Chapter 11: Aquatic Biodiversity

APES 2013

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What we don't know

- *Humans have only explored about 5% of the ocean.*
- *We also know very little about fresh water systesms*

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What we do know

- *Greatest marine biodiversity occurs in coral reefs, estuaries, and the deep ocean floor.*
- *Biodiversity is higher near coasts than in the open water because of the huge variety of producers in coastal areas.*
- *Biodiversity is greater at the bottom of the ocean than at the surface because of the greater variety of habitats and food sources.*

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Habitat Destruction

- *Remember HIPPCO*
  - *Habitat loss and degradation*
    - *90% of fish spawn in coral reefs, mangrove forests, coastal wetlands, or rivers. All of these areas are under pressure from human activities.*
    - *Dredging and trawlers*
      - *Attempts have been made to ban this, but they are often blocked or too difficult to enforce*
    - *Freshwater habitats are impacted by dams and excessive water withdrawal from rivers and lakes*

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Invasive Species

Fig. 11-4

- *Displace or cause extinction of native species which disrupts ecosystem services*
- *84% of coastal waters are being colonized by invasive species*
- *Causes 2/3 of fish extinctions (1900-2000)*
- *Many species arrive in ballast water*
- *Some are introduced purposely. Asian swamp eel has invaded Florida probably from discarded aquariums.*

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Purple Loosestrife

- *Perennial plant native to wetlands of Europe*
- *Imported since the 1880s for gardens as ornamental plants*
- *Each plant can produce more than 2.5 million seeds a year which can be transported by water or wildlife.*
- *Displaces natural vegetation and decreases biodiversity*
- *Two species have been introduced to combat this: a weevil and a leaf eating beetle.*

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Population Growth and Pollution

- *By 2020, 80% of people will live along or near coasts*
- *Only 4% of oceans are not impacted by pollution*
- *80% of ocean pollution comes from coastal development and activities*
  - *Common pollutants: nitrogen and phosphorus (from fertilizers)*
    - *This leads to eutrophication*
  - *Plastics*

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Climate Change

- *Sea level rise*
  - *Over the past 100 years average sea levels have risen 10-20 cm.*
  - *Estimated between 2050 and 2100 could rise as much as 1.6 meters*
  - *Effects: destroy coral reefs, flood low lying islands and coastlines, drown productive wetlands*

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Overfishing

- *Fishprint - area of ocean needed to sustain consumption of an average person, nation, or the world*
- *Found that we are overfishing by 157% of the oceans capacity*
- *Overfishing leads to commercial extinction*
- *It can take over 2 decades for a species to begin to rebound*

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Newfoundland Cod Fisherry

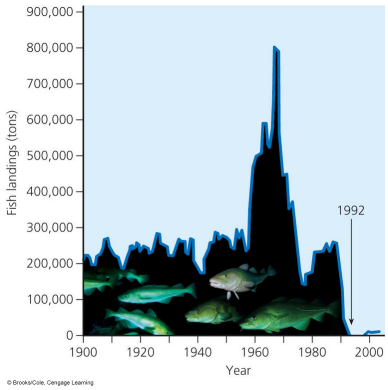

Fig. 11-6

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Industrial Fishing Methods

- *Involve global positioning systems, sonar, huge nets, spotter planes, and other technologies to find fish*
- *Trawler fishing - dragging a funnel shaped net along the ocean floor to catch bottom dwelling fish and shellfish*
- *Purse-seine fishing - large nets used to catch surface dwelling fish often using a spotter plane*
- *Longlining - using lines up to 130km (80 miles) with thousands of baited hooks*
- *Drift-net - large nets that hang up to 15m (50ft) below the surface and can be 64km (40 miles) long (UN has banned nets over 2.5km in international waters*

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Protecting Marine Biodiversity

- *International Laws*
  - *Convention on International Trade in Endangered Species (CITES) - 1975*
  - *Global Treaty on Migratory Species - 1979*
  - *International Convention on Biological Diversity - 1995*
- *National Laws*
  - *U.S. Marine Mammal Protection Act of 1972*
  - *U.S. Endangered Species Act of 1973*
  - *U.S. Whale Conservation and Protection Act of 1976*

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Whales

- *Order Cetaceans*
  - *Marine mammals ranging in size from one meter to thirty meters*
  - *Divided into two major groups:*
    - *toothed whales - bite and chew food and feed on squid, octopus, and other marine animals (ex. porpoise, sperm whale, and orca)*
    - *baleen whales - filter feeders with plates of baleen (whalebone) which filter plankton and krill (ex. blue whale, gray whale, and humpback whale)*

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Whales

- *Easy to kill because they are so large and need to surface to breathe*
- *Whale harvesting in International Waters (TRAGEDY OF THE COMMONS)*
- *Over-harvesting (1.5 million whales between 1925 and 1975) caused 8 of 11 major species to become commercially extinct*
- *The blue whale was hunted into near biological extinction*

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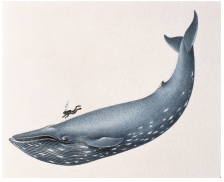
Blue Whales

- *Estimated before whaling that 250,000 were in ocean (today around 5,000)*
- *Very vulnerable to extinction*
  - *Take 25 years to mature sexually*
  - *Only produce offspring once every 2-5 years*



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Blue Whales

- *Have not been hunted commercially since 1964*
- *Classified as an endangered species since 1975*
- *Some biologists fear that there are too few for the populations to avoid extinction*
- *1946 - International Convention for the Regulation of Whaling established the International Whaling Commission (IWC) - regulates the whaling industry by setting annual quotas*
  - *Often data was inaccurate or just ignored*

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IWC

- *1970 - U.S. banned all whaling and importing of whale products*
- *1986 - Under pressure from the U.S. and other non-whaling countries, IWC imposed a moratorium on commercial whaling*
  - *Whales killed dropped from 42,480 in 1970 to 1,300 in 2007*
  - *Despite the ban, 26,000 whales were killed between 1986 and 2007*

Fig. 11-9

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Economic Incentive

- *Sometimes it is more economically beneficial to keep a species alive*
  - *Sea turtles bring almost three times more money alive than dead because of tourism*

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Marine Turtles

- *Out of seven species, six are critically endangered or endangered*
- *Hunted for meat, leather, and eggs are taken for food*
- *Often drown after being caught in fish nets*
- *In 2000, estimated just longline fishing killed 50,000 leatherback and 200,000 loggerhead turtles*
- *Impacted by pollution and climate change*

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Marine Sanctuaries

- *International Law - countries offshore fishing zone extens 370km from its shores*
- *Law of the Sea Treaty - coastal nations have 36% of ocean surface and 90% of fish stocks*
  - *Many governments use these areas to overfish (subsidize overfishing)*
- *IUCN has established a global system of marine protected areas (MPAs)*
  - *4,000 MPAs worldwide (200 in U.S. waters)*
  - *Most are only partially protected*

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Integrated Coastal Management

- *Community based effort to use coastal resources more sustainably*
- *Australia manages the Great Barrier Reef this way*
  - *ex. monitoring fishing, ocean acidity*

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Fishery Management

- *Maximum Sustained Yield (MSY) - number of fish that can be harvested annually without causing a population drop*
  - *Does not work well*
- *Optimum Sustained Yield (OSY) - takes into account other species and provides more room for errors in calculations*
- *Multispecies Management - takes into account many interacting species and competitive and predator-prey relationships*

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Government Subsidies

- *Estimates are that governments give fishers $30-34 billion per year to sustain their industry.*
  - *This equals a third of fishing revenues.*
  - *$20 billion for ships, fuel, and equipment.*

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Individual Transfer Rights

- *Government gives each fishing vessel a percentage of total allowable catch (TAC) each year.*
- *These owners can buy, sell, or lease their fishing rights like private property*
- *Started in New Zealand and Iceland*
- *U.S. started in Alaska for halibut. (1995)*
  - *Halibut fisheries were so depleted that the fishing season was only two days long per year*
  - *By 2005, the season could be extended to 258 days per year.*

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Problems with ITRs

- *Treats publicly owned waters as private but the public is still responsible for the costs of enforcement*
- *Forces small fishing operations out of business because they can not afford ITRs (This could promote illegal fishing.)*
- *TACs set too high to prevent overfishing*

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Consumer's Role

- *Demanding sustainable seafood*
- *Stricter labeling laws to inform how and where seafood is caught*
- *Certification system for sustainably caught food*
  - *MSC-certified*
  - *In 2006, Walmart pledged to sell only MSC-certified within 3-5 years*

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Sustaining Wetlands

- *U.S. has lost more than half of coastal and inland wetlands since 1900*
  - *Destroyed for crops, cities, roads, human health*
  - *Extracting minerals, oil, natural gas*
- *Laws/permits*
- *Goal is zero net loss of wetlands*
  - *mitigation banking*

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Florida Everglades

- *Once 100km (60mi) wide*
- *Since 1948, water has been diverted from here to supply heavily populated central and southern Florida*
- *Nutrient pollution from farms and residential areas*
- *Much of it paved over for development*
- *1962-1971 Kissimmee River straighten for flood control*
  - *Drained wetlands that farmers than used for pastures*
- *Currently only half the original size*

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CERP

- *Comprehensive Everglades Restoration Plan (1990)*
  - *Restore original flow of Kissimmee River*
  - *Remove 400km of canals and levees blocking water flow south of Lake Okeechobee*
  - *Buy 240 sq. km of farmland and allow it to be flooded to create artificial marshes to filter agricultural runoff*
  - *Create 18 reservoirs and underground water storage for residents of south Florida*
  - *Build new canals to recapture water flowing out to sea and divert back to Everglades*

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Great Lakes Invasive Species

- *Collectively, the Great Lakes are the world's largest body of fresh water*
- *Have been invaded by 162 non-native species*
- *Most arrive in bilge water*
- *Sea Lamprey - parasite that attaches and sucks the blood of fish (depletes sport fish like trout)*
  - *U.S. and Canada apply chemicals to lamprey spawning streams to kill larvae at a cost of $15 million a year*

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Great Lakes Invasive Species

- *Zebra mussel - arrived in ballast water of a European ship near Detroit in 1986*
  - *Has no known natural predators, has displaced organisms, and depleted food supplies*
  - *Clog irrigation pipes and water intake pipes*
  - *Costs $140 million per year ($16,000 per hour)*
  - *Have helped to increase water clarity by eating algae (good for underwater plants)*

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Great Lakes Invasive Species

- *Asian Carp*
  - *May be the next invader*
  - *Quickly grow up to 1.2m and 50kg*
  - *No natural predators in the Great Lakes*

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