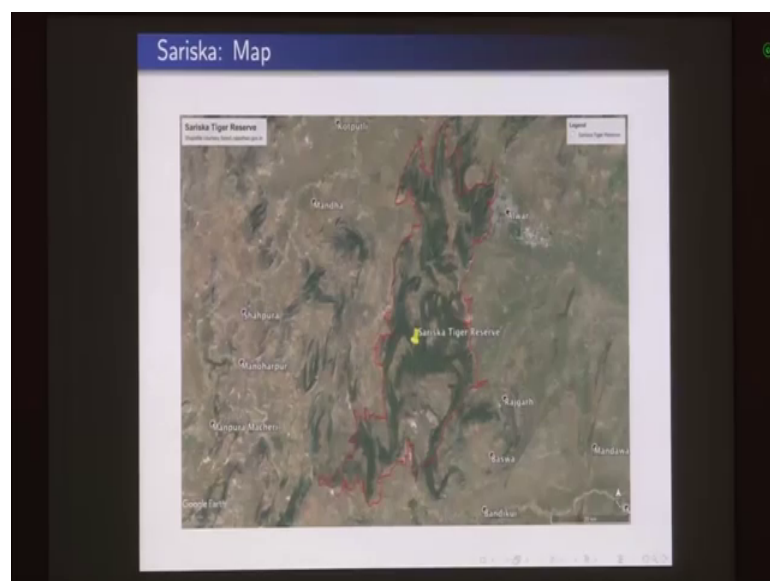
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Other strategies are to avoid setting up oil rigs in vulnerable spots, use better technologies, develop better models to anticipate spread, rapid response teams and technologies with lots of trials and lots of simulated scenarios and studies of long term impacts and other mitigation options that can be developed.

Now, last we looked at crisis and learning's. Thus, the Sariska case study; so, Sariska is a Tiger Reserve that is located in the state of Rajasthan, it has an undulating topography.

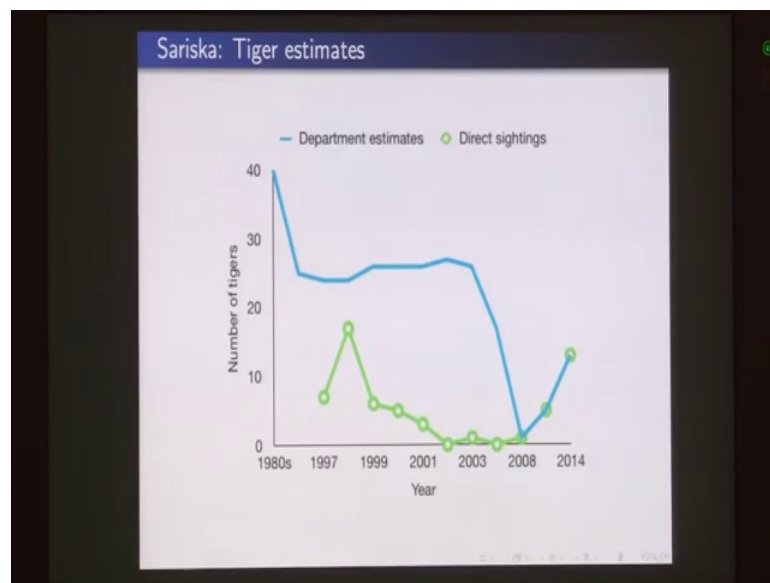
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There are forested areas, there are non forested areas. So, tree areas with density, tree canopy in areas with less dense tree canopy. And if you look at now most of the other surrounding areas have very little amount of recover.

Now, in this area with undulating topography you have a very heavy footfall of tourist and very good amount of animal diversity, plant diversity, and a number of other tourist attractions.

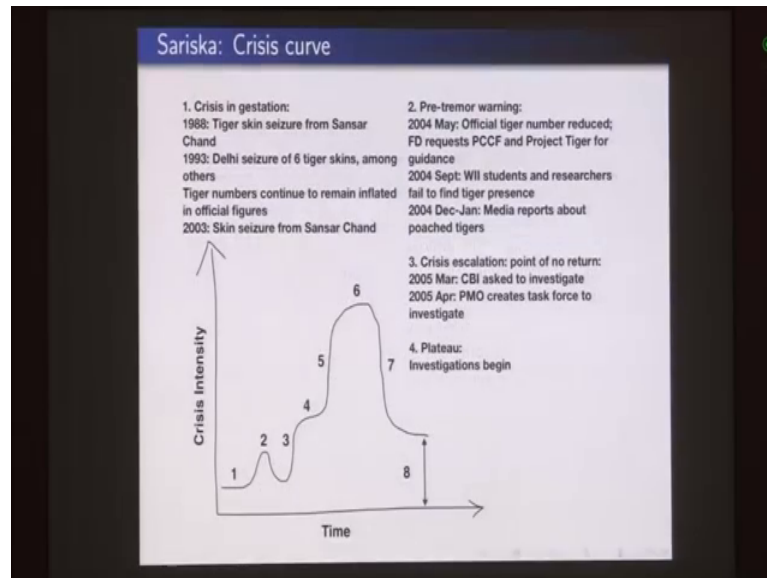
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So, in this case we saw that we had very different estimates of the number of tigers by the department, and as figured out from the direct sightings. So, departmental methods earlier used the pugmark method which was not that accurate. And these are the direct sightings that were reported by the tourist.

Now, if you are not using a very good method for quantification then it is possible that even when your tiger numbers are going down, or have gone down you will not be able to detect that and this is what happened.

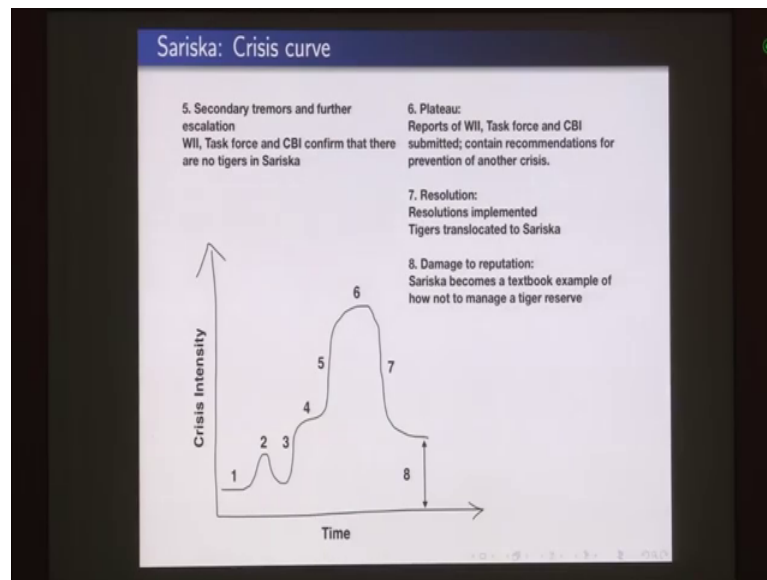
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So, and so in this case we have the crisis curve we had a long gestation period in which we were getting Tiger skin seizures from a number of places that could be lead to a poacher known as Sansar Chand. But then we could not do anything because there was no way of correlating these tiger skins directly with the areas that is Sariska.

Then pre tremor warning came in 2014. Then official number of tigers had to be brought down and then there were researchers and students who did not find any tigers, and then by 2004 December the media started reporting about poached tigers. Next there was a crisis escalation at this point when the prime minister office set up a task force and the CBI was also asked to investigate. Then there was this period of investigations.

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Now, after the investigations there were secondary tremors and further escalation. When WII task force and CBI all confirmed that there are no tigers left in Sariska. Then we came to this plateau region in which the reports were finally, submitted and they contained the recommendations that needs that needed to be used and then we have this resolution phase.

So, in the resolution phase all the recommendations were implemented and you we had tigers that were translocated to this area from other tiger reserves to recreate this populations. So, these tigers were reintroduced to this area, but even after all these there was a damage to reputation.

Because this became a text book example of how things should not be done? Later on this reputation damage was brought down because of all these translocations are with better protection strategies, we had a good text book example of how to overcome the crisis.

(Refer Slide Time: 40:35)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
Module 3: Monitoring & managing habitats
Module 4: Management of wildlife diseases
Module 5: Capturing and restraining wild animals
Module 6: Conservation genetics
Module 7: Ex-situ conservation
Module 8: Management of changes

Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sariska case-study
Revision - I
Revision - II
Revision - III

Sariska: Learnings I

- 1 Need for protection: Poachers can strike anywhere, so protection is needed at all times.
- 2 Mere filling of positions is not enough: Sariska had only four vacancies but the aged staff could not do effective patrolling.
- 3 Rationalisation of funding: Sariska had one of the largest funding in the country, but its effectiveness in protecting tigers was low. Need for performance auditing.
- 4 Need to revamp methodologies: The pugmark method had been shown to be unreliable by the scientific community, but was still being used by Project Tiger. Hence a need for constant upgradation of techniques.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

So, we look at turning points and the learning's. There is a huge need for protection of the areas. Poachers can strike anywhere and at all times then mere filling of positions is not enough you need more active staff, you need more trained stuff, there is a need for rationalization of funding. And there was a need for remapping of a methodologies. So, pugmark method has now been replaced completely by the camera trapping method. And then need for keeping channels of communication open.

(Refer Slide Time: 41:06)

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Impacts of climate change
Plastics and biodiversity
Oil spills
Crisis and learnings: The Sariska case-study
Revision - I
Revision - II
Revision - III

Sariska: Learnings II

- 1 Need for keeping channels of communication open: The letter from the director to CWLW and from CWLW to Project Tiger were largely ignored, when they shouldn't have been.
- 2 Need to re-analyse status quo: The poaching of tigers had not been recognised since ages since the park officials were determined to maintain the status quo figure of 25-26 tigers. This was only re-analysed when the figures showed a sudden drop, when the analysis could have been made much earlier.
- 3 Need for honest reporting of figures.
- 4 Need to involve tourists, etc. in monitoring: Non-sighting of tigers by tourists should itself had rung an alarm bell.

Dr. Ankur Awadhiya, IFS Wildlife Conservation

So, in this case the project tiger was replaced by the national tiger conservation authority. And so that is now providing much better channels of communication. Then need to reanalyze status quo need for honest reporting of numbers need to involve tourist. So, essentially conservation is not something that only the forest department is doing, or should be doing. Conservation is something that needs to be done by the society at large. So, you can you can and you should ask for information from the tourist, from the students, from the researchers, everyone. So, everyone should be able to give us these suggestions.

(Refer Slide Time: 41:38)

Module 1: Introduction, Importance, Threats
Module 2: Monitoring wild animals
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Module 6: Conservation genetics
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Module 8: Management of changes

Impacts of climate change
Plants and biodiversity
Diversity
Crisis and learnings: The Sariska case-study
Review - I
Review - II
Review - III

Sariska: Learnings III

- 1. Need for "research" to be directed to field-level problems, not just towards scientific papers: The scientific community could have been much more forthright in pointing out the problems than they did.
- 2. Need for rapid settlement of rights: The rights of the locals had not been settled, due to which they continued to stay in the reserve area. And the imposition of do's and don'ts meant that they had a heavy antagonism against tigers, so much so that they even connived with the poachers. Settlement of rights and relocation of people should be done on a priority basis.

Dr. Ankur Awasthiya, IFS Wildlife Conservation

Then there is a need of research to be directed to field level problems. Need for rapid settlement of rights.

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The slide is titled 'Sariska: Learnings IV'. It features a list of three numbered points:

- 11 Need for intelligence: The intelligence agencies, especially the forest, police and DIC should be revamped. They were unable to detect the presence of poachers in their areas.
- 12 Need for rationalisation of policies: The absence of immunity provisions meant that the forest staff was unable to use their weapons. These policies need to be rationalised soon.
- 13 Need for control over habitat degrading activities: The heavy presence of mining and grazing pressure degraded the habitat to such an extent that tigers did not breed properly. This was also responsible for their decimation since their removal through poaching could not be matched by increase in numbers through births.

At the top left, a table of contents lists modules 1 through 8. At the top right, it lists 'Impacts of climate change', 'Plastics and biodiversity', 'Oil spills', and 'Crisis and learnings: The Sariska case-study' with revision counts. The footer identifies 'Dr. Ankur Awadhiya, IFS' and 'Wildlife Conservation'.

More intelligence, more rationalization of policies, then provisioning of immunity to the forest guards, need of control over habitat degrading activities and need to improve the habitat productivity and corridor connectivity.

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The slide is titled 'Sariska: Learnings V'. It features a single numbered point:

- 14 Need to improve habitat productivity and corridor connectivity.

The layout is identical to the previous slide, with the same table of contents and revision counts at the top and the same footer information.

So, a number of these recommendations have now been put in place not only for Sariska, but all over the country, so that is all for today.

Thank you for your attention good luck for the examinations, do well be in touch [FL].