HOW CAN WE HELP TO SUSTAIN AQUATIC BIODIVERSITY?

Marine Biodiversity

- The most marine biodiversity is found:
  - 1. Coral reefs
  - 2. Estuaries
  - 3. Deep-ocean floor
- Biodiversity is higher near coasts than in the open sea because of the greater variety of nutrients, producers, habitats, and nursery areas
- Biodiversity is higher in the benthic region than in the pelagic region (top) because of the greater variety of habitats and food sources

Human activities are destroying and degrading aquatic biodiversity

- Human activities have destroyed or degraded a large portion of the world's coastal wetlands, coral reefs, mangroves, and ocean bottom, and disrupted many of the world's freshwater ecosystems.
- Rising sea levels are likely to destroy many coral reefs and flood some low-lying islands along with their protective coastal mangrove forests.
- Loss and degradation of many sea-bottom habitats caused by dredging operations and trawler fishing boats.

Human activities are destroying and degrading aquatic biodiversity

- In freshwater aquatic zones, dam building and excessive water withdrawal from rivers for irrigation and urban water supplies destroy aquatic habitats, degrade water flows, and disrupt freshwater biodiversity.
- The deliberate or accidental introduction of hundreds of harmful invasive species threatens aquatic biodiversity.
- Thirty-four percent of the world's known marine fish species and 71% of the world's freshwater fish species face premature extinction.

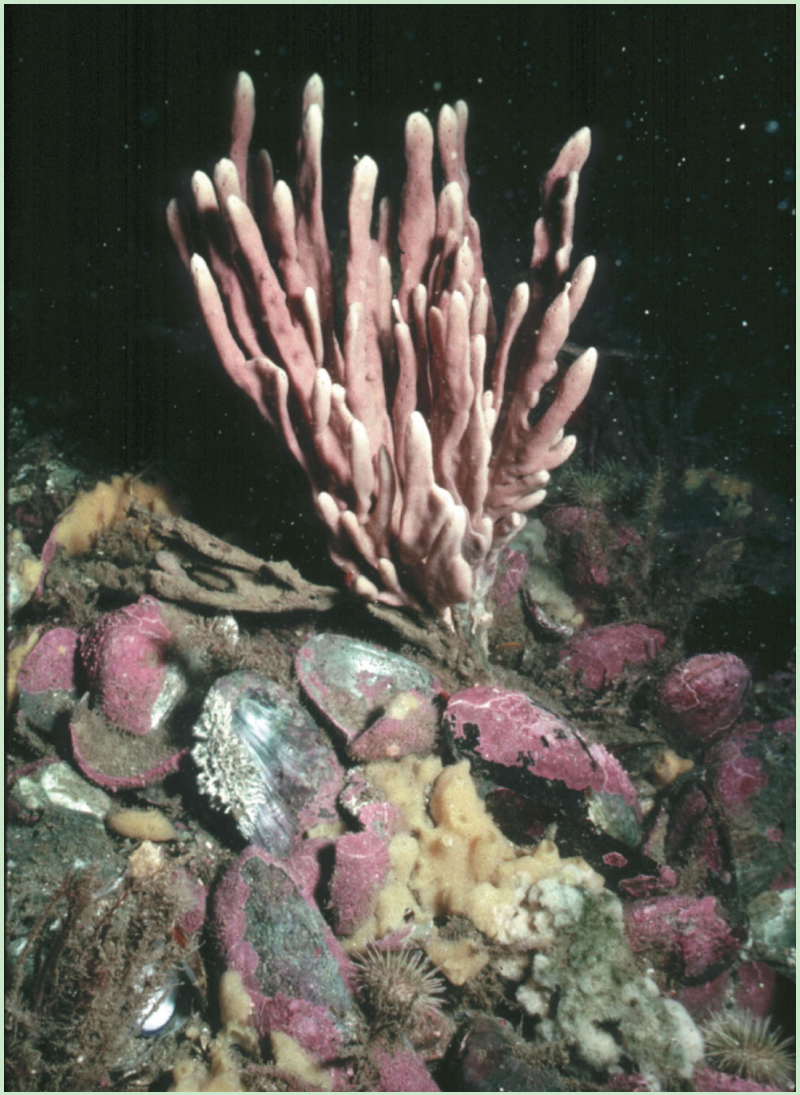
Bycatch

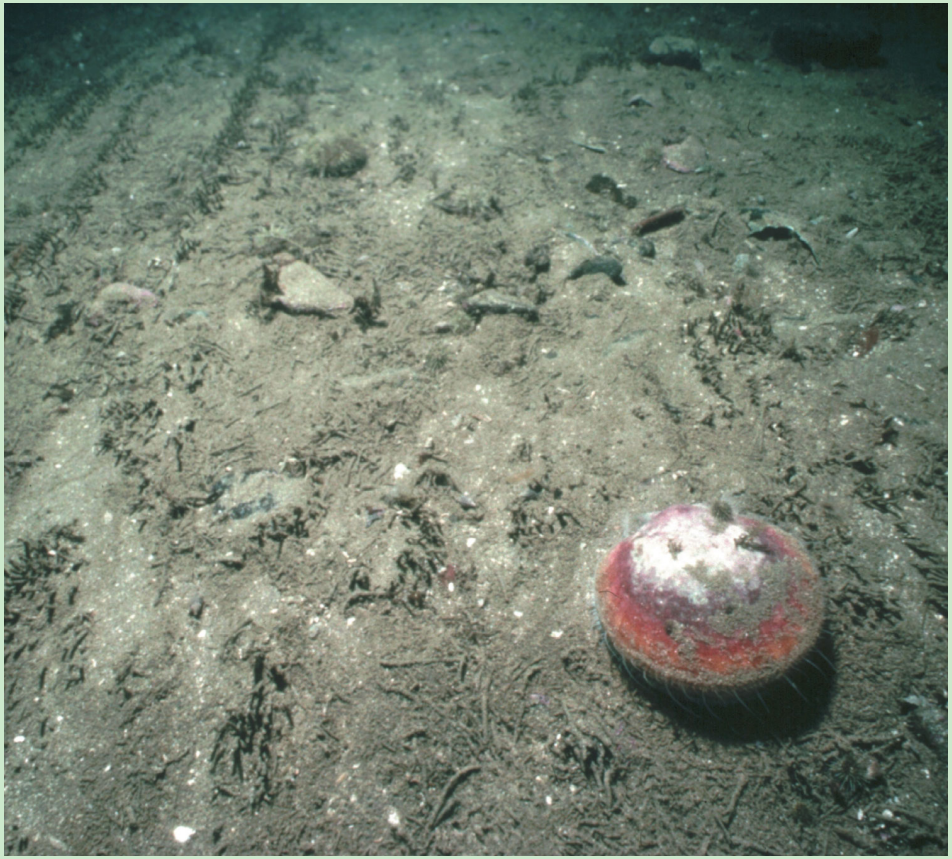
- **Bycatch** – nontargeted marine animals and fish that are caught in nets with the target fish

Human activities that affect marine ecosystems and fishing:

- Overfishing
- Habitat destruction
- Introduction of invasive species through ballast water of ships
- Pollution of waters with organic pollutants, municipal waste, pesticides, fertilizers

Before and after a trawler net





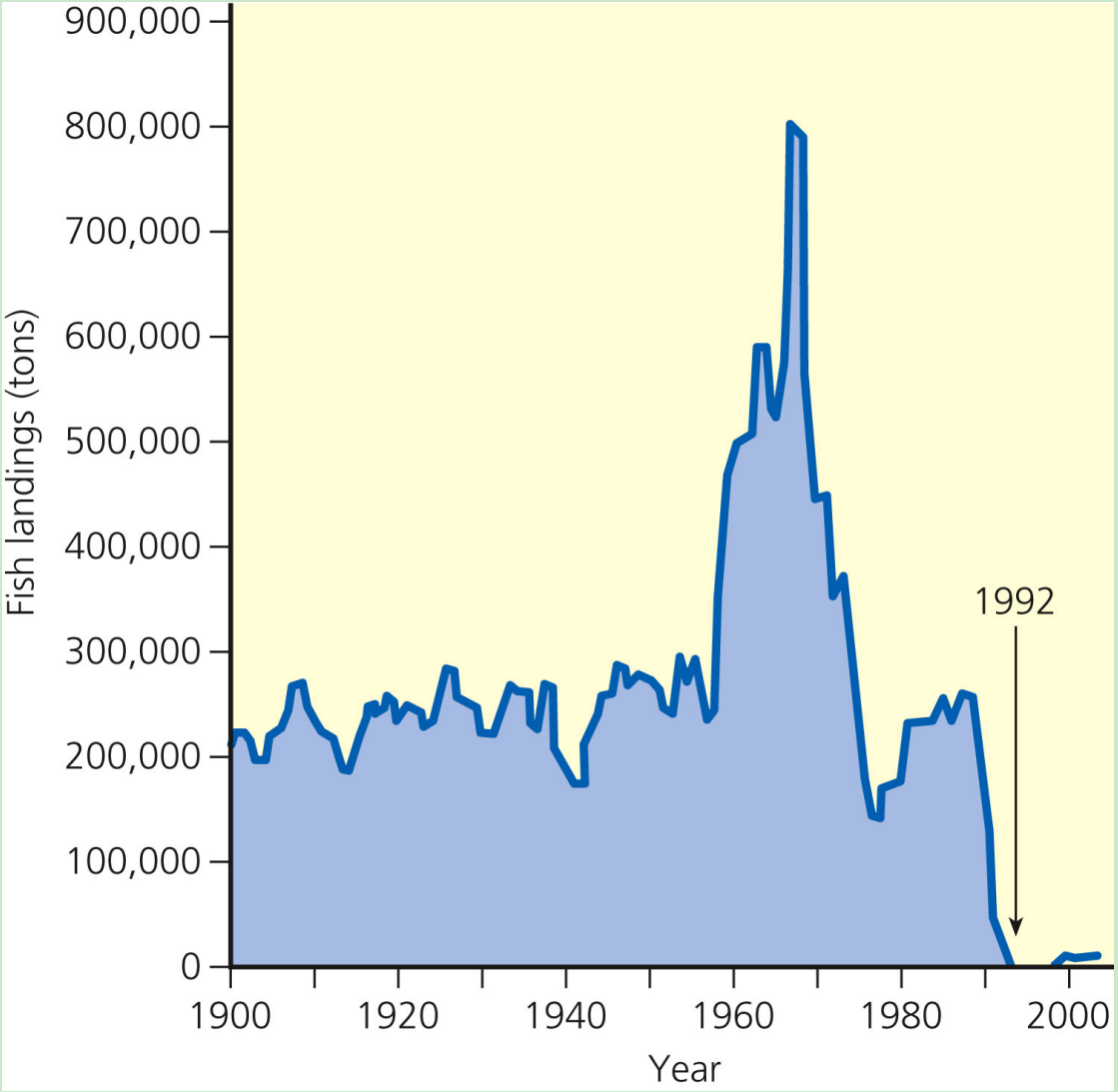
Overfishing: gone fishing; fish gone

- A **fishery** is a concentration of a particular wild aquatic species suitable for commercial harvesting in a given ocean area or inland body of water.
- The **fishprint** is defined as the area of ocean needed to sustain the consumption of an average person, a nation, or the world.
- Fifty-two percent of the world's fisheries are fully exploited, 20% are moderately overexploited, and 28% are overexploited or depleted.

Overfishing: gone fishing; fish gone

- Overharvesting has led to the collapse of some of the world's major fisheries.
- When overharvesting causes larger predatory species to dwindle, rapidly reproducing invasive species can more easily take over and disrupt ocean food webs.

The collapse of Canada's 500-year-old Atlantic cod fishery



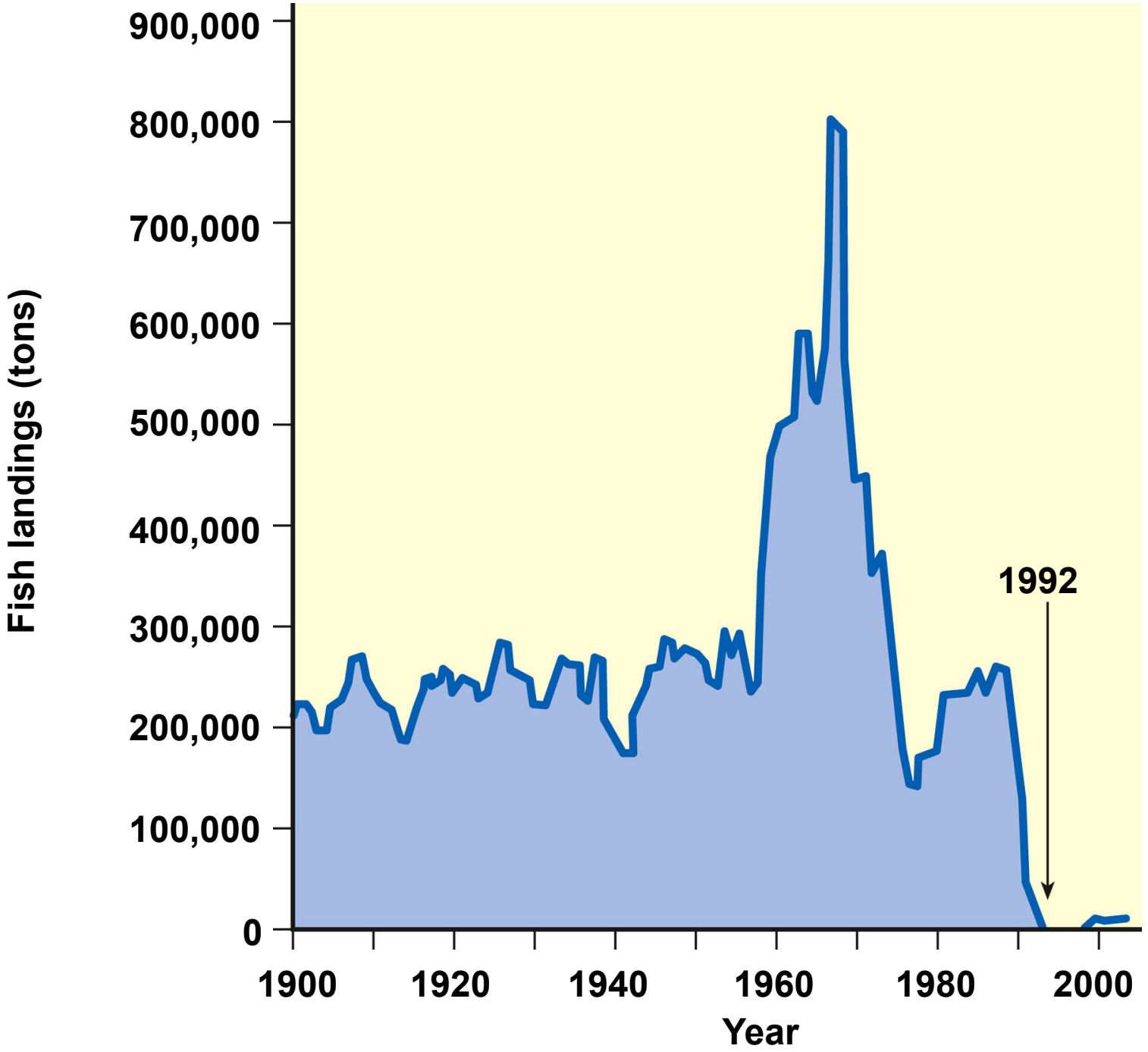

Fish landings (tons)
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1900
1920
1940
1960
1980
2000
Year
1992

Fig. 9-25, p. 197

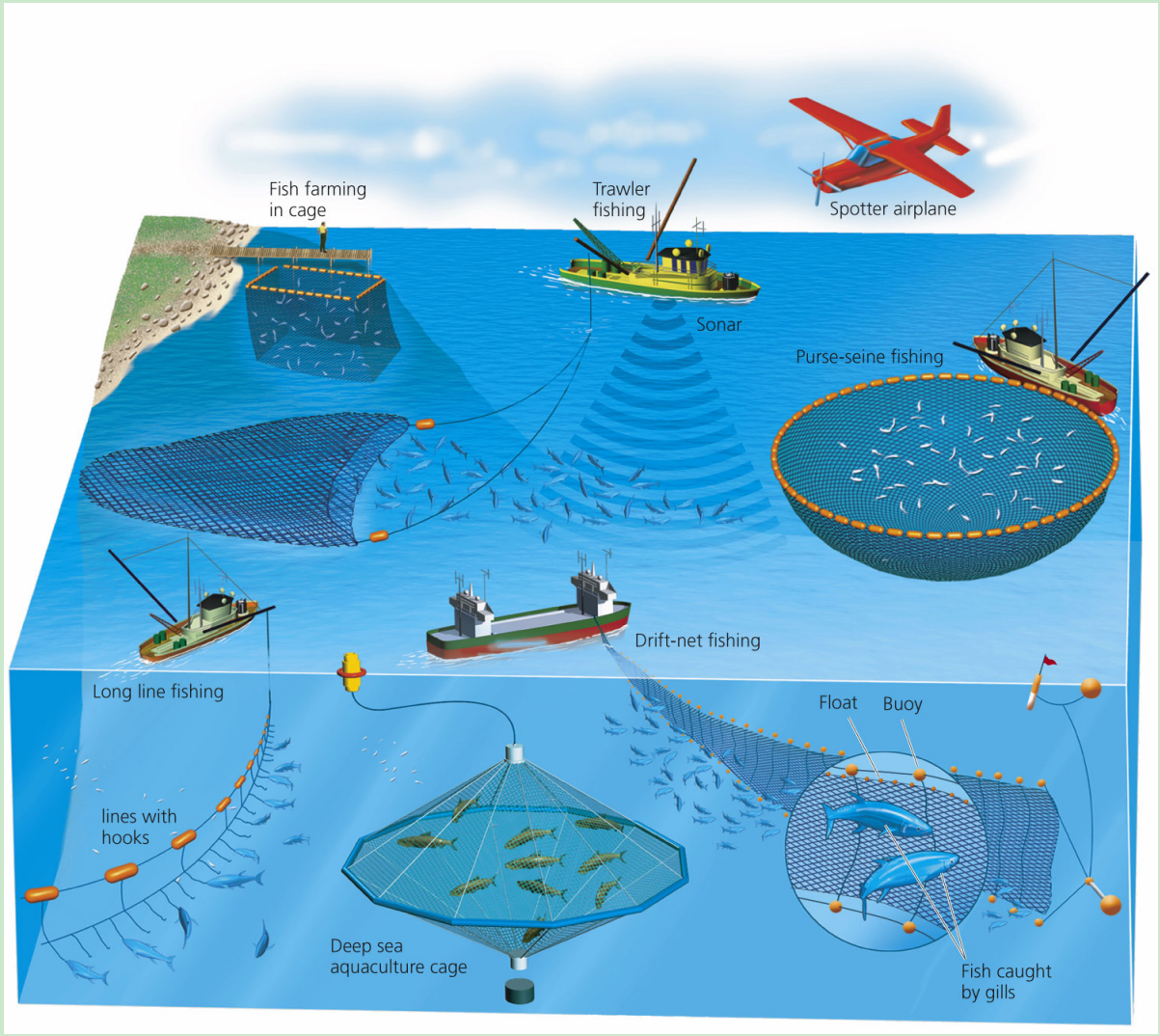
CASE STUDY: Industrial Fish Harvesting Methods

- Industrial fishing fleets dominate the world's marine fishing industry, using global satellite positioning equipment, sonar fish-finding devices, huge nets and long fishing lines, spotter planes, and gigantic refrigerated factory ships that can process and freeze their catches.
- Trawler fishing is used to catch fish and shellfish by dragging a funnel-shaped net held open at the neck along the ocean bottom.
- Purse-seine fishing, is used to catch surface-dwelling fish by using a spotter plane to locate a school; the fishing vessel then encloses it with a large net called a purse seine.

CASE STUDY: Industrial Fish Harvesting Methods

- Longlining involves lines up to 130 kilometers (80 miles) long, hung with thousands of baited hooks to catch open-ocean fish species or bottom fishes.
- Drift-net fishing catches fish with huge drifting nets that can hang as deep as 15 meters (50 feet) below the surface and extend to 64 kilometers (40 miles) long.
- Drift-nets can trap and kill large quantities of unwanted fish, called bycatch, along with marine mammals, sea turtles, and seabirds.
- Almost one-third of the world's annual fish catch by weight consists of bycatch species, which are mostly thrown overboard dead or dying.

Major commercial fishing methods



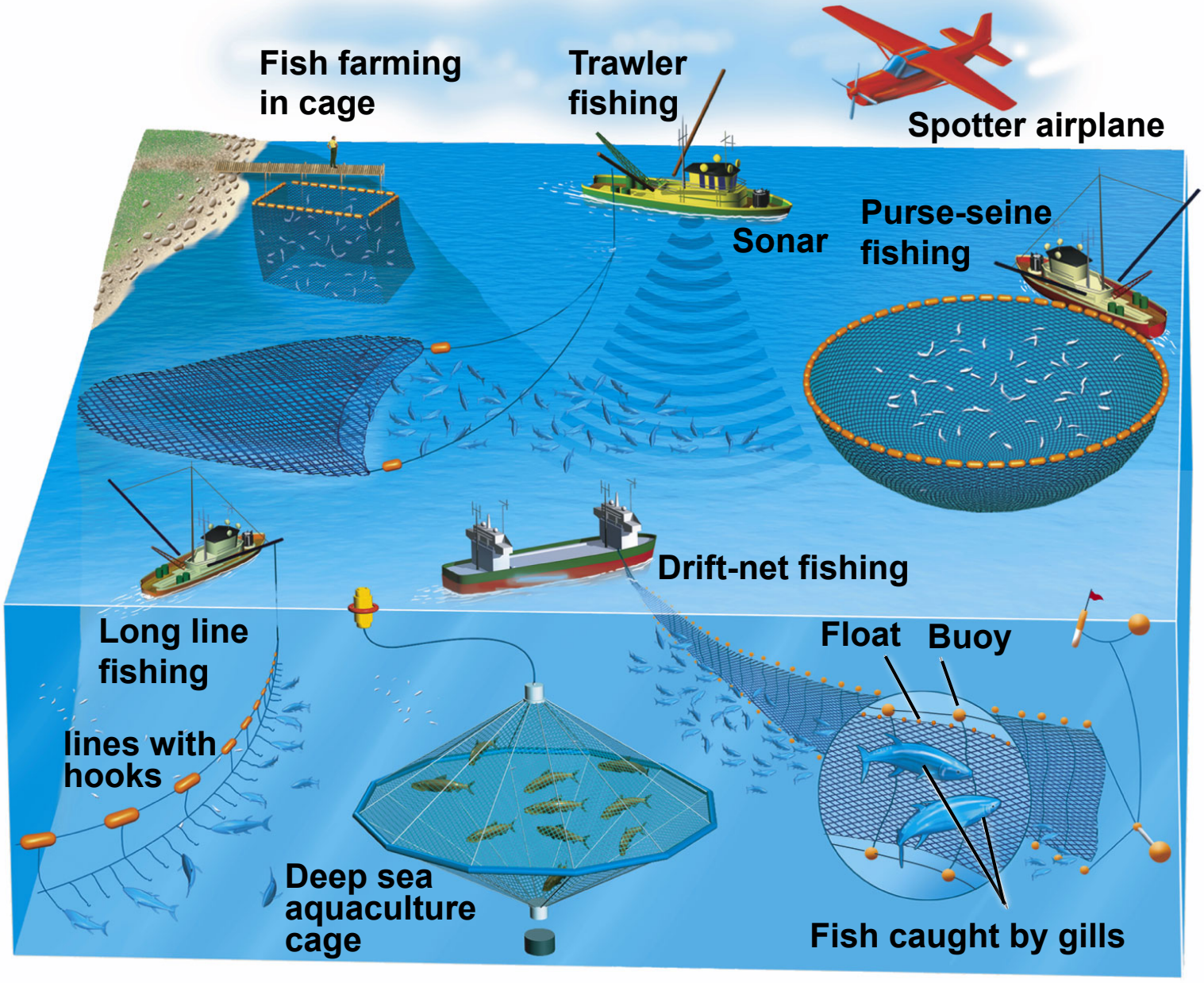

Fish farming in cage
Trawler fishing
Spotter airplane
Sonar
Purse-seine fishing
Drift-net fishing
Long line fishing
lines with hooks
Float
Buoy
Deep sea aquaculture cage
Fish caught by gills

Fig. 9-26, p. 198

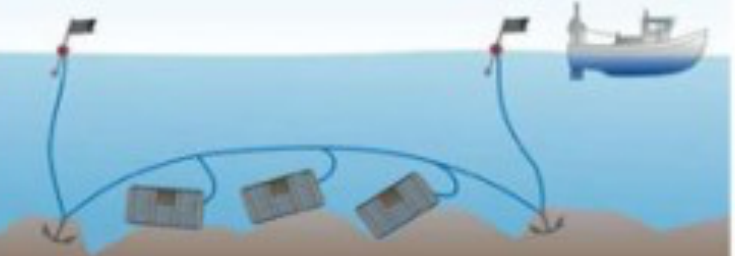
Trawling (Pelagic)

Trawling (Pelagic - Pairs)

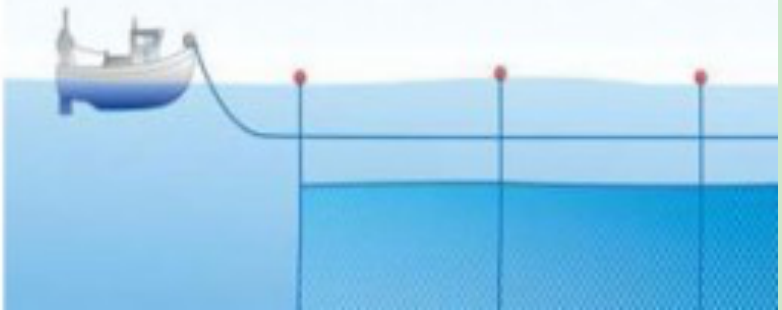
Longlining (Pelagic)

Longlining (Demersal)

Potting



Netting



We can protect and sustain marine biodiversity

- Protecting marine biodiversity is difficult for several reasons.
  - The human ecological footprint and fishprint are expanding so rapidly into aquatic areas that it is difficult to monitor the impacts.
  - Much of the damage to the oceans and other bodies of water is not visible to most people.

We can protect and sustain marine biodiversity

- Many people incorrectly view the seas as an inexhaustible resource that can absorb an almost infinite amount of waste and pollution and still produce all the seafood we want.
- Most of the world's ocean area lies outside the legal jurisdiction of any country and is thus an open-access resource and subject to overexploitation.

Laws Protecting Marine Species:

- Convention on International Trade of Endangered Species (CITES)
- Global Treaty on Migratory Species
- US Marine Mammal Protection Act
- US Endangered Species Act
- US Whale Conservation and Protection Act
- International Convention on Biological Diversity

Ways to protect our marine biodiversity:

- **Commercial Extinction** – when it is no longer profitable to hunt and kill animals for food source (whales were the first)
- **United Nations Law of the Sea** – all coastal nations have sovereignty up to 12 miles offshore but each country decides on their own fishing policy (many overfish)
- **Marine Protected Areas** – a global system, mostly at the national level, of areas that protect some areas from human activities
- **Marine Reserves** – fully protected areas or no-take MPAs where no extraction and alteration of any living or nonliving resources is allowed (again –mostly done by individual nations within their water right)

- Zoning of marine areas probably will be able to protect marine ecosystems better than setting perimeter limits for nations.

Methods for Managing Fishing and Fisheries:

- Set catch limits below the maximum sustainable yield
- Improve monitoring and enforcement of regulations
- Reduce/eliminate fishing subsidies
- Charge fees for harvesting fish and shellfish from publicly owned offshore waters
- Certify sustainable fisheries (fish farms currently unregulated)
- Establish no-fishing areas
- Establish more protected areas
- Rely more on integrated coastal management
- Label sustainably harvested fish

Methods for Managing Fishing and Fisheries:

- Publicize overfished and threatened species
- Use wide-meshed net to allow escape of smaller fish
- Use net escape devices for seabirds and turtles
- Ban throwing edible and marketable fish back into the sea
- Restrict coastal locations for fish farms
- Control pollution more strictly
- Depend on more herbivorous fish species
- Kill organisms in ship ballast water with nitrogen to prevent invasive species
- Dump ballast water far out in open ocean water and replace with deep-sea water

We can protect and sustain marine biodiversity

- Several ways to protect and sustain marine biodiversity:
  - Protect endangered and threatened aquatic species.
  - Establish protected marine sanctuaries.
  - Protect whole marine ecosystems within a global network of fully protected marine reserves.

Ways to manage fisheries more sustainably and protect marine biodiversity

Solutions

Managing Fisheries

Fishery Regulations

Set low catch limits

Improve monitoring and enforcement

Economic Approaches

Reduce or eliminate fishing subsidies

Certify sustainable fisheries

Protect Areas

Establish no-fishing areas

Establish more marine protected areas

Consumer Information

Label sustainably harvested fish

Publicize overfished and threatened species

Bycatch

Use nets that allow escape of smaller fish

Use net escape devices for seabirds and sea turtles

Aquaculture

Restrict coastal locations of fish farms

Improve pollution control

Nonnative Invasions

Kill or filter organisms from ship ballast water

Dump ballast water at sea and replace with deep-sea water

Lobster fishing in Maine

- The fishermen have grid areas where they put their pots. These areas are ‘owned’ by families and others can’t put their pots there unless given permission. Only lobsters within a certain size are allowed to be harvested. The others (large and small) are returned to the water where they came from. Breeding females (those with eggs) are notched and then returned. The notch lets other lobstermen know that they are breeding females and cannot be harvested so that they insure a new generation of lobsters. That means year after year they are protected. Large lobsters are returned because they are considered good breeding stock.

Maintaining Sustainable Marine Biodiversity

- **Individual Transfer Quotas** – the government gives each fishing vessel owner a specified percentage of the total allowable catch for a fishery in a given year.

- **Maximum Sustainable Yield (MSY)** – the maximum number of a species that can be harvested annually from a stock without

Taking an Ecosystem Approach to Sustaining Aquatic Biodiversity

- Strategies for applying the ecosystem approach to aquatic biodiversity include:
  - Complete the mapping of the world's aquatic biodiversity, identifying and locating as many plant and animal species as possible.
  - Identify and preserve the world's aquatic biodiversity hotspots and areas where deteriorating ecosystem services threaten people and other forms of life.

Taking an Ecosystem Approach to Sustaining Aquatic Biodiversity

- Create large and fully protected marine reserves to allow damaged marine ecosystems to recover and to allow fish stocks to be replenished.
- Protect and restore the world's lakes and river systems (the most threatened ecosystems of all).
- Initiate worldwide ecological restoration projects in systems such as coral reefs and inland and coastal wetlands.
- Find ways to raise the incomes of people who live in or near protected lands and waters so that they can become partners in the protection and sustainable use of ecosystems.

Taking an Ecosystem Approach to Sustaining Aquatic Biodiversity

- The harmful effects of human activities on aquatic biodiversity and ecosystem services could be reversed over the next 2 decades if an ecosystem approach is implemented, at a cost one of penny per cup of coffee consumed in the world each year.