Core Case Study: Southern Sea Otters: Are they back from the brink of extinction?

Why did the sea otters become nearly extinct by the early 1900s?

They were hunted for their fur and their food source (shellfish) was also used heavily by humans.

How has their population been able to recover since the 1930s?

The US Fish and Wildlife Services declared the Southern Sea Otters an endangered species and was therefore protected by the Endangered Species Act.

Why should we care about sea otters?

1. *They generate millions of dollars in tourism.*

2. *Some believe it is unethical to allow a species to prematurely go extinct.*

3. *They are a keystone species that play an important ecological role in the ecosystem because of their interactions with other species. They also control populations of sea urchins and other kelp eating species.*

How Do Species Interact?

Species Interact in 5 Major Ways:

Interaction	Definition	Example
1. *Inter*specific Competition *Intra*specific Competition	*-competition for resources between DIFFERENT species* *-competition for resources between members of the SAME species*	
2. Predation	*-when members of one species (the predator) feeds directly on another species (the prey)*	
3. Parasitism	*-when one organism (the parasite) feeds on the body of, or the energy used by, another species (the host), usually by living on or in the host* *-one benefits, the other is harmed*	
4. Mutualism	*-an interaction that benefits both species by providing each with food, shelter, or some other resource*	
5. Commensalism	*-an interaction that benefits one species but has little, if any, effect on the other*	

The most common interaction between species is *competition* for *limited resources.*

Explain the Competitive Exclusion Principle.

No two species can occupy the same niche. Otherwise competition will occur and there will be a "winner and a loser."

Predators may capture prey by:
1. Walking-
2. Swimming
3. Flying
4. Pursuit and *Ambush*
5. Camouflage
6. *Chemical* Warfare- *use venom to paralyze prey*

Prey may avoid capture by:
1. Camouflage
2. Chemical Warfare- *discourage predators with chemicals that are Poisonous, irritating, foul smelling, or bad tasting.*
3. Warning Coloration- "Eating me may be risky!"
4. Mimicry- *evolve to look like a poisonous species*
   The nonpoisonous viceroy looks and acts like the poisonous monarch
5. Deceptive Looks- *body markings that make the prey look bigger or scarier than they actually are*
6. Deceptive Behavior- *scare off predators by puffing up, spreading wings, or living in large groups*

(b) Wandering leaf insect

Why are predators so important?

Predators control population sizes of prey and play a role in the evolution of that species.
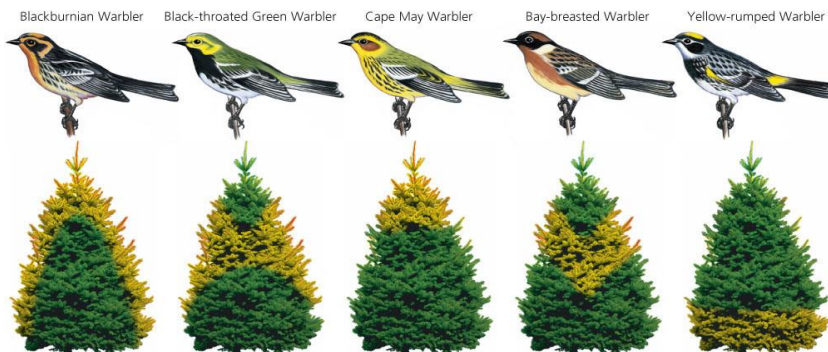
Describe an example of coevolution.

Bats and Moths: Bats hunt at night using echolocation. As a countermeasure, certain moths have evolved ears that are sensitive to this frequency, thus allowing them to try to escape.

How Can Natural Selection Reduce Competition between Species?

Explain how the different types of warblers represent resource partitioning.

Each species of warbler must live in different parts of the tree in order to overlap niches.

Blackburnian Warbler   Black-throated Green Warbler   Cape May Warbler   Bay-breasted Warbler   Yellow-rumped Warbler

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Why is it important that species 1 and 2 evolved, as shown in the graph below?
They evolve in a way that their niches no longer overlap, thus reducing competition.
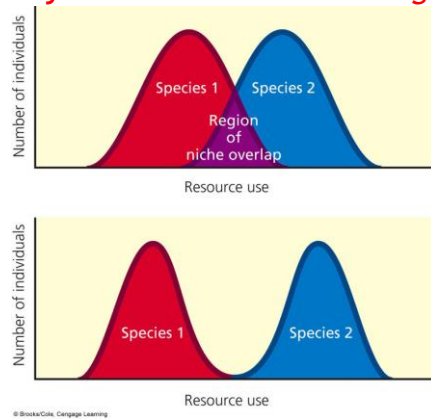
What Limits the Growth of Populations?
Population dynamics is the study of *how the distribution, numbers, age structures, and density change in a population in response to changes in environmental conditions*.

Populations are distributed usually in 3 general patterns:
1. *Clumped*

Why would populations want to clump together?
Species cluster around resources, clumped populations have a better chance at finding scattered resources, living in groups protects some from predators, hunting in packs give some a better chance of catching prey, and some species form groups for mating and caring for the young.

2. *Uniform*

3. *Random*

Four variables that govern changes in population size
1. *Births*
2. *Deaths*
3. *Immigration*
4. *Emigration*

Population change= *(Births+Immigration) - (Deaths+ Emigration)*

Age Structure- *proportion of individuals at various age groups*	
1. Pre-reproductive stage-	*Not mature enough to reproduce*
2. Reproductive stage-	*Capable of reproduction*
3. Post-reproductive stage-	*Too old to reproduce*

The size of a population will increase if is made of individuals that are mostly in their *reproductive stage or soon to be in the reproductive stage.*

Growth pattern terms to know:

1. Biotic Potential-	*Capacity for population growth under ideal conditions*
2. Intrinsic Rate of Increase (r)-	*Rate at which a population would grow if it had unlimited resources* *-populations with a high intrinsic rate of growth typically reproduce early in life, have short generation times, can reproduce many times, and have many offspring*
3. Environmental Resistance-	*Combination of all factors that limit the growth of a population*
4. Carrying Capacity (K)-	*The maximum population size based on the habitat and number of resources*
5. Logistic Growth-	*Involves rapid exponential growth followed by a steady decrease until the population levels off* *S-curve*

r-selected species   vs.   K-selected species

-many, usually small offspring   *-reproduce later in life*
-little to no parental care   *-have a small number of offspring*
-population overcomes   *-longer life spans*
 environmental changes quickly   *-provides parental care*
-opportunists- reproduce and   *-population typically follows a logistic curve*
 disperse rapidly
-can exhibit "boom and bust"
 growth cycles
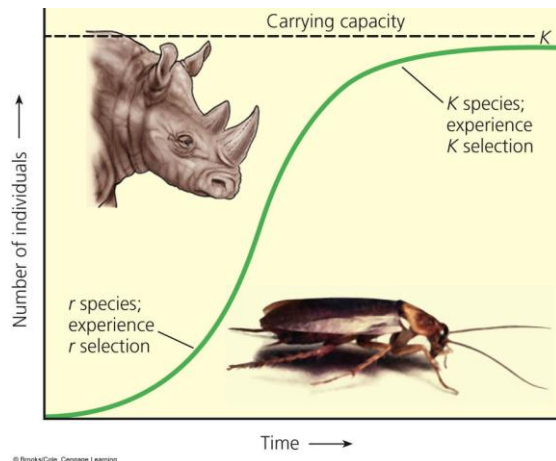
Locate the following on the graph:
1. Carrying Capacity
2. K-selected species
3. R-selected species

Explain why the cockroach is *r* selected.
-short life span, high biotic
potential, many offspring

Explain why the rhino is *K* selected.
-longer life span, fewer offspring,
provides some parental care

Factors that play a role in the loss of genetic diversity and the survival of small, isolated populations:
1. Founder Effect- *when a few individuals colonize in a new habitat that is geographically isolated; genetic variability may threaten the survival*

2. Demographic Bottleneck- *occurs when only a few individuals survive a disaster*
   Lack of genetic diversity limits the population size

3. Genetic Drift- *involves random changes in the gene frequencies that can lead to unequal reproductive success*

4. Inbreeding- *occurs when individuals of a small population mate with one another*

Population Density- *number of individuals in a population found in a particular area*	
Density-dependent population controls:	*Factors that limit population growth that are based on a population's size* *Ex: parasitism, infectious disease, competition*
Density-independent population controls:	*Factors that limit population growth that are not based on population size* *Ex: natural disasters, fire, habitat destruction*

Four Patterns of Variation in Population Size:

1. Stable-	*Population size fluctuates slightly above and below carrying capacity*
2. Irruptive-	*Populations explode to a high peak then crash to a more stable lower level*
3. Cyclic (Boom and Bust Cycles)-	*Cyclic fluctuations in population size*
4. Irregular-	*Changes in population size with no recurring pattern*

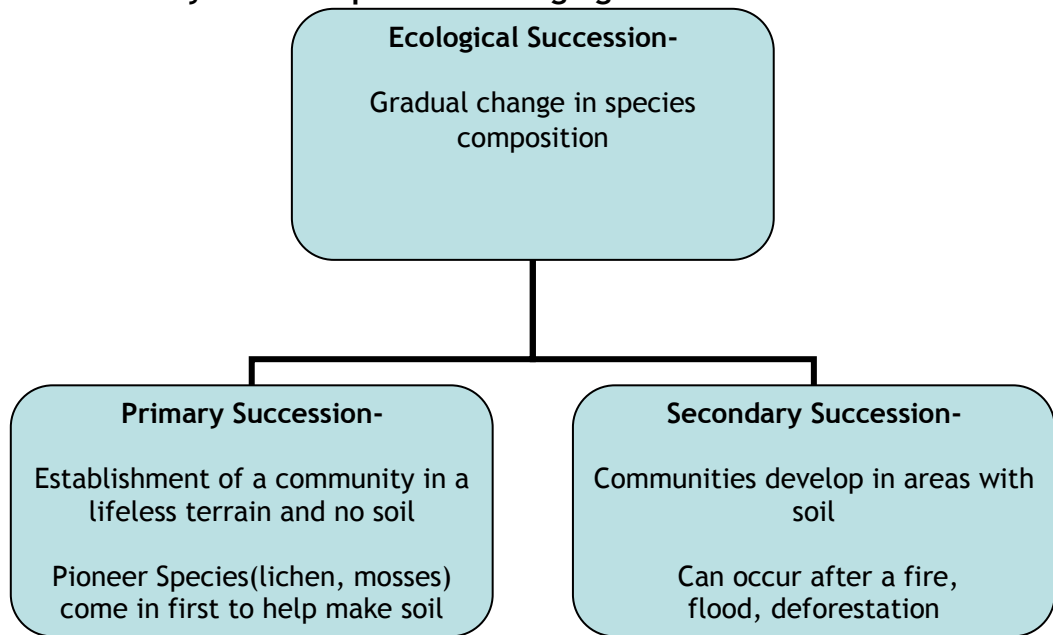Explain the population cycles for the snowshoe hare and Canada lynx using the graph below.

Top-down population control
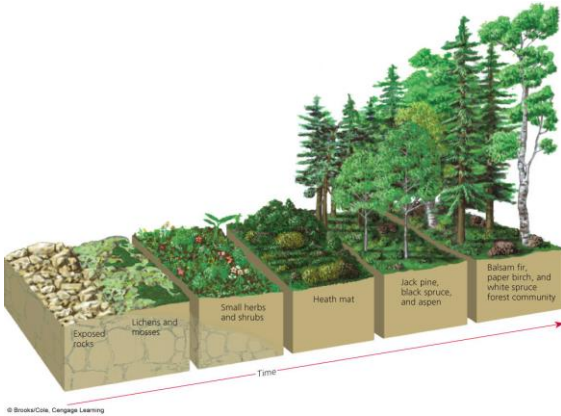*Changes in food availability*
Predatory/Prey interactions
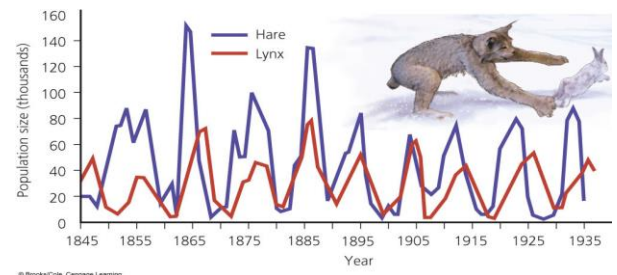
Describe 2 examples from history that have controlled human populations.

1. *Bubonic Plague*

2. *AIDS*

How Do Communities and Ecosystems Respond to Changing Environmental Conditions?

Ecological Succession-

Gradual change in species composition

Primary Succession-

Establishment of a community in a lifeless terrain and no soil

Pioneer Species(lichen, mosses) come in first to help make soil

Secondary Succession-

Communities develop in areas with soil

Can occur after a fire, flood, deforestation

Label the following diagrams of succession as primary or secondary AND explain why.

PRIMARY SUCCESSION- begins with rock
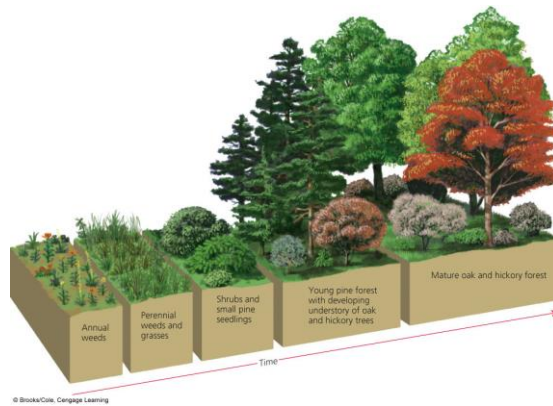
SECONDARY SUCCESSION- begins with soil/grass

What is a climax community?
Dominated by a few long-lived plant species and is in balance with its environment

Core Case Study: Are There Too Many of Us?

The world population is currently around *7 billion* people!

The world population in 2050 is projected to be *9.3 billion*.

Describe the 2 views on the question "Can the Earth support that many people?"

1. *"The planet already has too many people that are collectively degrading the Earth's natural capital. There are too many people in developing countries and the per capita resource consumption in developed countries is too high."*

2. *"Technological advances will allow us to overcome the environmental resistance and will increase the Earth's carrying capacity.*

Two serious consequences if birth rates aren't lowered:

1. *Death rates may increase because of declining health and environmental conditions.*

2. *Resource use and environmental degradation may intensify as more consumers increase their already large ecological footprints. This could increase environmental stresses such as disease, biodiversity loss, water shortages, traffic congestion, pollution of the oceans, and climate change.*

How Many People Can the Earth Support?

In the last 200 years, the human population has experienced *exponential* growth.

Three factors that account for this increase:

1. *Humans developed the ability to expand in to diverse new habitats and different climate zones.*

2. *The emergence of early and modern agriculture allowed more people to be fed for each unit of land area farmed.*

3. *The development of sanitation systems, antibiotics, and vaccines helped control infectious disease agents.*

What are the effects of altering nature to meet our needs?

-reduction in biodiversity
-increasing use of the Earth's NPP
-increasing genetic resistance of pest species and disease causing bacteria
-elimination of many natural predators
-introduction of invasive species
-interfering with earth's chemical cycling and energy flow process

Why is it a problem that most of the world's population growth is taking place in developing countries?

Most of the world's growth is taking place in already overcrowded developing countries that are least equipped to deal with the pressures of rapid growth.

What is cultural carrying capacity?

the optimum level that would allow most people to live in reasonable comfort and freedom without impairing the ability of the planet to sustain future generations.

What Factors Influence the Size of the Human Population?

What three factors lead to population growth/change?

1. *births*

2. *deaths (mortality)*

3. *migration*

What is the equation for population change (growth rate)?

POPULATION CHANGE = *(births+immigration) - (deaths+emigration)*

Crude birth rate: *# of births per 1,000*

Crude death rate: *# of deaths per 1,000*

List the world's 10 most populous countries (give 2008 population for top 5)

1. *China (1.3 billion)*

2. *India (1.1 billion)*

3. *US (300 million)*

4. *Indonesia (240 million)*

5. *Pakistan (173 million)*

6. *Brazil*

7. *Nigeria*

8. *Bangladesh*

9. *Russia*

10. *Japan*

Replacement Level Fertility- *average # of children a couple must have to replace themselves*

Total Fertility Rate- *average # of children born to a woman in a population during her reproductive years*

List the ten factors that affect TFR and how they change it:

| FACTOR	WHAT HAPPENS TO TFR?
1. *Importance of children as part of the labor force*	*TFR increases if children are an important part of the work force.*
2. *Cost of raising and educating children*	*TFR decreases in developed countries where it is more expensive to raise a child.*
3. *Availability of private and public pension systems (retirement)*	*TFR increases when retirement systems are not in place because children will be needed to care for the elderly.*
4. *Urbanization*	*TFR decreases in urban areas (better jobs, birth control, etc)*

5. *Education and employment opportunities available for women*	*TFR decreases when women have access to education and jobs outside the home.*
6. *Average age of marriage*	*TFR decreases when a woman has her first child after the age of 25.*
7. *Availability of legal abortions*	*TFR decreases when abortions are legally available.*
8. *Availability of reliable birth control*	*TFR decreases when women can better choose when they want to have children.*
9. *Religious beliefs, traditions, and cultural norms*	*TFR increases when religion or culture demands large families.*
10. *Infant Mortality Rate (IMR)- # of kids per 1,000 that die before their 1st birthday*	*TFR decreases when IMR is low. A high IMR usually indicates poor nutrition and high incidence of infectious diseases.*

Two useful indicators of overall health of a country or region:

1. Life Expectancy- *average # of years a newborn can expect to live*
2. Infant Mortality Rate- *# of kids per 1,000 that die before their 1st birthday*

Why are people living longer?

- *Increased food supply and distribution*
- *Better nutrition*
- *Medical advances like vaccines and antibiotics*
- *Safer water supplies*
- *Better sanitation*
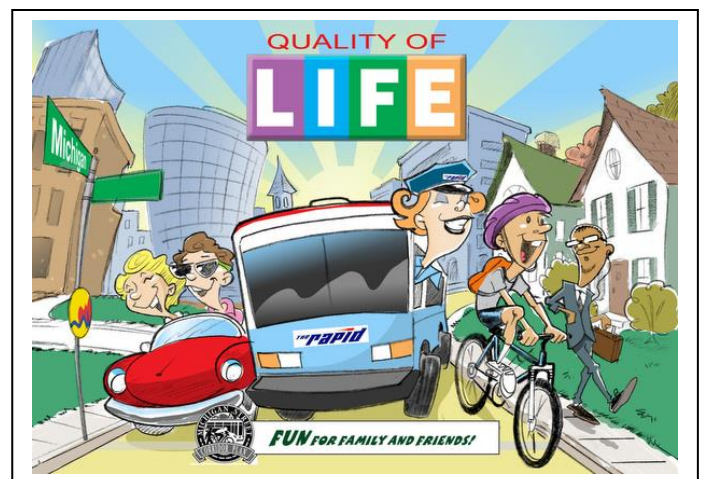
Why is IMR in the US still so high?

- *Inadequate health care for poor women before and after birth*
- *Drug addictions among pregnant women*
- *High birth rate among teenagers*

Why Do People Migrate?

- *Seek jobs and economic improvement*
- *Religious persecution, ethnic conflicts, political oppression*
- *Environmental degradation*

How Does the Population's Age Structure Affect Its Growth or Decline?

Age Structure Categories:

Pre-reproductive	*Age 0-14*
Reproductive	*Age 15-44*
Post-reproductive	*Age 45 and older*

How can age-structure information be used to make population and economic projections?

Examples:

A large pre-reproductive group will signify a future increase in population size.

A large post reproductive group will signify a larger need for retirement resources.

Ex: baby boomers

Label each of the pyramids as: expanding slowly, stable, expanding rapidly, and declining

Expanding Rapidly   Expanding Slowly   Stable   Declining

Prereproductive ages 0–14   Reproductive ages 15–44   Postreproductive ages 45–85+

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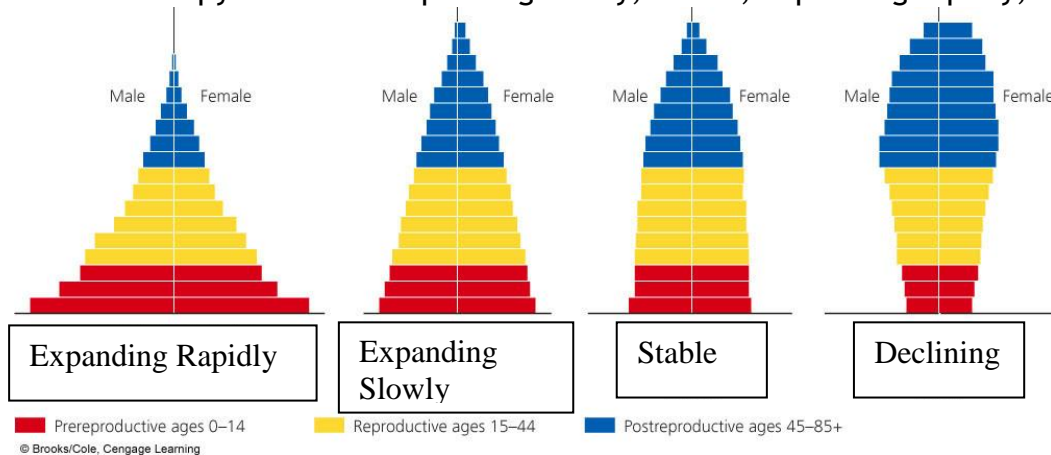
Name 3 problems that can occur when populations rapidly decline.

1. *Can threaten economic growth*
2. *Labor shortages*
3. *Can reduce government revenues with fewer workers*

How Can We Slow Human Population Growth?

Demographic Transition: *shows the stages of population growth; as countries become more industrialized, first their death rates and then their birth rates decline*
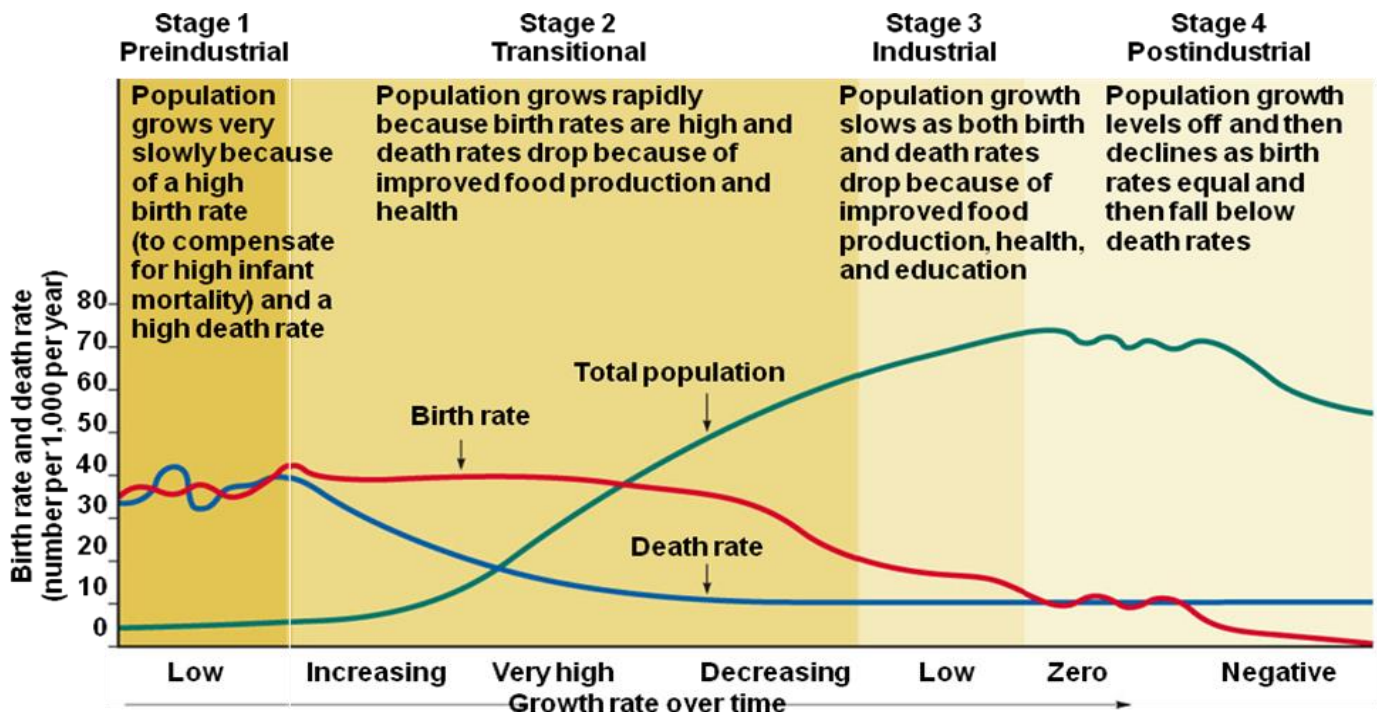
What does family planning involve and how can it reduce population growth?

Family Planning- *education and clinical services to help a couple choose how many children to have and when to have them*

-major factor in reducing the # of births throughout the world
-has reduced the # of legal and illegal abortions
-responsible for a 55% drop in TFR in developing countries

How does empowering women reduce population growth?

Women tend to have fewer children if they are educated, hold a paying job outside the home, and live in societies where their human rights are not oppressed.

Case Study: What is China's One Child Policy?

Goal- *bring population growth under control and encourage economic growth*
*Discourages premarital sex and urges people to delay having kids.
*Married couples who pledge to have only 1 child receive more food, larger pensions, better housing, free school tuition, and preferential employment.

Results-
TFR has decreased from *5.7 to 1.6*
350 million+ people have moved from *extreme poverty to middle class*

Negative Effects-
Since there is a strong preference for a male child, there have been many abandoned or murdered baby girls. Some of the girls are sold.
There have also been reports of forced abortions and other coercive actions.

Core Case Study: The Passenger Pigeon: Gone Forever
   Describe in detail the 2 main reasons why passenger pigeons were once the most numerous bird species, but are now extinct.
      1. *Uncontrolled commercial hunting- they tasted delicious, their feathers made good pillows, and their bones were used as fertilizers*
            -they were easy to kill because they traveled in large flocks
      2. *Habitat loss as forests were cleared to make room for farms and cities*

What Role Do Humans Play in the Premature Extinction of Species?
   During the last 3.65 billion years that life has existed on Earth, there has been a continuous, low level of extinction called *background extinction*.

   Extinction Rate is expressed as *a percentage or # of species that go extinct*.

   Define: Mass Extinction- *extinction of many animals in a short amount of time*

   How many mass extinctions has the Earth gone through?
      5
   What are some of the possible causes of these past mass extinctions?
      The causes are poorly understood, but most likely due to global changes in environmental conditions. (like asteroids)

Local Extinction-	Ecological Extinction-	Biological Extinction-
When a species is no longer found in an area it once inhabited but can still be found elsewhere	*When so few members of a population are left that it can no longer play its ecological role in the community*	*No longer found anywhere in the world*

   Conservation biologists project that extinction rate will increase to *10,000* times the normal background extinction rate due to *habitat loss, climate change, and other human activities*. This equates to an annual extinction of about *1%* per year.

   Extinction experts consider extinction rates of 0.01%-1% to be conservative because:
      1. *Rates of extinction and biodiversity loss will likely increase due to an increasing size of the human population.*

      2. *Current and projected extinction rates are higher than the global average in parts of the world that are highly endangered centers of biodiversity (hotspots).*

      3. *We are eliminating, degrading, fragmenting, and simplifying many biologically diverse environments such as the tropical forests, reefs, wetlands, and estuaries.*

Endangered Species	
Definition:	Examples:
So few individual survivors that the species could soon become extinct over all or most of its natural range	*Giant Panda, Siberian Tiger, Whooping Crane, California Condor, Bluefin Tuna*

Threatened Species	
Definition:	Examples:
Still abundant in its natural range but, because of declining numbers, it is likely to become endangered in the near future	*Polar Bear, African Elephant, Great White Shark*

The International Union for the Conservation of Nature and Natural Resources has put out a *Red* Lists which lists the world's *threatened* species.

Describe what makes some species particularly vulnerable to ecological and biological extinction:

Characteristic:	Example:
-Low Reproductive Rate (k-strategist) *-Specialized Niche* *-Feeds at High Trophic Levels* *-Commercially Valuable*	*-Blue Whale* *-Giant Panda* *-Grizzly Bear* *-Rhinoceros*

Why Should We Care About Preventing Premature Species Extinction?

We should care about preventing premature species extinction because:

1. Instrumental Value- *usefulness to us in providing many ecological and economic services*

2. Ecotourism- *species diversity that provides economic benefit from wildlife tourism*

3. Genetic Information- *allows species to adapt to changing environmental conditions through evolution*

4. Existence Value- *satisfaction of knowing that the biodiversity exists*

5. Aesthetic Value- *appreciation for the beauty*

How Do Humans Accelerate Species Extinction?

Most important causes of premature extinction:

H	*Habitat Loss*
I	*Invasive Species*
P	*Population Growth*
P	*Pollution*
C	*Climate Change*
O	*Overexploitation*

Why are temperate areas more likely to be affected by habitat loss and degradation?
Because of widespread economic development in temperate countries

Define: Endemic Species- *found in only 1 area of the world*

Why are they so vulnerable to extinction? *Habitat loss in that area will wipe out the entire population*

What creates Habitat Islands? *Any habitat that is surrounded by a different one is a habitat island. National Parks are often considered habitat islands because the protected areacan be encircled by industrial activities.*

Define: Habitat Fragmentation- *caused by roads, logging, agriculture, and urban development and occurs when a large area of land is reduced and divided into smaller patches*
-decreases tree populations
-pushes populations into smaller areas that can increase disease, competition, etc
-block migration routes

Case Study: A Disturbing Message from the Birds
Worldwide, *70%* of birds are declining.

Major reasons are: *habitat loss* and fragmentation of breeding habitats, introduction of *invasive species*, and illegal trapping for *pet trade*.

For seabirds, an issue is being caught in *baited lines from fishing boats*, for migratory birds, flying into power lines, towers and *wind turbines*.

Birds are important ecologically because they: control *populations of rodents and insects*, remove *dead animal carcasses*, and spread *seeds of plants*.

Birds are also environmental *indicators* because *they live in every climate and biome, respond quickly to environmental changes, and are relatively easy to track and count.*

POSITIVE EFFECTS OF ENVIRONMENTAL DESTRUCTION

HEY, MY ALLERGIES ARE GONE!

SINGER
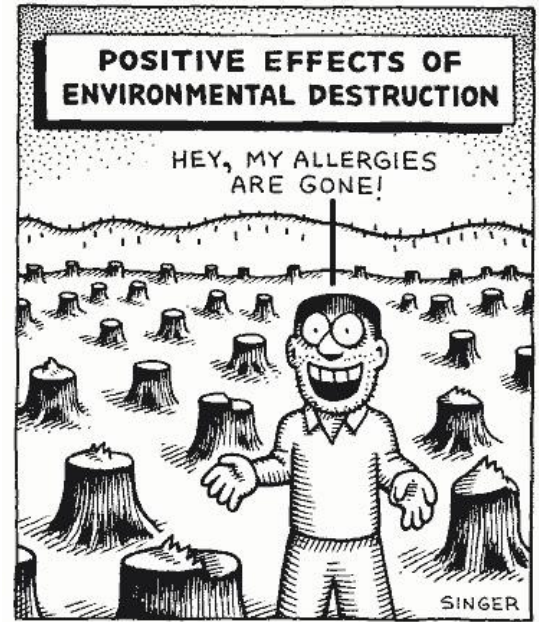
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After habitat loss and degradation, introduction of *invasive* species is the biggest cause of premature animal and plant extinction.

What is the Kudzu vine and what problems is it causing?
   -deliberately introduced in the 1930s from Japan to help control soil erosion
   -quickly engulfs and suffocates gardens, trees, etc and is difficult to kill

Describe how the fire ant got to the southeast US. What problems are they causing?
   The Argentina Fire Ant was accidentally introduced in Alabama because the shipment of lumber was infested with these ants.
      These ants have no natural predators and spread rapidly killing off native ant species and have caused thousands in economic damage to crops.

| Characteristics of Successful Invader Species:	Characteristics of Ecosystems Vulnerable to Invader Species:
High Reproductive Rate (r-selected)	*Climate Similar To Habitat of Invader*
Pioneer Species	*Absences of Predators*
Long Lived	Early successional systems
High dispersal rate	Low diversity of native species
Generalist	*Absences of Fire*
High genetic variability	*Disturbed by Human Activity*

List 2 ways of controlling invasive species:
   1. *Don't capture or buy wild animals*

   2. *Don't dump contents of an aquarium into waterways, wetlands, or storm drains*

      Pesticide Pollution Problems:
Define BIOACCUMULATION: *accumulation of chemicals (like DDT and methyl mercury) in the fat cells of animals*
Define BIOMAGNIFICATION: *the concentration of chemicals is at the highest concentration at the top of the food chain*

The Bioaccumulation of Methylmercury

Biomagnification of Methylmercury in the Ecosystem

Methylmercury Bioaccumulation in Organisms
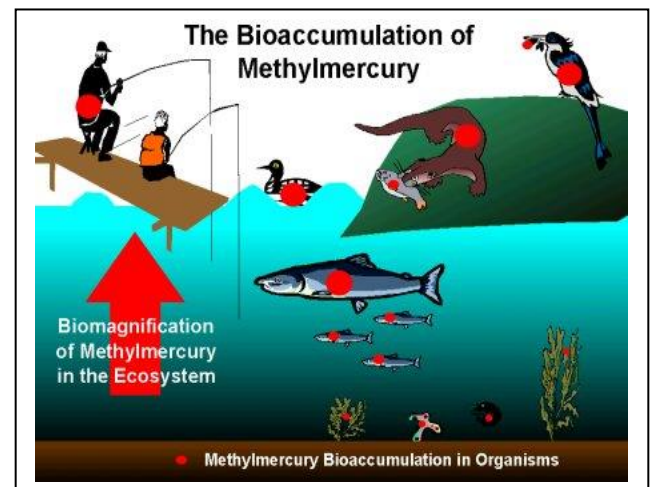
Two Alarming Disappearances:
Honeybees are responsible for 80% of pollination in insect-pollinated plants, but are dying due to *pesticide use*, parasites, fungi, invasion, and bee colony collapse syndrome.
Polar bears are suffering because of less *floating sea ice*, and pollutants like *PCBs* & DDT.

Poaching is the illegal killing, capturing, and selling of wild species.
-rapidly growing wildlife smuggling is a high profit, low risk business
-smugglers are rarely caught or punished
Illegal pet trade:
-exotic animals carry dangerous infectious *diseases*

What is bush meat and why is it causing such problems in Africa?
Bush meat= meat from a gorilla
Hunting and killing has rapidly increased in Africa due to an increasing population and reduced food from fishing
*The increased hunting has led to local extinction and threatens other species within the food chain.*
Who is Jane Goodall?
She works to protect Chimpanzees and their habitats by educating people around the world.

How Can We Protect Wild Species From Extinction Resulting From Our Activities?

Law or Treaty:	Description:	
Convention on International Trade in Endangered Species (CITES)	*-internationally bans hunting, capturing, and selling threatened* or endangered species *-lists over 900 species that can't be commercially traded* *-however, enforcement varies by country*	
US Endangered Species Act	*-designed to identify and protect endangered species in the US* *-forbids federally funded projects that would damage the habitat of endangered or threatened species* *-illegal for Americans to buy or sell products made from endangered or threatened species* *-close inspection of animals entering the US* *-private land owners are given financial incentives to help protect endangered species on their land*	
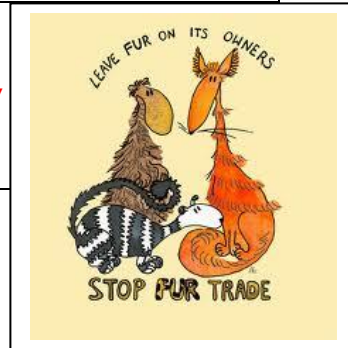
Solutions:
1. *Wildlife Refuges*- serve as sanctuaries for animals and birds
   o Ex: Pelican Island- established as a refuge for birds by President Roosevelt
2. *Seed Banks*- preserve genetic information and endangered plant species by storing their seeds around the world- expensive though
3. *Botanical Gardens*
4. *Zoos, Aquariums, Game Parks*
5. *Captive Breeding* and then release into the wild to build up populations

California Condor- nearly extinct from lead poisoning from ammunition
-in order to save the species, the birds were captured to breed in captivity

6. Define: THE PRECAUTIONARY PRINCIPLE- *precaution should be taken if there is preliminary evidence that indicates a human activity causes harm to health or the environment*