AP Environmental Science Ch. 11

**Sustaining Aquatic Biodiversity and Ecosystem Services**

Case Study: The Plight of Sea Turtles

* All seven species in danger through:
	+ Trawler fishing
		- Destroyed many coral gardens that are turtle feeding grounds
	+ Turtles hunted for leather
	+ Eggs taken for food
* Pollution of ocean water

11-1 What Are the Major Threats to Aquatic Biodiversity and Ecosystem Services?

* Aquatic species and the ecosystem and economic services they provide are threatened by:
	+ Habitat loss, invasive species, pollution, climate change, and overexploitation
	+ All made worse by the growth of the human population and resource use

We Have Much to Learn about Aquatic Biodiversity

* We have explored about 5% of the oceans
* Greatest marine biodiversity
	+ Coral reefs, estuaries, and deep-ocean floor
* Biodiversity is higher
	+ Near the coast than in the open sea
	+ In the bottom region of the ocean than the surface region

Human Activities Are Destroying and Degrading Aquatic Habitat

* Marine
	+ Coral reefs
	+ Mangrove forests
	+ Seagrass beds
	+ Ocean acidification
* Freshwater
* Dams

Invasive Species Are Degrading Aquatic Biodiversity

* Invasive species
	+ Threaten native species
	+ Disrupt and degrade whole ecosystems
	+ Blamed for about two-thirds of all fish extinctions since 1900
* Example
	+ Lionfish in the Atlantic

Population Growth and Pollution Can Reduce Aquatic Biodiversity

* 80% of all humans living along coasts
* Nitrates and phosphates, mainly from fertilizers, enter water
	+ Leads to eutrophication
* Toxic pollutants from industrial and urban areas
* Plastics
* Ocean garbage

Climate Change Is a Growing Threat

* Sea levels will rise and aquatic biodiversity is threatened
	+ Coral reefs
	+ Swamp some low-lying islands
	+ Drown many highly productive coastal wetlands
	+ Warmer ocean water stresses phytoplankton

Overfishing and Extinction: Gone Fishing, Fish Gone

* Fishery – concentration of a particular wild aquatic species suitable for commercial harvesting in a specific area
* Fishing key factor in the depletion of up to 80% of the population of some wild fish species in only 10-15 years
* Trawlers
	+ Destroy ocean bottom habitat
* Purse-seine fishing
	+ Can kill dolphins
* Long-lining
	+ Kills large numbers of sea turtles, dolphins, and seabirds
* Drift net fishing
	+ Large bycatch
* Fishprint – area of ocean needed to sustain the fish consumption of an average person, nation, or the world
* Overfishing leads to commercial extinction
	+ Commercially valuable fish become scarce
	+ Bluefin tuna ranching
* Some marine mammals are also threatened due to overfishing

Case Study: The Great Jellyfish Invasion

* Most jellyfish feed on zooplankton, fish eggs, small fish, and other jellyfish
* Often found in blooms of thousands of individuals
	+ Numbers of blooms rising in recent years
		- Overfishing of species that prey on jellyfish
		- Excessive nutrients in land runoff
		- Warmer waters

Case Study: Why Should We Protect Sharks?

* Sharks are keystone species
	+ If they become extinct, their ecosystems will suffer
* For every shark that injures a person, people kill about 1.2 million sharks
	+ 32% of open-ocean shark species are threatened with extinction

Extinction of Aquatic Species Is a Growing Threat

* Biological extinction
	+ Overfishing, water pollution, wetlands destruction, excessive removal of water from lakes and rivers
	+ 34% of marine species are threatened
	+ 71% of freshwater species are threatened
* How are we protecting sea turtles?

11-2 How Can We Protect and Sustain Marine Biodiversity?

* We can help to sustain marine biodiversity by:
	+ Using laws and economic incentives to protect species
	+ Setting aside marine reserves to protect ecosystems and ecosystem services
	+ Using community-based integrated coastal management

Laws, Treaties, and Economic Incentives Can Help Sustain Aquatic Biodiversity

* Human ecological footprint and fishprint are expanding
* Much of the damage in the ocean is not visible
* The oceans are incorrectly viewed as an inexhaustible resource
* Most of the ocean lies outside the legal jurisdiction of any country
* Some examples:
	+ 1975 Convention on International Trade in Endangered Species
	+ 1979 Global Treaty on Migratory Species
	+ U.S. Endangered Species Act of 1973
	+ U.S. Whale Conservation and Protection Act of 1976
	+ 1995 International Convention on Biological Diversity

Marine Sanctuaries Protect Ecosystems and Species

* Offshore fishing
	+ Exclusive economic zones for countries
		- 200 nautical miles
	+ High seas governed by treaties that are hard to enforce
* Law of the Sea Treaty
	+ Misused
* Marine protected areas (MPAs)
	+ Protected from human activities

Establishing a Global Network of Marine Reserves: An Ecosystem Approach

* Marine reserves
	+ Closed to:
		- Commercial fishing
		- Dredging
		- Mining and waste disposal
	+ Core zone
		- No human activity allowed
	+ Less harmful activities allowed
		- Example: recreational boating and shipping
* Fully protected marine reserves work fast
	+ Fish populations double
	+ Fish size grows
	+ Reproduction triples
	+ Species diversity increase by almost one-fourth
* Cover less than 1% of world’s oceans
* Marine scientists want 30-50%

Restoration Helps to Protect Marine Biodiversity but Prevention Is the Key

* Japan’s attempt
	+ Seeding reef with new corals
* Problems that cause degradation need to be addressed
* Integrated coastal management
	+ Community-based sustainability movement

11-3 How Should We Manage and Sustain Marine Fisheries?

* Sustaining marine fisheries will require:
	+ Improved monitoring of fish and shellfish populations
	+ Cooperative fisheries management among communities and nations
	+ Reduction of fishing subsidies
	+ Careful consumer choices in buying seafood

Estimating and Monitoring Fishery Populations Is the First Step

* Maximum sustained yield (MSY)
	+ Traditional approach
	+ Projects maximum annual harvest without causing population drop
* Optimum sustained yield (OSY)
	+ Attempts to account for interactions among species
* Multispecies management
* Large marine systems
	+ Using large complex computer models
* Precautionary principle
	+ Sharply reducing fish harvests
	+ Closing overfished areas

Some Communities Cooperate to Regulate Fish Harvests

* Community management of the fisheries
* Co-management of the fisheries with the government
	+ Government sets quotas for species and divides the quotas among communities
	+ Limits fishing seasons
	+ Regulates fishing gear

Government Subsidies Can Encourage Overfishing

* Governments spend over 30 billion dollars per year subsidizing fishing
	+ Often leads to overfishing
	+ Discourages long-term sustainability of fish populations

Consumer Choices Can Help to Sustain Fisheries and Aquatic Biodiversity

* Need labels to inform consumers how and where fish was caught
* 1999 – Marine Stewardship Council (MSC)
	+ Certifies sustainably produced seafood
* What is the proper use of sustainable aquaculture?

11-4 How Should We Protect and Sustain Wetlands?

* We can maintain the ecosystem and economic services of wetlands by protecting remaining wetlands and restoring degraded wetlands

Coastal and Inland Wetlands Are Disappearing around the World

* Wetlands have been disturbed for centuries
* Sea level rise
* Will inundate coastal wetlands

We Can Preserve and Restore Wetlands

* Laws for protection
	+ Zoning laws steer development away from wetlands
	+ In U.S., a federal permit is required to fill wetlands greater than three acres
* Mitigation banking
	+ Can destroy wetland if one is created of equal area
	+ Ecologists argue that this as a last resort

Case Study: Can We Restore the Florida Everglades?

* Damage in the 20th century
	+ Drained
	+ Diverted
	+ Paved over
	+ Nutrient pollution from agriculture
	+ Invasive plant species
* 1947 – Everglades National Park was an unsuccessful protection project
* 1990 – Comprehensive Everglades Restoration Plan (CERP)
	+ Restore curving flow of ½ of Kissimmee River
	+ Remove canals/levees in strategic locations
	+ Flood farmland to create artificial marshes
	+ Create 18 reservoirs to create water supply for lower Everglades and humans
	+ Recapture Everglades water flowing to sea and return it to Everglades
* Already weakened by Florida legislature

11-5 How Should We Protect and Sustain Freshwater Lakes, Rivers, and Fisheries?

* Freshwater ecosystems are strongly affected by human activities on adjacent lands, and protection of these ecosystems must include protection of their watersheds

Freshwater Ecosystems Are in Jeopardy

* 40% of world’s rivers are dammed
* Many freshwater wetlands destroyed
* Invasive species
* Overfishing
* Human population pressures

Case Study: Can the Great Lakes Survive Repeated Invasions by Alien Species?

* Collectively, world’s largest body of freshwater
* Invaded by at least 162 nonnative species
	+ Sea lamprey
	+ Zebra mussel
	+ Quagga mussel
	+ Asian carp

Managing River Basins Is Complex and Controversial

* Columbia River – U.S. and Canada
	+ 119 dams
* Dams
	+ Provide hydroelectric power
	+ Provide irrigation water
	+ Hurt salmon

We Can Protect Freshwater Ecosystems By Protecting Watersheds

* Freshwater ecosystems protected through:
	+ Laws
	+ Economic incentives
	+ Restoration efforts
* Wild rivers and scenic rivers
	+ 1968 National Wild and Scenic Rivers Act

Freshwater Fisheries Need Better Protection

* Sustainable management
	+ Support populations of commercial and sport fish species
	+ Prevent overfishing
	+ Reduce or eliminate invasive species

11-6 What Should Be Our Priorities for Sustaining Aquatic Biodiversity?

* Sustaining the world’s aquatic biodiversity requires:
	+ Mapping it
	+ Protecting aquatic hotspots
	+ Creating large and fully protected marine reserves
	+ Protecting freshwater ecosystems
	+ Restoring degraded coastal and inland wetlands

We Can Use an Ecosystem Approach to Sustain Aquatic Biodiversity

* Complete the mapping of the world’s aquatic biodiversity
* Identify and preserve aquatic diversity hotspots
* Create large and fully protected marine reserves
* Protect and restore the world’s lakes and rivers
* Ecological restoration projects worldwide
* Make conservation financially rewarding

Three Big Ideas

* The world’s aquatic systems provide important economic and ecosystem services
	+ Scientific investigation of these poorly understood ecosystems could lead to immense ecological and economic benefits
	+ Aquatic ecosystems and fisheries are being severely degraded by human activities that lead to aquatic habitat disruption and loss of biodiversity
* We can sustain aquatic biodiversity
	+ Establish protected sanctuaries, manage coastal development, reduce water pollution, and prevent overfishing

Tying It All Together: Sea Turtles and Sustainability

* The sea turtle habitat is being destroyed
* When oceans are left undisturbed, ecosystems tend to recover
* We need to:
	+ Reduce sediment inputs and excess nutrients
	+ Value aquatic biodiversity