

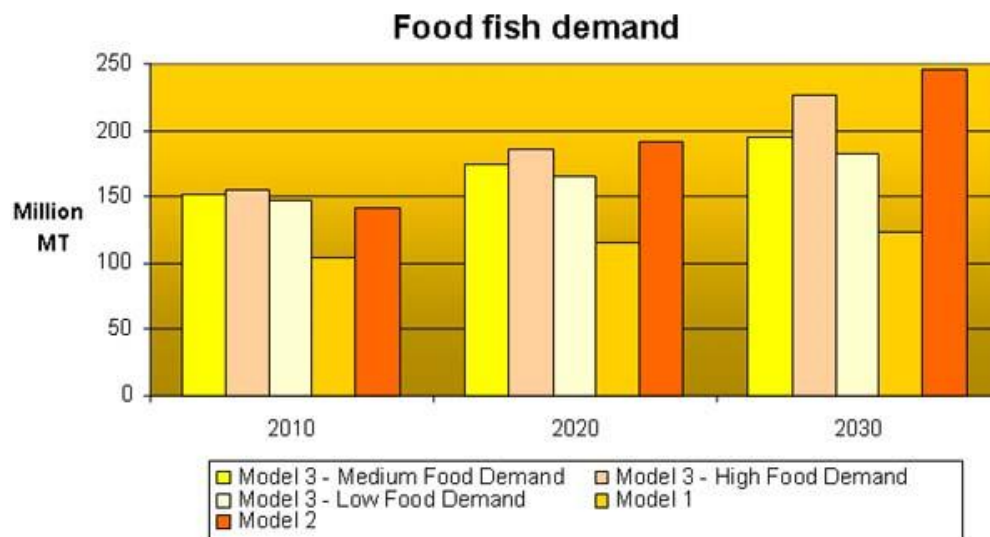
4.3 AQUATIC FOOD PRODUCTION SYSTEMS

The demand for aquatic food is increasing dramatically worldwide and at the same time there is a pressure for more efficient production and distribution systems to deliver healthy and safe food also taking into account the environmental and sustainability issues throughout the entire aquatic food value chain.

4.3.1 Demand for aquatic food resources continues to increase as human population grows and diet changes.

→ Demand for fish has increased and continues to grow:

Global demands for food from aquatic environments are expected to increase in future decades, because these foods will help to meet the needs and preferences of a growing human population. Median projections suggest global population growth of 2.4 billion, to over 9.7 billion, by 2050. Food demand is expected to rise even faster than population growth, owing to the emergence of a larger proportion of 'middle-class' people who have greater spending power and typically consume more animal protein than people with lower income.



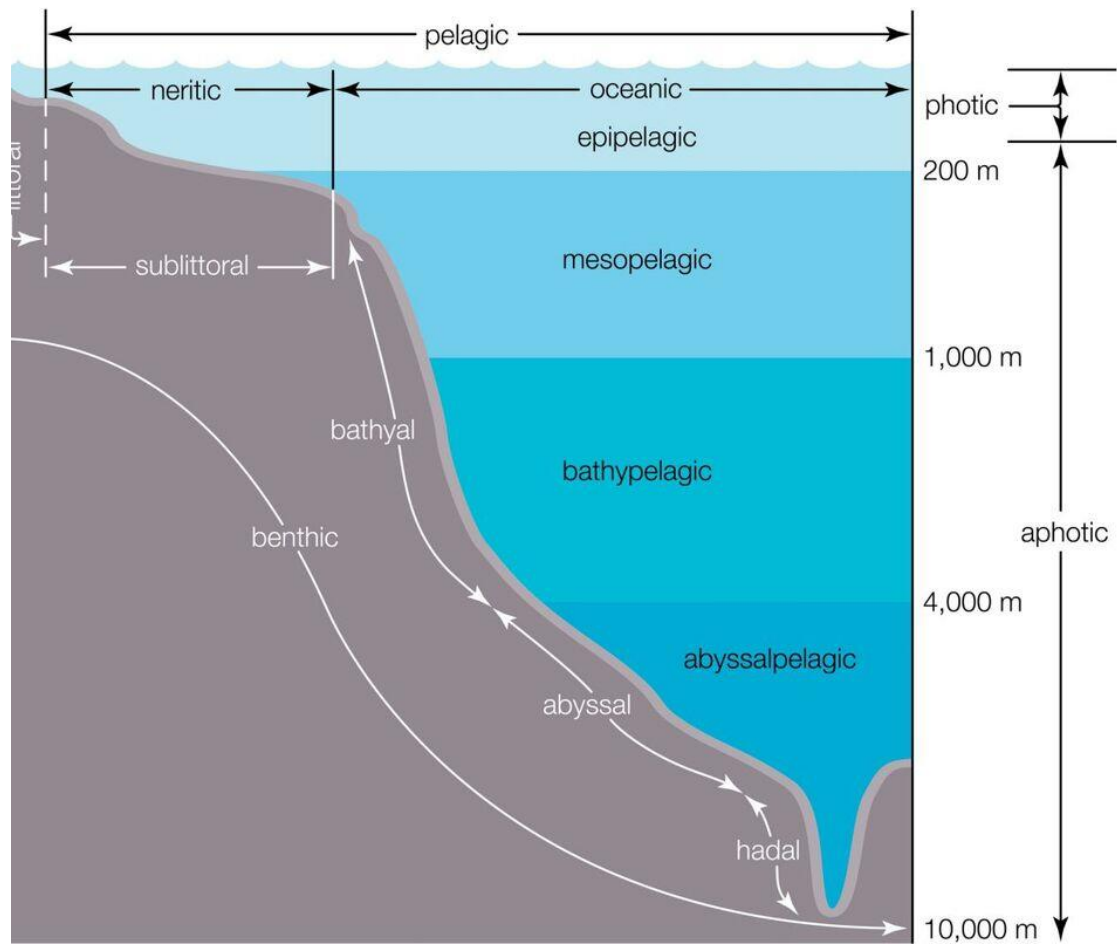
Source: www.fao.org

4.3.2 Photosynthesis by phytoplankton supports a highly diverse range of food webs.

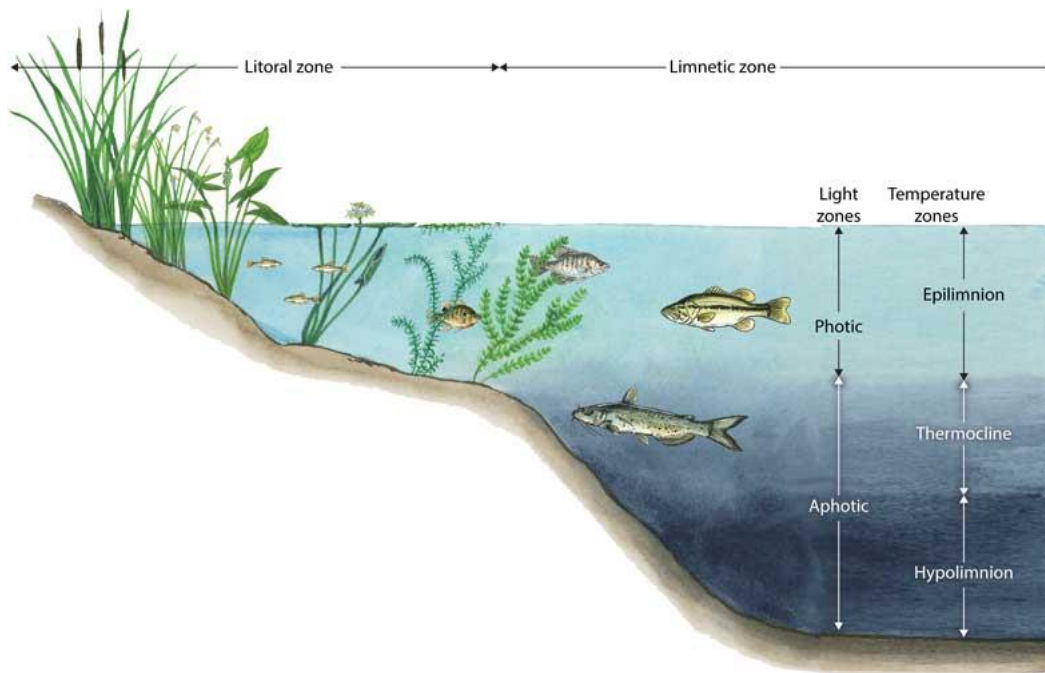
The most abundant life forms in the ocean are plankton; most are so small that you can't even see them. The first link in all marine food chains are the phytoplankton, or 'plant' plankton, which use sunlight to make

sugars from carbon dioxide and water (photosynthesis). Because they need sunlight, they can only live in the photic zone. Through photosynthesis, phytoplankton make food for themselves and give off oxygen, which is a waste product for them but essential for all animals on Earth. Phytoplankton produce all the food at the bottom of the ocean food chain, so they are called primary producers. Most of the photosynthesis on Earth happens in the oceans and phytoplankton produce a large share of the oxygen in the air we breathe

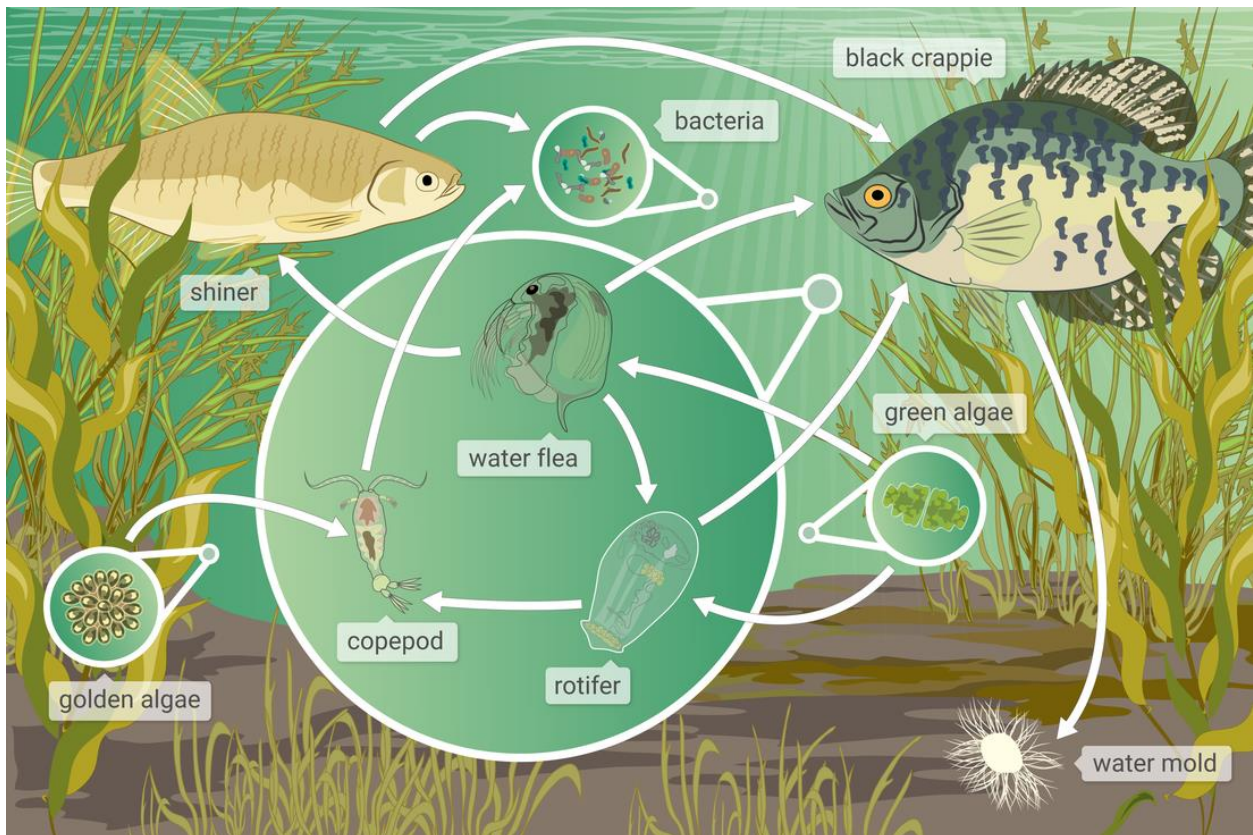
Different oceanic zones:

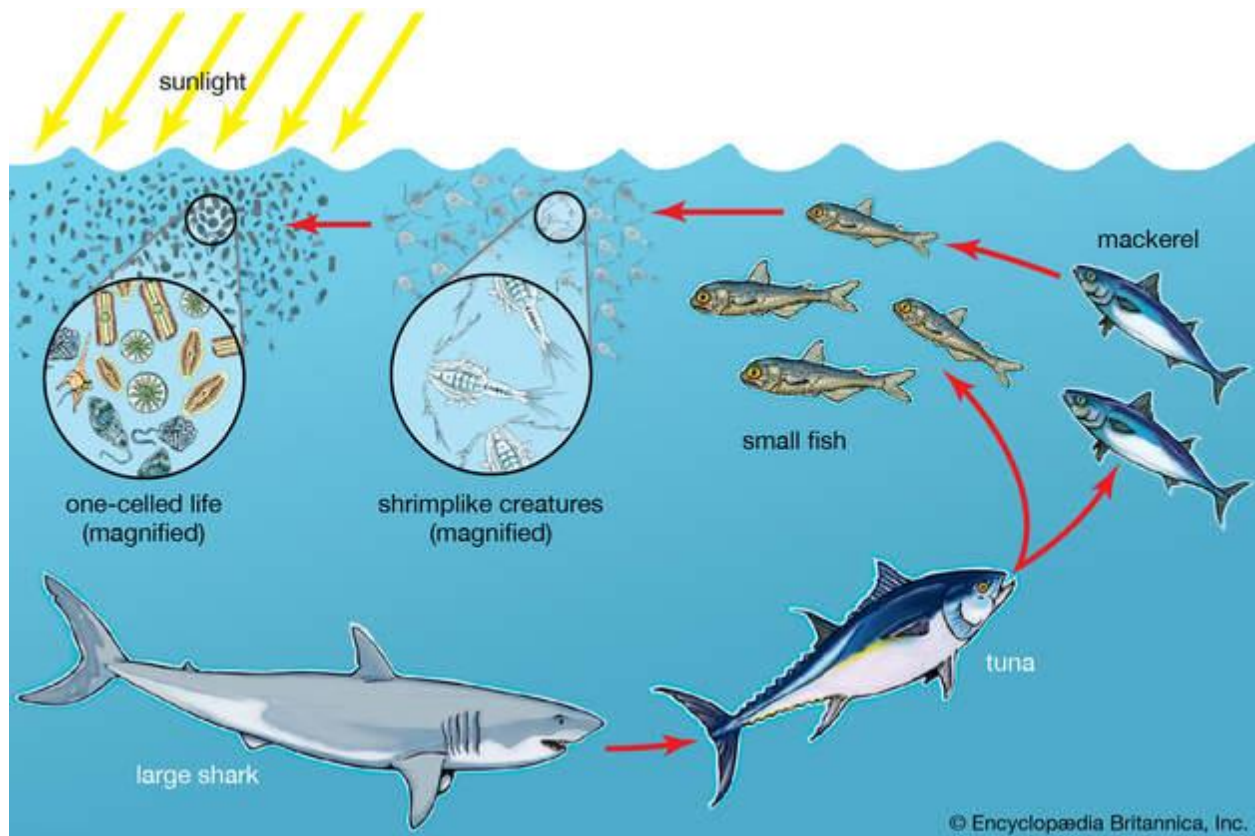


Different lake ecosystem zones:



Food chains and webs within aquatic ecosystems:





4.3.3 Aquatic (freshwater and marine) flora and fauna are harvested by humans.

Food resources available from aquatic ecosystems:

Sustainable fishing guarantees there will be populations of ocean and freshwater wildlife for the future. Aquatic environments are home to countless species of fish and invertebrates, most of which are consumed as food. (Others are harvested for economic reasons, such as oysters that produce pearls used in jewelry.) Seafood is respected all over the world, in many diverse cultures, as an important source of protein and healthy fats. For thousands of years, people have fished to feed families and local communities.

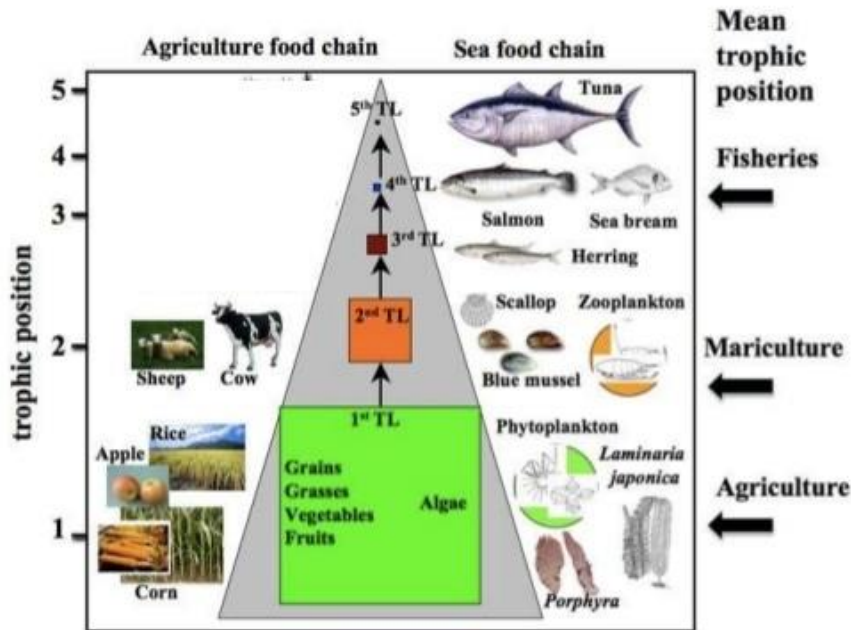


4.3.4 The highest rates of productivity are found near coastlines or in shallow seas, where upwellings and nutrient enrichment of surface waters occurs.

Factors which affect primary production within aquatic ecosystems:

Boundary ecosystems are characterized by the presence of large plants. In the open water of the ocean and large lakes the basic production of living material (primary production) is carried out by microscopic algae (phytoplankton) floating freely in the water. At the bottom there is not enough light to allow growth of large, attached plants. In boundary ecosystems much of the area is shallow enough for light to reach the bottom and permit large plants to grow. Phytoplankton is also present, but the large plants give the boundary systems their special character.

Terrestrial and Aquatic Systems



4.3.5 Harvesting some species, such as seals and whales, can be controversial.

The relationship between humans and marine mammals is a special, but sometimes controversial one. It is culturally diverse and politically influential and is based on attitudes ranging from spiritual reverence to fondness of taste. Our relationship with whales and seals have profoundly influenced recent human history.

4.3.6 Ethical issues arise over biorights, rights of indigenous cultures and international conservation legislation.

The principal ethical issues in fisheries relate broadly to human and ecosystem well-being. The most important ones being poverty; the right to food; legislation and overfishing and ecosystem degradation.

Fisheries constitute an important source of livelihood for millions of people. Nearly 35 million fishers are directly engaged in fishing and fish farming as a full-time or part-time occupation (FAO, 2002). Fishers are particularly concentrated in developing countries, where about 95 percent of the world's fishers live.

The state of world fisheries presents us with pressing ecological, economic, social and political challenges

with significant ethical implications. For example, the depletion of a nation's fishery resources represents a moral failure by society to maintain the natural environment and its productivity. It compromises food security, threatening vulnerable communities in particular, and reduces the livelihood opportunities of future generations. The contamination, by pollution, of an otherwise extremely healthy source of food, reducing food safety and threatening human health, is another indication of moral failure in relation to both present and future generations.

4.3.7 Developments in fishing equipment and changes to fishing methods have led to dwindling fish stocks and damage to habitats.

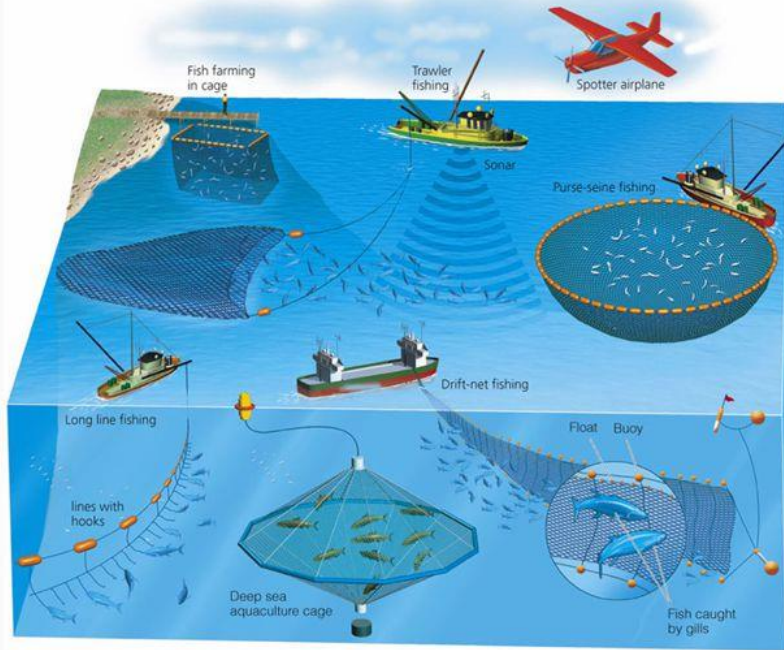
Consider how two contrasting cod fisheries in *Newfoundland* and *Iceland* have been managed:

- How sustainable are they? (for example, cod).
- What did they improve? (for example, boats, fishing gear (trawler bags), and detection of fisheries and boats via satellites).
- How are they being managed? (for example, use of quotas, designation of marine protected areas (exclusion zones), and restriction on types and size of fishing gear (including mesh size of nets).]

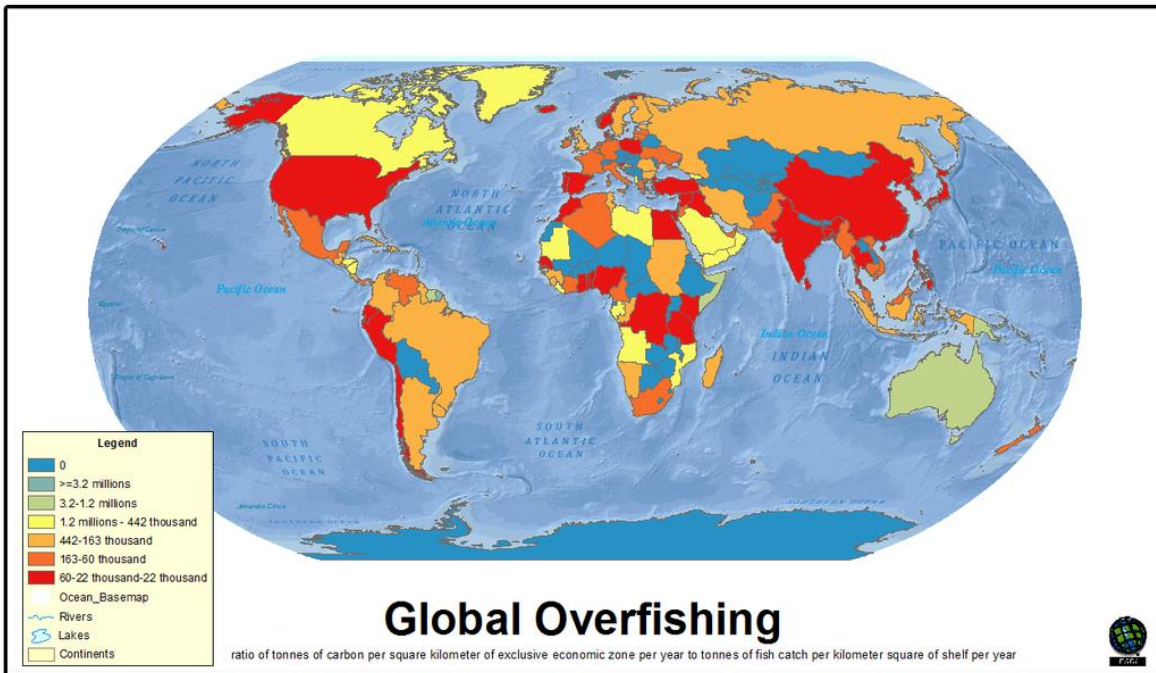
In the past, fishing was more sustainable because fishermen did not have the resources or the technology to tread into the deeper waters at far flung locations. Their vessels were small with limited capacities for stocking fish and the absence of technology like sonar restricted their fish-hunting activities. The United Nations Food and Agriculture Organisation (FAO) estimates that 91.1% of the world's fisheries are either fully exploited or overexploited. With the introduction of modern industrial fishing techniques the industry has reached a crushing over-capacity that has already decimated a vast range of global fish populations. Today, however, fishing is a multimillion dollar industry with well-equipped ships and hi-tech facilities that enable fishermen to explore new shores and deeper waters to keep up with the increasing demand for seafood.

Keep in mind that once a fish stock is over-fished to the point of collapse, it is very difficult for it to recover.

Major Commercial Fishing Methods Used to Harvest Various Marine Species

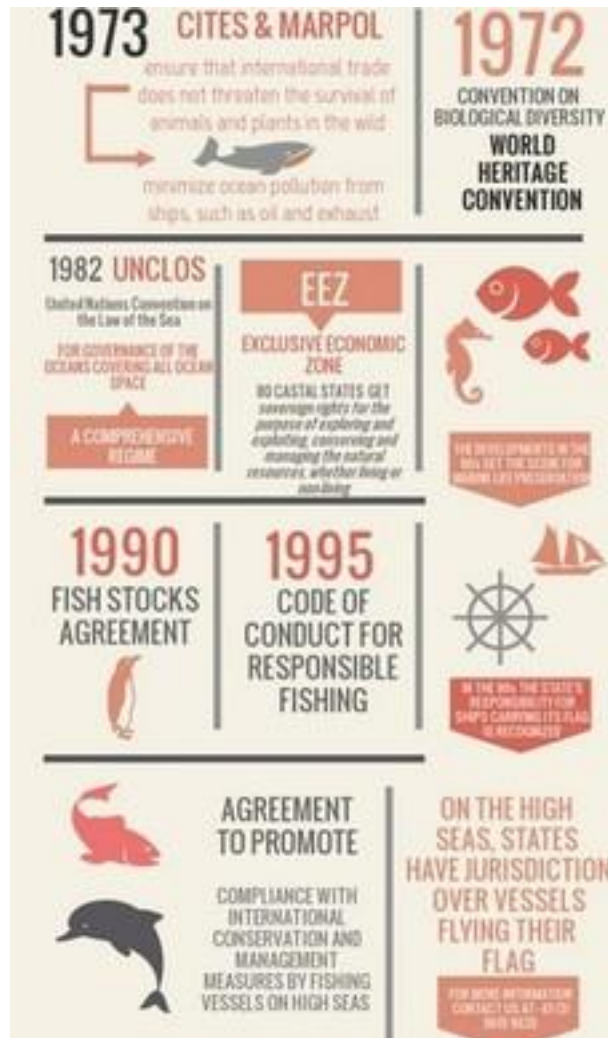


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4.3.8 Unsustainable exploitation of aquatic systems can be mitigated at a variety of levels (international, national, local and individual) through policy, legislation and changes in consumer behaviour.

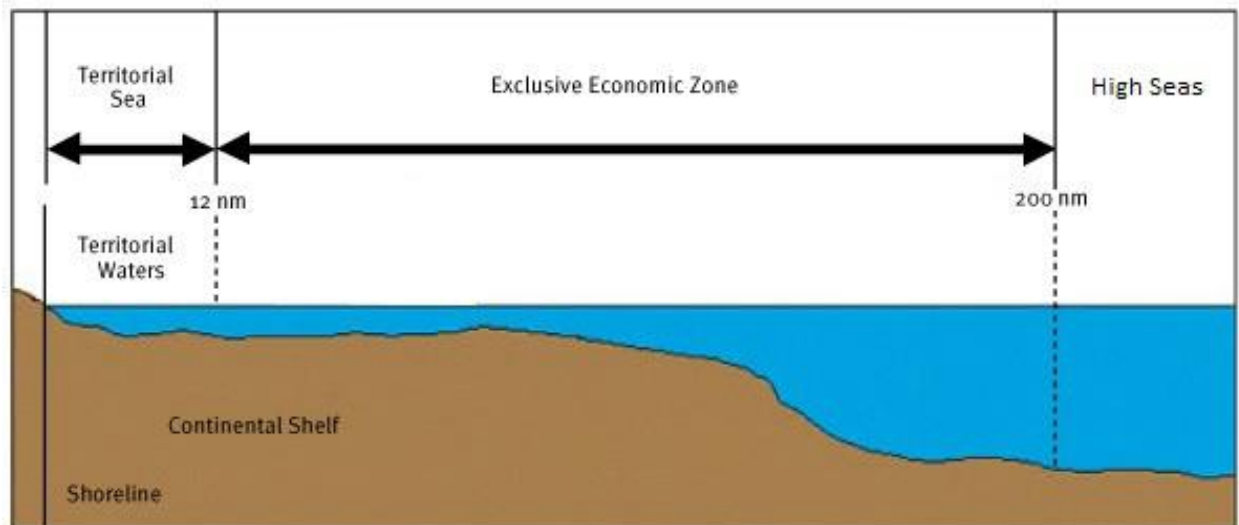
Can you explain with reference to a case study, why unsustainable fishing has occurred in some areas?



Source: www.ocean-law.org

There are many international agreements in place, however. There are 17 Regional Fisheries Management Organizations (RFMOs), composed of nations that share economic interests in a particular area. When member nations agree to RFMO regulations, they are bound by these rules, which may include catch limits and specifications on the types of gear used. Evidence suggests these regulations have led to decreased bycatch (such as dolphins in tuna nets), but maintaining healthy fish stocks has remained a challenge. Enforcing fishing regulations on the high seas is extremely difficult, but member nations have worked to address the problem of illegal fishing and prevent illegally caught seafood from being imported.

One organization that has demonstrated enforcement success is the North Pacific Anadromous Fish Commission (NPAFC), which exists primarily to preserve salmon stocks. Member nations are Canada, Japan, South Korea, Russia, and the United States. The commission prohibits catching salmon on the high seas, which is primarily accomplished using drift nets. Drift nets float freely in ocean currents, usually near the sea's surface. They are used to catch schooling fish like salmon and sardines. Unfortunately, these nets result in a lot of bycatch, ensnaring seabirds, marine mammals, and other non-targeted species.



4.3.9 Aquaculture has grown to provide additional food resources and support economic development and is expected to continue to rise.

→ Open and semi-closed aquaculture systems:

Open system culture generally refers to fish farming in natural water bodies such as oceans, bays, estuaries, coastal lagoons, lakes, or rivers.

Semi-closed aquaculture refers to the land-based production of a species, in which water is exchanged between the farm and a natural waterway.

→ Capture fisheries and aquaculture:

Aquaculture is the farming, breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean. Aquaculture produces all sorts of fish, shellfish, and seaweeds including food fish, sport fish, bait fish, ornamental fish, crustaceans, mollusks, algae, sea

vegetables, and fish eggs. Aquaculture also includes the production of fish and shellfish released into the wild to rebuild wild populations.

Approximately half the seafood eaten worldwide is farm-raised. Because harvest from wild fisheries has peaked globally, aquaculture is widely recognized as a necessary way to meet the seafood demands of a growing population. As a result, aquaculture is the fastest growing form of food production in the world.

Capture fishery production is the volume of wild fish catches landed for all commercial, industrial, recreational and subsistence purposes. Capture fishery involves catching fish directly from water bodies i.e. lakes, sea, ponds, etc.

4.3.10 Issues around aquaculture include: loss of habitats, pollution (with feed, antifouling agents, antibiotics and other medicines added to fish pens), spread of diseases and escaped species (some involving genetically modified organisms).

Like any form of industrial production, aquaculture has environmental impacts. The major impacts for the aquaculture industry include: using more fish than they produce, disease and parasite transfer, the introduction and spread of exotic species, chemical pollution, habitat destruction for farm siting or due to farm activities, and the killing of predators that prey on the farmed species.

Social impacts are also considered to be a major impact of aquaculture production and there are numerous conflicts around the world. The major conflicts include: traditional livelihood and community displacement and abusive labor practices. In some cases the impacts have been extreme and people have ended up being killed in the conflicts. Social impacts are mainly driven by export driven commodity production like shrimp, where companies seek to maximize profits by exploiting poor countries who have poor regulations.

Case study:

Discuss the controversial harvesting of a named species.

[Example, the historical Inuit tradition of whaling versus modern international conventions.]

The whaling controversy is the international environmental and ethical debate over whale hunting. The debate has focused on issues of sustainability and conservation as well as ownership and national sovereignty.

4.3.A2 Evaluate strategies that can be used to avoid unsustainable fishing.

[What is maximum sustainable yield (MSY) as applied to fish stocks?]

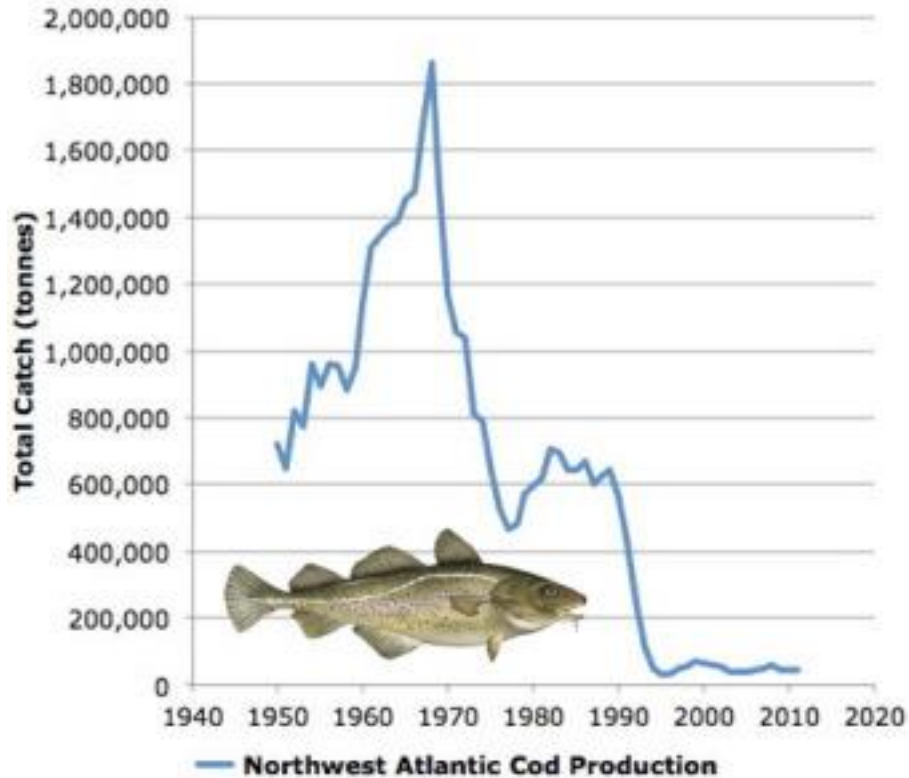


image from howtoconserve.org

The central strategy is to protect and restore marine fisheries, which in turn support fishing livelihoods and supply meals to millions of people around the world.

Depending on the fishery, strategies can:

- Increase the estimated biomass of severely distressed stocks.
- Prevent further declines in and/or increase the biomass of stocks facing moderate distress.
- Reduce bycatch of non-target species or juvenile age cohorts of target stocks.
- Where possible and relevant, protect and restore critical marine habitat such as mangroves and coral reefs.

HOW TO PREVENT OVER-FISHING

Implementing proper fishing management practices can increase the number of fish in the ocean by 50%



FACTORS THAT LEAD TO OVER-FISHING:



Too Much Fishing Capacity



Destructive Fishing Techniques



Weak Fishing Limits



Control Number & Size Of Fishing Vessels



Protect Critical Areas From Fishing



Require Science-Based Catch Limits

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Homework:

The potential value of aquaculture for providing food for future generations.

About 567 aquatic species are currently farmed all over the world, representing a wealth of genetic diversity both within and among species. Aquaculture is practiced by both some of the poorest farmers in developing countries and by multinational companies. Eating fish is part of the cultural tradition of many people and in terms of health benefits, it has an excellent nutritional profile. It is a good source of protein, fatty acids, vitamins, minerals and essential micronutrients. Aquatic plants such as seaweed are also an important resource for aquaculture as they provide nutrition, livelihood and other important industrial uses. Eighty percent of current aquaculture production is derived from animals low in the food chain such as herbivorous, omnivorous fish and mollusks.

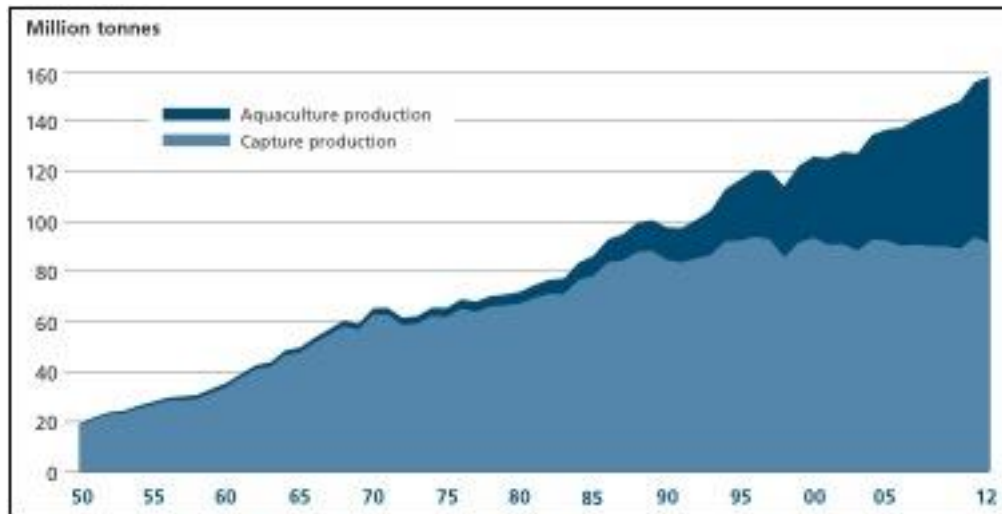


image from sharkresearch.rsmas.miami.edu 378 x 193 Search by image

A case study that demonstrates the impact of aquaculture.

Depletion and Salinization of Potable Water; Salinization of Agricultural Land: Pumping of groundwater to supply freshwater to shrimp farms has resulted in depletion and, sometimes, salinization of local water supplies, causing water shortages for coastal communities. There have also been many reports of crop losses after agricultural land has become salinized by effluent water pumped out from shrimp farms onto land.

Human Rights Abuses: There has been large scale displacement of families to make way for shrimp farms in some developing countries, contributing to landlessness and food insecurity. Non-violent protests against the industry have frequently been met with threats, intimidation and violence. Protesters have been murdered in at least 11 countries, including an estimated 150 people in Bangladesh alone.