1 Driving Species to Extinction

2 Animal Habitats

- Since the beginning of agriculture, human activities have made major changes in the world's ecosystems.
- Most human interventions have reduced the habitats of wild animals and plants.
  - Creation of fields for planting and pastures for grazing.
  - Clearance of forests.
  - Draining of marshes.
  - Hunting for food, furs, sport.
  - Introduction of new plants and animals into ecosystems have had unexpected effects.
  - Pace of destruction increasing since the expansion of Europe after 1500.

3 Pre-Renaissance Extinctions

- Egypt:
  - Extension of cultivated area, draining of marshland, and organized hunting.
  - By time of the Old Kingdom (2950-2350 BCE) elephants, rhinoceroses, and giraffes had disappeared from the Nile Valley.

4 Pre-Renaissance Extinctions, 2

- Greece:
  - By 200 BCE the lion and leopard were extinct on the Greek mainland and in the colonies in Asia Minor.
  - Wolves and jackals were confined to remote mountainous areas.
  - Trapping of beavers made them extinct in northern Greece.

5 Pre-Renaissance Extinctions, 3

- Roman Empire: Slaughter of animals for spectacle continued for hundreds of years.
  - E.g., 9,000 captured animals were killed during the 100 day celebration of the Coliseum in Rome.
  - E.g., 11,000 slain to mark Trajan's conquest of province of Dacia.

6 Pre-Renaissance Extinctions, 4

- Medieval Europe:
- Expansion of settled areas reduced the habitats of plants and animals.
- The European bison was common in early Middle Ages, but very rare by the 18th century.

7 Pre-Renaissance Extinctions, 5

- The great auk, a flightless seabird, was once found in huge colonies along the coasts of Scotland and Iceland.
  - In 1540, 2 ships were filled with freshly killed auks in 30 minutes.
  - The eggs were also eaten by sailors. The auks laid only one egg per year.
  - By the 18th century the auk was rare. The last pair were killed in Iceland in 1844.

8 Near Extinctions and Devastations

- Wild animals common across all of Europe that were driven to extinction in large areas of the continent.
- Wolves – common throughout Europe until 500 years ago.
  - In 15th century wolf packs were on the streets of Paris in daylight.
  - In Britain, full-scale wolf hunts were held in Scotland in the 16th century.

- Now extinct in all of Britain.
- Brown Bear – common in medieval western Europe. Now survives only in remote mountainous areas.
- Beaver – trapped for its fur until driven to extinction across Europe.

9 Rid the world of pests

- Some of the loss of species diversity was a side-effect of agriculture or of hunting. But others were intentional.
- Citations:
  - Rev. Edmund Hickeringill, 17th century English clergyman:
    - "So noisome and offensive are some animals to human kind, that it concerns all mankind to get quit of the annoyance, with as speedy a riddance and dispatch as may be, by any lawful means."
  - John Worlidge, from his *Systema Agriculturae*, 1668:
    - "February: pick up all the snails you can find, and destroy frogs and their spawn
    - April: gather up worms and snails
    - June: destroy ants
    - July: kill…wasps and flies."

10 Rid the world of pests, 2

- In 1533 the English Parliament passed an act requiring all parishes to have nets to catch rooks, choughs and crows.
- In 1566 churchwardens were authorized to pay for corpses of foxes, polecats, weasels, stoats, otters, hedgehogs, rats, mice, moles, hawks, buzzards, ospreys, jays, ravens, and kingfishers.
- In 1732 in an authorized organized hunt, 5,480 moles were destroyed.
- In 1774, 14,000 sparrows were killed and 3,500 eggs destroyed.
  - Such policies continued in Britain into the 20th century.

11 European Amazement at the Diversity of Life Elsewhere

- By the time that Europeans began exploring the rest of the world, they had so devastated their own continent that they could hardly believe how abundant life was everywhere else.
- Citations:
  - French explorer Pierre Radisson, reaching Lake Superior in 1658:
    - There were "stores of fishes, sturgeons of vast bigness, and pikes seven feet long. A month's subsistence for a regiment could have been taken in a few hours."

12 More Citations

- **An early settler in Florida:**
  - "Quantities of wild pigeons, parrots and other birds were so numerous that boatloads of birds' eggs were taken."
- **Woods Rogers, an English sailor landing off the coast of Chile in 1709:**
  - The seals and sea lions were "so thick on the shore that we are forced to drive them away before we could land being so numerous that it is scarce credible to those who have not seen them."

13 More Citations, 2

- **Captain Cook, arriving in Australia at the end of the 18th century:**
  - Found that the sea was so full of fish that they broke the fishing nets. Flocks of thousands of birds could easily be shot since they had no fear of humans.
- **Captain Thomas Melville, sailing into Sydney harbour:**
  - Seeing a vast number of sperm whales: "We sailed through different shoals of them from 12 o'clock in the day till sunset, all round the horizon, as far as I could see from the mast head."

14 A Bonanza Waiting to be Taken

- The early settlers and explorers drew on the store of animals with no concern for the fate of any individual species and no worry that the supply would diminish.
- The drastic effects were soon apparent.

15 ☐ ## A Bonanza Waiting to be Taken, 2

- Islands that had isolated populations of, for example, flightless birds, that flourished because of the total lack of predators suffered rapid extinctions.
- 90% of bird extinctions have occurred on islands.

16 ☐ ## Native Australian Species Devastated

- Australia has been particularly badly affected since the start of European colonization.
- The duck-billed platypus was extinct by 1850.
- Of 31 native species found in the Murray-Darling basin in 1856, 22 are now extinct.

17 ☐ ## Australian Species Devastated, 2

- Red kangaroo Emu
- **Widespread kangaroo hunts nearly wiped them out.**
- **In 1850, a hunter reported in Victoria reported:**
- "Emus and kangaroos on our arrival were plentiful in all parts…also bustards in large flocks of…40 or perhaps more. The bustards now are scarce, and only met in distant places. The kangaroo and emu are nearly extinct in the district; the country is almost void of game.

18 ☐ ## Australian Species Devastated, 3

- Hare wallaby Bilby
- By the end of the 19th century, some of the rarer marsupials such as the hare-wallaby were already extinct. The last of the bilbies, the commonest form of native game, was shot in 1912.

19 ☐ ## Extinction in North America: The Bison

- The size of the herds was between 40-60 million animals.
- When the native peoples obtained horses and rifles, they began hunting the bison for food and hides, killing about 300,000 a year, well within their replacement rate.
- White settlers began to exploit the bison in the 1830s, killing about 3 million a year.
  - By the end of the 19th century, there were only about 20 animals left.

20 ☐ ## Extinction in North America: The Passenger Pigeon

- One of the first settlers in Virginia wrote:
  - "There are wild pigeons in winter beyond number or imagination, myself have seen three or four hours together flocks in the air, so thick that even have they shadowed the sky from us."
- An estimate of the total number in North America when Europeans arrived is 5 billion—about 1/3 of all the birds in North America then, and about the same as *all* of the birds in the U.S.A. today.

21 ☐ ## The Passenger Pigeon, 2

- A reason for the huge numbers was the lack of natural predators other than hawks and eagles.
- But they were vulnerable to humans.
  - Each female laid only one egg per year.
  - The birds nested in vast colonies and migrated in huge flocks, making them easy to hunt.
  - The natives captured the pigeons in large nets. Europeans adopted the same practice.
  - They were sought for both their feathers and their meat.

22 The Passenger Pigeon, 3

- In the mid 19th century large-scale commercial hunters and trappers began supplying the cities with a cheap source of meat.
- According to well documented records, on July 23, 1860, 235,200 birds were sent east from Grand Rapids, Michigan.
- In 1874, Oceana County in Michigan sent 1 million birds to markets in the east, and in 1876 it was selling 400,000 at the height of the season. In 1869, Van Buren County, Michigan, sent 7 ½ million birds east.
  - Numbers fell rapidly. By the late 1880s a "large" flock was only a few hundred strong.
  - The last known specimens were seen in the eastern U.S. in the 1890s. The last survivor died in captivity in 1914.

23 Introducing New Species to an Ecosystem

- European settlers took with them domesticated animals from their home countries.
  - And, accidentally, also took many of the pests from Europe.
- When the continents drifted apart millions of years ago, the flora and fauna began evolving in isolation from each other.
  - Now, after 1500, they were brought into contact.
  - There were virtually no animals suitable for domestication in the Americas or Australia, so European settlers brought their own
  - Many of these escaped, went wild, and spread rapidly.

24 Domesticated Animals Gone Wild

- **Pigs**
  - Introduced everywhere. In the wild, they multiplied rapidly.
  - Australia now has over 20 million wild pigs.

25 Animals Gone Wild, 2

- **Cattle**
  - First carried to the Americas by Columbus in 1493. Within 50 years they were found in huge herds in Florida, Mexico, and Peru.
  - By 1700 there were 50 million cattle on the pampas of South America.
  - In Australia, the wild herds can be traced to 8 animals that escaped from a domesticated herd in 1788.

26 Animals Gone Wild, 3

- **Sheep**
  - Taken to Mexico in the 1540s. Within 30 years there were immense, migrating wild herds 200,000 strong in a single area, and by 1614 there were 620,000 wild sheep around Santiago, Chile.
- In Australia and New Zealand there were no hoofed animals before the arrival of the settlers at the end of the 18th century.

27 Animals Gone Wild, 4

- Within 100 years there were 100 million sheep and 8 million cattle in Australia.
- In New Zealand, 9 million sheep within 30 years, and now 70 million sheep.

28 Animals Gone Wild, 5

- **Horses**
  - Taken to the Americas by Columbus in 1493 and soon became wild.
  - They migrated from Mexico to the Great Plains, were domesticated by the native people, bringing a fundamental change in their way of life.
  - White settlers moving across the Appalachians viewed the huge herds of horses as a pest and shot them in large numbers.
- **Camels**
  - Introduced into Australia as a pack animal in the 19th century. There are now more camels in Australia than in Arabia, and they are viewed as pests.

29 The Rabbit Disaster

- In 1859, a farmer in Victoria, Australia, established a few rabbits for game.
  - With no natural predators, they bred quickly and soon were devastating crops over a wide area.
  - By 1880 they reached New South Wales and were affecting sheep farming in South Australia.

30 The Rabbit Disaster, 2

- Large-scale eradication campaigns had little effect.
  - In the mid-1880s, 1.8 million rabbits were killed in Victoria and 7 million in New South Wales, without slowing up their spread.

31 Myxomatosis

- In the years 1902-1907 a 1000 mile long fence was built from the north to the south coast to exclude rabbits, but it was breached in the 1920s.
  - The rabbit population of Australia increased in less than a century from a handful to about 500 million in 1950.
- In desperation the Australian government deliberately introduced the disease *myxomatosis* from Brazil, which was fatal to rabbits.

32 Myxomatosis, 2

- Within a year the death rate among the rabbit population was 99.8%.
  - But the 0.2% of the population that was immune to the disease continued breeding.
  - In 7 years, the death rate from the disease was less than 25%.
- The rabbit population is growing again, rapidly. Now consisting primarily of animals immune to *myxomatosis*.

33 Myxomatosis, 3

34 Accidental Introduction of Pests

- Rats and mice traveling unnoticed on ships going to the New World caused havoc.
  - Early settlements in Jamestown, Virginia (1609) and Sydney, Australia (1790) were nearly wiped out when rats from the ships ate most of the stores of grain.
  - In the 1570s (50 years after the Spanish conquest), Peru was overrun with rats.
  - The same in Australia from mice escaping from ships visiting the colony. In one area of South Australia, 32 million mice were killed in 4 months in 1917.
- There were no natural predators for rats and mice in the New World. They therefore multiplied rapidly.

35 No Predators, an Abundance of Prey

- The starling was introduced from Europe into Central Park in New York as an ornamental bird in 1891.
- Some escaped. By 1926 there were flocks in Georgia, New England, and Kentucky. In another 30 years, they were across the U.S.A.
- The starlings took over the ecological niche of native birds, devastating the population of bluebirds and flickers.

36 Effect on Plant Life

- Grazing animals can destroy the natural ground cover.
  - Goats were introduced on the island of St. Helena in 1810. Now 22 of 33 native plants are extinct.
  - In the 1830s, Charles Darwin found the plains of Uruguay impenetrable because of growth of prickly cardoon, which had flourished after other edible plants were overgrazed by huge herds of wild cattle and horses.

37 The Prickly Pear

- British settlers introduced the prickly pear in Australia in 1839 to provide hedges
  - The plant quickly went wild and created barriers over 6 feet high.

38 The Prickly Pear, 2

- By 1925 over 60 million acres of land were affected. In half of this area no other plant could grow.
- The prickly pear was eventually brought under control by the importation of larvae from an Argentinean moth.

39 The Problem of the Commons

- How did it happen that some species were hunted to extinction while others were allowed to run wild until they became major pests?
- A concept due to American ecologist, William Ophuls:
  - In the case of animals hunted to extinction, no one owned the animals and therefore no one had an interest in controlling the rate of killing and assuring a sustained population.
  - Cost of exploitation was low. (A horse & rifle for bison, or a net for passenger pigeons.) Many hunters were drawn into the market.
  - The rational action for an individual hunter is to maximize the immediate kill before competitors got there.

40 Fishing

- Overfishing and dangerously depleting stocks is a constant and invariable feature of human civilization.
  - Only technological inability to fish to excess has prevented disasters in the past.
- Example from Europe:
  - Fishing in medieval Europe was an important part of the diet.
  - In the late Middle Ages stocks fell drastically.
  - By 1500 fishing for herring in the Baltic was at a halt.
  - In a few decades cod was depleted off the coast of Europe.

41 Mechanization and Factory Fishing

- Example: The Cod in Newfoundland
  - When European stocks were depleted, cod fishing was transferred to the Grand Banks of Newfoundland, where the fish could be scooped out of the sea with buckets.
  - The fish in the oceans seemed inexhaustible.
- Once highly mechanized fish factory ships became common after 1945, fish stocks reached serious levels of depletion everywhere.

42 The Fur Trade

- The original fur trade exploited European animals for European markets.
  - When supplies became exhausted, the search widened to other areas.
  - The history of the fur trade goes back to the Roman Empire when merchants obtained furs from the nomadic tribes in Russia.

43 The Fur Trade, 2

- Real growth took place in the Middle Ages, when furs became a status symbol.
  - In England there were many regulations to restrict wearing furs to the upper classes.
  - In 1337 Parliament reserved the wearing of furs to royalty and to nobility with incomes over £100 a year.

44 Many Pelts per Garment

- An intact pelt came from one trapped animal. It took many pelts to make an item of clothing.
  - Several hundred squirrel pelts for the lining of a cloak.
  - 1400 for an average sized bedspread.

- Henry VIII had a gown made from 350 sable pelts.
- Edward I bought 120,000 squirrel pelts every year (and many other animal pelts as well) between 1285 and 1288.
- Richard II bought 109,000 pelts a year in the early 1390s.
- In 1393 one ship left Novgorod for Flanders carrying 225,000 furs.

45 Depletion of Domestic Stocks

- By the end of the Middle Ages, the fur trade was a vital part of the economy of many European and Asian countries – over 1/3 of the income of Russia was from fur exports.
- But stocks were becoming exhausted almost everywhere in Europe and Asia.

46 The Canadian Fur Trade

- From the start of settlement in North America, the fur trade has been a driving force, especially in Canada.
  - French and British traders competed with each other. When stocks in one area were depleted, trappers would move on.
  - In the 1760s the Hudson's Bay Company was taking 100,000 beaver skins per year at a single trading post.

47 Sealing

- The market for seal skins was driven by the insatiable desire for pelts when the availability of fur-bearing animals had been depleted to the point of exhaustion everywhere.

48 Sealing, 2

- The animals were usually clubbed to death when they went on land to breed and were defenseless.

49 Sealing, 3

- Stocks were quickly depleted wherever sealing was started.
  - An area would be hunted to exhaustion and then abandoned for another, richer area.
- By the 1830s about 80,000 seals a year were killed in Newfoundland.
  - At the peak in the 1850s, the kills were 600,000 a year.

50 Sealing, 4

- Large steamships could process up to 20,000 seals a day.
- Sealing continues today, but at a much lower rate due to the greatly reduced stocks of animals, legislative protection, and a consumer boycott of furs and skins.

51 Whaling

- The most prolonged attack by humans on any single species.
  - A sperm whale can weigh 100 tons and measure over 100 feet long.
  - They have few predators apart from killer whales and humans.

52 Whaling, 2

- Whales are long lived – many survive into their 70s – but their reproduction rate is low, about 1 or 2% per year.
- Sustained killing of whales, especially if near their breeding grounds can easily drive a local population to extinction.

53 Whale Oil

54 Whale Oil, 2

- Whales were hunted more for their oil than for their meat.
- Candles were made from spermaceti of sperm whales.
  - London even had 5000 street lamps lit by whale oil in the 1740s.

55 Whaling History

- The general pattern of whaling is similar to that of sealing and the fur trade:
  - An area was exploited, with severe competition between different fleets and different whalers to maximize the immediate kill, until it was exhausted. Then the fleets moved to a different area and started again.

56 The Right Whale

- Until the 18th century, whalers concentrated on the *right* whale.
- Whales are divided into three categories: right whales, rorqual whales, and sperm whales.
  - Right whales are slow and easy to catch. (Hence they are the “right” whales.)
  - Right whales were chased in rowing boats with harpoons thrown from the boat.

57 Local Exterminations

- Whales were hunted to the point of extermination wherever they were sought.
  - In the Mediterranean, before the fall of the Roman Empire—to complete extermination.
  - From 900, in the Bay of Biscay along northern Spain.
  - To grounds off Newfoundland in the 16th century.
  - From 1600 to the island of Spitzbergen, a breeding ground for right whales. The population was depleted in 25 years.
  - Then on to Greenland, the Arctic, east North America, Labrador & Davis straits.

58 All Three Whale Types Decimated

- First the right whales were hunted to near extinction, then whalers turned to the sperm whales—less oil per whale, but a higher value end product.
  - By the end of the 19th century sperm whales were also near extinction.
  - The whaling industry was revitalized by the introduction of fast steamships and the explosive harpoon, which made it possible to hunt the rorqual whale.
  - By the end of the 20th century, all three whale types are near extinction.

59 The International Whaling Commission

- In 1946, the International Whaling Commission (IWC) was established to protect the dwindling stocks from extinction and to assure the long-term viability of the industry.
  - Quotas were set for each participating country, but they were so high that the population continued to fall. And not all whaling countries were members of the commission.
  - In 1982, the IWC declared a moratorium on commercial whaling.
  - But “scientific” whaling was allowed.
  - Huge numbers of whales were then killed for “scientific” purposes, and still ended up as meat in restaurants.

60 A Testament to Human Myopia

- In whaling, sealing, trapping, and many of the world’s fisheries, it is the same story again and again:
  - The pressure to maximize short-term gain before others got to the same stocks outweighed all consideration of a long-term future for the resources on which they depended.
  - Humans have treated other species as though their supply was limitless, or that it did not matter if they were driven to extinction.

- Human action, whether deliberate or inadvertent has drastically altered the world's ecosystems, for the worse.

61 The Conservation Movement

- In the last 100 years, a reaction to the slaughter arose in many countries, leading to the establishment of special wilderness areas.
  - National Parks
  - Protected habitats and reserves.
  - And particular protected species.
- Conservation organizations formed:
  - Audubon Society, Sierra Club, World Wildlife Fund, Friends of the Earth, Greenpeace.
- International conventions and treaties signed.
  - But not necessarily enforced.
- But it may all be too little, too late.