

12

Economic  
Standards  
12.2.2. and 12.2.7.



# Sustaining Economies and the Earth's Resources

## **California Education and the Environment Initiative**

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## **LESSON 1 Economic Forces**

None required for this lesson.

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# Fishing the World's Oceans



With over 700 miles of coastline, it should be no surprise that a large part of the California economy includes the buying and selling of fish. Because seafood is an excellent source of lean protein, it is growing in popularity around the world.

For developing countries, fish represents a key source of dietary protein. China has the largest fishing industry, feeding the demand of its own people and markets elsewhere. China's domestic consumption of fish has grown five-fold since the 1970s, as its population has grown.

And Americans are eating more seafood now than ever—over 16 pounds of fish and shellfish per person in 2006. But our domestic supply of fish can only satisfy about 20% of our demand; the rest of the 4.9 billion pounds of seafood we consume each year must be imported.

After half a century of steady growth in the global “catch,” the United Nations projects a massive shortfall in seafood supply within the next 50 years. Increased demand, coupled with an increase in the use of fishing technology, has contributed to the decline in an overall supply of fish. One study found that almost a third



Chinese fishing boat unloads catch

of all fished species are already depleted. As fish prices rise, it becomes more attractive for the domestic industry to sell fish abroad than to send it “home.”

Several factors contribute to the problem: overfishing, pollution and habitat damage, and even possibly climate change. The United States is the world's fourth largest exporter of fish (behind China, Norway and Thailand) and the second largest seafood importer (behind Japan). Our domestic fisheries are working with those of other nations to address the looming supply problem soon to hit the global fish market.

### The Global Fish Market

Almost half the fish on the global fish market come from marine ecosystems in the open ocean. As the demand for fish rises, supply tightens and prices rise. Pressures of the market (price and demand) encourage a rush to cash in, resulting in ecosystems being overfished, as too many fish are caught in too short a time period, before they can breed and mature to replenish the population. Some of the fish caught are the fish the market demands for human use. But another way an ecosystem can be overfished is by an

excess of bycatch—fish, mammals and other marine life caught unintentionally, as a byproduct of certain fishing technologies. The increasing use of technology and the size of fishing vessels have made bycatch a real problem. These marine animals are often returned to the ocean in great numbers, either dead or dying, no longer able to help keep the marine ecosystem functioning.

Increased competition for a declining resource, when coupled with increasing consumer demand, results in even higher global fish prices. The higher “catch value” draws additional fishing companies and fishing vessels into the ocean, looking to “cash in” on an already scarce resource.

But, in many cases, the “catch value” is not enough

to allow the average fishing company to compete for the scarce resource. Some governments respond by giving money or other support, called subsidies, to their domestic fishing fleets, so that they can go after the scarce, higher-priced fish. Often this results in further scarcity of fish species, as too many boats chase too few fish.

### Managing the Supply

Protecting the global fish supply is complicated: fish are a moving target! Since fish are in the open ocean, they are considered a “common good.” The National Oceanic and Atmospheric Association (NOAA) regulates our domestic fisheries. NOAA is a federal agency, part of the U.S. Department of Commerce.



Swordfish caught in net

Established more than 200 years ago (in 1807), it is responsible for preserving the health of coastal and marine ecosystems. The National Marine Fisheries Service (NMFS) is part of NOAA and it monitors over two-hundred fish populations in the United States' "exclusive economic zone," (EEZ). The U.S.'s EEZ is the ocean anywhere between 3 to 200 miles offshore of the continent —one of the largest EEZ areas in the world.

The NMFS creates fishery management plans that dictate the types and quantity of fish that can be caught in the EEZ, or when they can be caught, depending on the fish population's health.

Past attempts by NMFS to control the seafood supply and industry practices have not always worked. For instance, restricting the fishing season for a certain species can cause a fishing frenzy, where large quantities of that fish are "dumped" onto the global market all at once, driving the price down. This quickly puts smaller fisheries out of business and can result in populations being overfished. More success has been had by limiting or eliminating certain kinds of fishing technology with extremely high (or damaging) catch rates (such as bottom-trawling); establishing protected



Bycatch thrown overboard

areas (marine sanctuaries) that serve as "safe zones" for marine species thus allowing them to grow and reproduce; keeping the ocean's ecosystems healthy; and finally, transferable quotas, which are a type of quotas allocated to individual fishermen or vessel owners, which can be sold or leased to others.

And whatever NMFS does has little to no effect on the fishing practices of other countries. Worldwide, national fisheries are self-governed by individual countries. However, 99% of the countries that fish are members of the World Trade Organization (WTO). The WTO helps to form agreements between the member nations,

some of which relate to fishing. In addition, the UN created a Code of Conduct for Responsible Fisheries in 1995. This code encourages member nations to adopt responsible fishing practices, such as: using technology that reduces or eliminates bycatch; enforcing proper licensing to fish and registration of fishing vessels; and ensuring that active vessels are less-polluting (low emissions). But not everyone upholds the UN “code” or honors WTO agreements. This creates disparities in the market, making it more difficult for fishing companies in those nations that are following regulations to compete against those from nations that do not regulate their fisheries.

### Meeting Future Demands

The United Nations recognized the potential fish supply problem as early as the 1990s and began a dialogue with member nations to address the issue. Today, national and international regulations encourage responsible fishing and free trade, with the goal of maintaining a healthy ocean and a healthy economy. But market forces continue to drive fisheries to catch more and more fish in order to make ends meet, exacerbating the supply problem. Regulation alone

cannot protect or replenish the global fish supply.

From scarcity often comes economic opportunity. Many see aquaculture as one solution, while others point to the environmental costs and hazards of farming fish. California has the most diverse fish farming industry in the nation, raising everything from catfish to caviar. Investing in aquaculture has created jobs

and economic opportunities for many of our coastal towns. But is it the answer to satisfying the world’s growing demand for fresh seafood? Will it ensure that the ocean’s ecosystems remain healthy and vibrant? Can it help sustain an industry that has been a part of our cultures and economies for thousands of years? With time and careful monitoring, we may be able to answer these questions.



Hauling in fish

# From Ocean to Table: The Atlantic Cod

Atlantic cod are native to most of the North Atlantic Ocean. They are found in the waters from western Greenland south to Cape Hatteras, North Carolina, with the largest populations off the coast of northern Labrador and the Nantucket Shoals of Massachusetts. Cod are known for their three rounded dorsal fins and two anal fins, and also have a prominent barbel (a “whisker”) on their chin. Adults can reach 5 to 6 feet. Deepwater (offshore) cod tend to be larger than coastal (inshore) cod, the former reaching 25 pounds at full size, the latter half that.

Cod reproduce for the first time when 5 or 6 years old. The number of eggs produced by a single female in a year increases with size and age. Atlantic cod spawn once a year. Cod living in coastal areas (inshore) generally move offshore to reproduce. Larvae hatch in 10 to 40 days after spawning, depending on the water temperature.

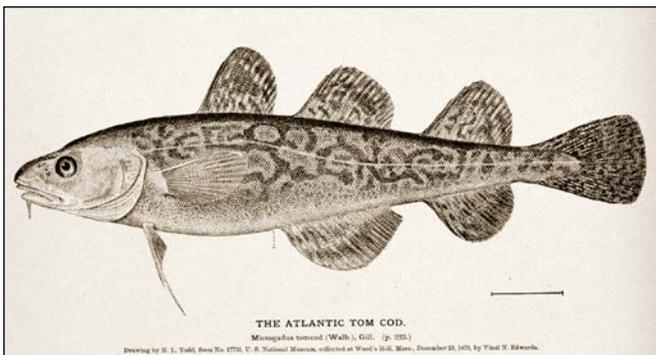
Atlantic cod live in a variety of habitats but generally are found at depths of 200 to 360 feet and in temperatures ranging from 34 to 36° F in the summer and at depths of 295 to 440 feet and

in temperatures of 36 to 39 F in the winter. They are seldom found deeper than 660 feet. Cod living in polar waters migrate to more southerly and deeper waters in winter and spring, while most other cod do not migrate. Some cod do move considerable distances in search of food or in response to overcrowding at certain spawning grounds, but generally adults remain within the area(s) in which they are born. Cod do not swim about in large schools and instead travel in small groups when searching for food.

Cod are omnivorous, feeding mainly upon small crustaceans, such as shrimp and amphipods. Adults will eat almost anything that fits into their mouths, including clams, cockles, mussels and other mollusks, as well as crabs, lobsters and sea urchins. Adults also hunt smaller fish, such as herring, mackerel, silver hake, and young haddock. Strange items, such as shoes, jewelry, and rope, have been found in cod stomachs.

## Human Consumption of Atlantic Cod

Cod is a flavorful fish, which can be baked, broiled, poached, fried, made into cakes or chowder, or salted for long-term storage without much loss of flavor or nutrition. The meat is a good source of lean protein, and cod-liver oil is a good source of omega-3 fatty acids, which improve circulation and help prevent blood clots. Cod is fished year-round and has historically been cheaper than other protein sources, such as beef for European and Northeastern U.S. communities. As one of the most important of all commercial fishes, cod was at one time called the “beef of

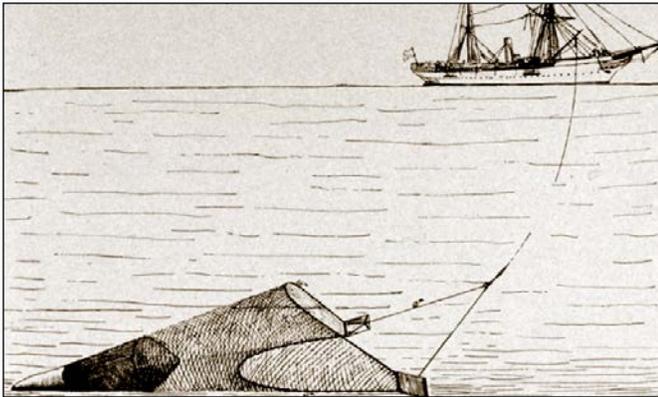


Atlantic cod

the sea.” For these reasons, North Atlantic cod fisheries have been a large part of the European and U.S. economies for decades.

### Harvesting Atlantic Cod

Cod can be caught with a rod and reel, using a piece of bait covering a hook. However, most commercial cod anglers use nets.



Bottom trawling

To catch cod, anglers use bottom trawling devices. These are large nets that are dragged across the sea floor, pulled by a boat on the surface above (called a “trawler”). These nets pick up any cod in the path of the net but also pick up other bottom-dwelling fish, such as halibut and flounder, and any other marine life on the ocean floor.

The contents of the nets are dumped onto the decks of the vessel, and the cod (and other fish of value) are sorted from the rest. The bycatch is either dumped directly back into the ocean or ground into small pieces, which are then dumped into the water.

### Transporting and Processing Cod and Other Fish

When fish are caught on the open sea, vessels must transport the catch back to the

market. This might literally mean selling fish in a marketplace, but in most cases, fish are sold to commercial companies for processing and distribution to consumers.

While many times fish might be eaten as filets, sometimes even directly from a fish market, most of the time consumers buy their fish pre-packaged from grocery stores. Fish are processed for many purposes. Besides whole pieces of fish, processing also includes canning fish products and manufacturing fish meal and oil. For example, Atlantic cod is used for a number of purposes, most notably for cod liver oil, an oil high in omega-3 fatty acids. Fish meal is another byproduct of fish processing. It is used primarily to feed pet fish or fish raised on fish farms.

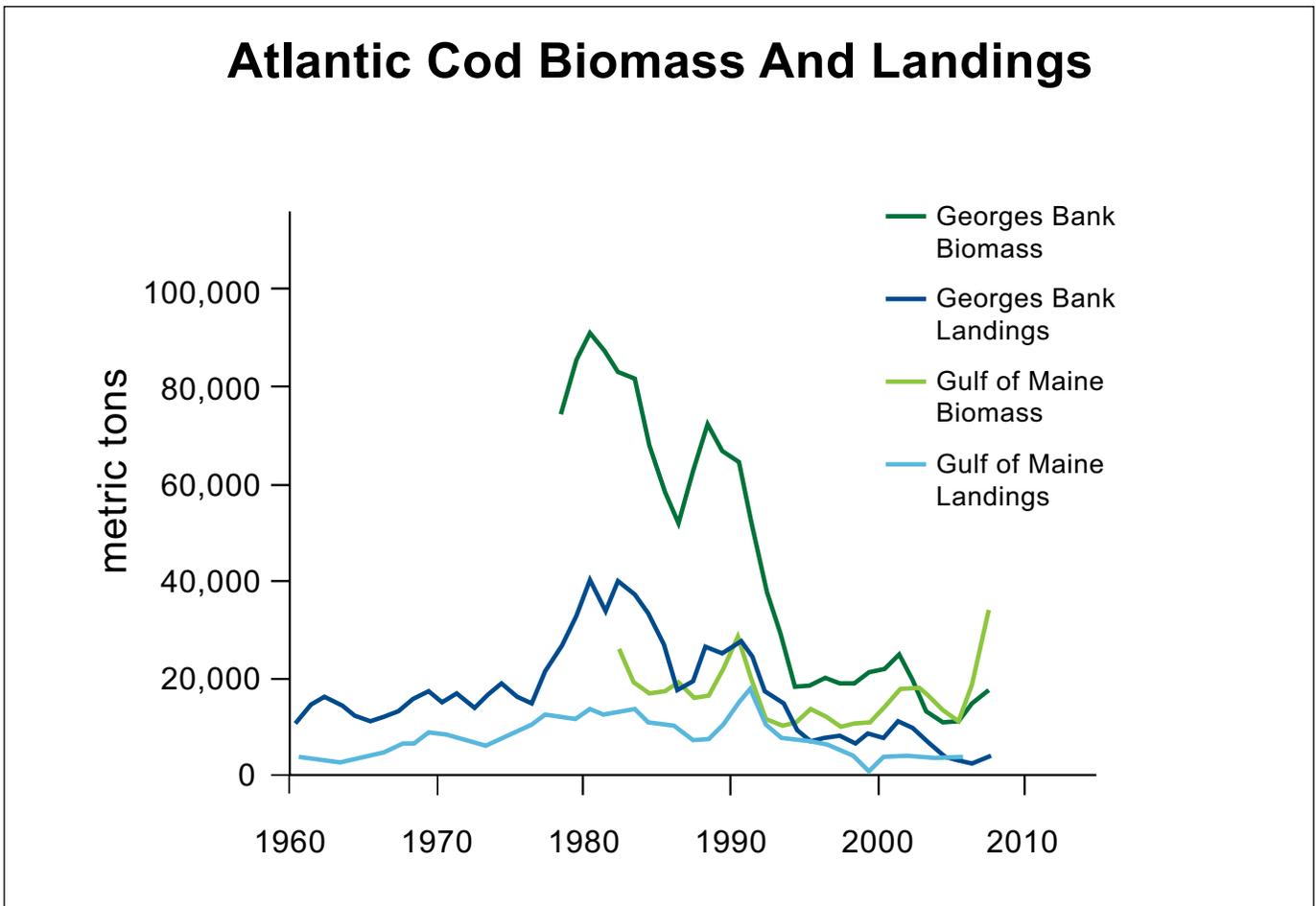
After fish and fish products are processed and packaged, they are shipped to markets for sale to consumers. Transportation of fish can be costly, depending on fuel prices and the fact that the product must be kept frozen, and these add to the price of the fish.

### The Affects of Human Consumption of Atlantic Cod

Scientists declared an Atlantic cod population “collapse” in the early 1990s. Since then, cod stocks



George's Bank cod fishery



Atlantic cod biomass and landings

have declined approximately 95%, leading many scientists to wonder if the population will ever recover.

There are several reasons for the Atlantic cod’s decline: the increase in demand for cod is certainly one, but changing ocean temperatures (climate change), rising levels of pollution, and disturbance of the ocean floor (where many juvenile cod spend their early years) through bottom trawling, have all put pressure on the cod population. As a result, both the biomass (tonnage of available cod) and landings of cod (tonnage of cod brought in by fisheries) have decreased.

But the ocean ecosystem has also been affected along with the cod population. Since cod

is a major predator in the ocean food chain, their decline has raised the crustacean populations in the Northern Atlantic, in turn putting pressure on the plankton populations upon which these crustaceans feed. Furthermore, these reductions in the amount of zooplankton have led to declines in the populations of many smaller fish—themselves another food source for adult cod—as well in the numbers of cod larvae, which feed on zooplankton. In 2003, some scientists claimed that starvation, along with the lasting effects of overfishing, would lead to the extinction of the Atlantic cod and the cod-fishing industry altogether.

# Catch of the Day: Stolen Seafood

**Fishing pirates are like cockroaches. Nothing gets rid of them.**

Sometime shortly after Canada Day this year (2006), as fisheries bureaucrats around the world prepared for an autumn summit on protecting global marine stocks, five rusting trawlers slipped into the narrow channel of international water between Greenland and Labrador and set down their lines. These trawlers are known as the “Rostock Girls.” How much fish they caught is unknown because no sooner had surveillance aircraft [operated by the Northwest Atlantic Fisheries Organization (NAFO)] spotted them, than they took off—probably to offload their catch on a refrigerated vessel. But you can bet they didn’t leave without lots of fish. Steinar Matthiasson, an adviser with the Fisheries Ministry of Iceland, says the same boats took as much as 40,000 tons of redfish last spring from just outside that country’s territorial limits. “And that,” he says, “is quite a bit.”



Unloading redfish catch

Fish pirates, according to the few people who have hunted them, are a lot like cockroaches: nothing gets rid of them. And the few you catch merely remind you how big the problem is. If there is a leader in high-seas pillaging, it is the Rostock Girls, a fleet that has plundered the oceans for so long that it has become a floating emblem of global inactivity toward illegal fishing. All five Rostock Girls ships were blacklisted last year for fishing the high seas without the licenses or quotas required by NAFO and its sister organization, the Northeast Atlantic Fisheries Commission (NEAFC). Yet the ships entered ports in Germany and Poland last winter, refueling and dry-docking and generally enjoying hospitality from countries that claim to abhor their kind. By spring, they were back on the open water. In this brave new world of “cooperative conservation,” that is not supposed to happen.

Hopes for a crackdown on the Rostock Girls rose in October after inspectors in Kaliningrad, Russia, boarded the boats under the authority of international conventions. But as of last week, the Russian authorities had neither seized the vessels’ fishing gear nor filed charges in court. “We’re glad they’re doing something,” says Sari Tolvanen, a Greenpeace activist who has tracked the ships for two years. “But I haven’t heard whether the legal case has been prepared, or whether they’ll detain the vessels or expel them.” The Rostock Girls, she notes, have escaped the long arm of the law before. And, let’s face it, when you think about environmental protection (or any kind of law enforcement), Russia is not a country that leaps to mind.

## Catch of the Day: Stolen Seafood

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Notorious though they may be, the Rostock Girls are merely part of a trend that experts say is driving world fish stocks toward collapse. With catch quotas shrinking for nearly every major fish species, and with diners as hungry as ever for fresh fish, the incentive to trawl “under the radar” has never been greater, says Daniel Pauly, director of the Fisheries Centre at the University of British Columbia and a leading expert on worldwide fish trends. Some estimate the annual take of illegal fish at \$9 billion worldwide, but the longer term ecological costs are incalculable. A recently published study led by Dalhousie University warned we are on course to literally “fish out” the seas by 2050, and urged the international community to adopt a strict conservation plan. But as Pauly notes, most countries don’t even try to calculate the amount of fish stolen from the seas, much less eliminate pirate fishing. “They pretend to themselves that it doesn’t happen,” he says.

European Union countries, in particular, have been criticized for routinely allowing ships to land catches that exceed their lawful quotas, and for harboring unregistered boats. And the Rostock Girls, for one, have exploited this transnational apathy. Named for the German port where they and their crews wintered in 2005, the fleet has protected itself by waging a global shell game of holding companies and operating firms that discourages serious prosecution. Its Russian owners are thought to live in Kaliningrad, says Tolvanen, but corporate searches show that they’ve registered a holding company, AB Bocyp Fishing, in Cyprus while the vessels themselves fly “flags of convenience” from countries like Belize and Dominica—nations too small or too corrupt to take action against fish pirates.

Their crews and names of the boats also tend to shift with the winds. Until recently, they



Illegal catch

were staffed mainly by Russians, and went by the Slavic handles Okhotino, Ostrovets, Oyra, Ostroe and Olchan. But their reputations began to precede them, and last year the group reflagged in Georgia under names that sound lifted from a Cuban flamenco act: the Carmen, the Eva, the Isabella, the Ulla, the Juanita. Greenpeace now refers to them as the “Spanish Chorus Line.”

They are, in short, the modern version of high-seas fugitives, fishing mainly on those fringes of national limits technically defined as “high seas,” and defying the authority of anyone who interrupts them. Their favorite prey appears to be the redfish, a bug-eyed creature with spiny fins that is known to diners as “ocean perch.” Like all slow-breeding ground fish, redfish have been dwindling lately in the North Atlantic. But the \$1,500 per ton they command on the open market is a powerful motivator. Last May, when choppers and cutters from the Icelandic Coast Guard intercepted the Rostock Girls on the edge of the country’s 12-mile limit, the poachers flat out ignored them. The Icelanders addressed them by loudspeaker, quoting international laws stipulating that unidentified vessels are assumed to be undermining conservation. But the crew of the Rostock Girls did not respond.

A few days later, the Carmen turned south and steamed 200 miles out to sea. As the

## Catch of the Day: Stolen Seafood

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Russian trawler seized for illegal fishing

Icelanders looked on, the ship met a refrigerated, Panamanian-flagged vessel called the Polestar. According to international fisheries treaties, no law-abiding country should have accepted these fish because they were caught by blacklisted vessels. Icelandic authorities were initially pleased when ports in Japan and South Korea turned the Polestar away. But their hopes fell when a buyer surfaced at the port of Hong Kong, and the fish were divided into containers destined for a variety of Asian countries. One of those countries, says Matthiasson, was Japan.

The Rostock Girls, meanwhile, disappeared over the waves. Icelandic authorities tracked them to their Baltic stopping grounds, through Poland, Lithuania and on to Russia. But having little support in years past at the ports of their so-called allies, authorities in Reykjavik weren't holding out much hope for results. They've even resorted to tipping off Greenpeace when they discover the ships' location, thinking shame might accomplish what international will cannot. The eco-group has gladly accepted the intelligence, painting "Stop Pirate Fishing" signs on the hulls of the ships as

crews look on. But as Tolvanen says: "It's a bit bizarre for us to be asked to do something the government should."

All of which puts the problem in the court of organizations like NAFO, who depend on individual member countries to carry out the rules of their conventions. Johanne Fischer, the organization's executive secretary, downplays the significance of pirate fishing in the North Atlantic, saying the number of vessels spotted during its surveillance flights has declined in recent years, while international cooperation improves. As evidence, she points to an agreement from the September summit—convened about the time the Rostock Girls were docking in Europe—requiring all 12 members of NAFO to close their ports to known pirate-fishing vessels except in emergencies. No dock, no fuel, no food and certainly no landing illegal fish. "[The Rostock Girls] tried to land their catches and were turned away," Fischer adds from NAFO headquarters in Dartmouth, Nova Scotia. "So you could say they've already faced some consequences."

Perhaps. But the poachers did eventually sell the fish, which highlights the problem between the statements of fisheries alliances and the actions of their members. And even under the new rules, there seems little incentive for nations to do the right thing: investigating the boats is costly, legally complex and time-consuming, while ignoring them will produce little more than diplomatic protest. The result, says University of British Columbia's Pauly, is a bleak outlook for any species that hasn't already been fished out. "For every major collapse like that of the northern cod, we have 10 species that are eroding," he says. "You can't do any kind of work in fisheries these days and be optimistic."

*Adaptation of article by: Charlie Gillis*

*Source: Maclean's; 12/4/2006, Vol. 119 Issue 48, p52–53, 2p*

# Fish Farming



Fish hatchery

Just as humans have farmed the land and domesticated animals for thousands of years, they also have cultivated fish and aquatic plants. More than 2,000 years ago, Chinese rice farmers raised carp as a second “crop” in their rice ponds. Carvings on ancient Egyptian tombs show men harvesting tilapia from ponds. Ancient Romans also bred fish in artificial ponds, called *piscinae*, for food and commercial sale and as a status symbol.

Most early aquaculture involved freshwater species, since it was easier to control fish in ponds or streams than in ocean waters. Some preindustrial societies, such as Australian aborigines, built elaborate networks of canals with gates and weirs to sort and catch fish. The first ocean fish farms may have been seawater ponds that were built 1,500 to 1,800 years ago in the Hawaiian Islands. These systems had walls made of coral and lava rocks, cemented together with algae, and canals that channeled fish in and out of the ocean through movable grates.

Freshwater aquaculture spread through Europe during the Middle Ages, spurred by Catholic Church doctrine that called for meatless fasting days throughout the year. Monarchs, nobles and monks harvested live fish from streams and stocked them in ponds until they were needed. After water-powered mills appeared around the year 1000, farmers began breeding carp in millponds across Europe.

Rich supplies of fish and shellfish helped to draw European explorers to the New World, but by the 1800s some North American fisheries were already degraded or overharvested. In response, fish culturists began importing and breeding fish to increase supplies. By the 1850s they had learned to propagate artificially, but efforts were too limited to slow the decline of many American fisheries.

In 1871 Spencer Baird, assistant secretary of the Smithsonian Institution, persuaded Congress to create a Commission on Fish and

Fisheries, with Baird in charge. The commission was the first U.S. government agency created to conserve a renewable resource. Under Baird the commission built a research laboratory at Woods Hole, Mass., and launched a broad research program on America's fisheries.

The commission also built a network of fish hatcheries and redistributed salmon, shad, trout, striped bass and other species across the nation. One venture, importing European carp as a cheap protein source for rural communities, proved to be a serious mistake—and an example of the pitfalls of introducing exotic animals to new habitats. Carp spread throughout the continental U.S. and were viewed as pests because they stirred up river and stream bottoms during feeding.

Aquaculture became part of the agricultural extension system in the early 20<sup>th</sup> century. State and federal researchers developed ways to raise new species like catfish, which local extension offices and land-grant colleges taught to farmers. In 1938, alarmed by the decline of the historic wild salmon and steelhead fisheries on the Columbia River, in the Pacific Northwest, Congress ordered the construction of large-scale hatcheries to boost fish stocks. But hatcheries could not compensate for overfishing and dam construction on the Columbia. From 1960 through 1990, up to 150 million juvenile Chinook salmon were released into the Columbia



Catfish

each year, but the efforts failed to produce sustained increases in harvests.

After World War II the booming postwar economy created growth conditions for aquaculture, giving Americans more time and income for sports (including fishing) and travel (which exposed them to new cuisines and restaurants). Land-based agriculture shifted from small family farms to large-scale production, aided by new machines, synthetic fertilizers and pesticides and animal antibiotics. Similarly, fish farming became more scientific as researchers developed low-cost feeds and standardized procedure for managing ponds and hatcheries.

### The Blue Revolution

Starting in the early 1960s, aquaculture grew rapidly in the United States and around the world. Total production, including aquatic plants, rose from about 1 million tons in the early 1950s to almost 60 million tons in 2004. Nearly all the growth occurred in Asia and the Pacific.

Marine experts call the jump to mass production the “Blue Revolution” in a nod to the earlier “Green Revolution” in the 1940s, when private foundations and national governments provided new high-yielding crop varieties to poor farmers in Asia and Latin America. These crops needed synthetic fertilizers and pesticides, which often caused new problems, such as making insects resistant to pesticides. The Green Revolution thus came to symbolize both the benefits and pitfalls of massive technical intervention in agriculture.

In the United States Southern farmers started building ponds on marginal croplands in the 1950s and stocking them with catfish, a popular and easy-to-raise sport fish with a mild flavor. From the mid-1960s forward, the industry became an important job source in

Mississippi, Alabama, Louisiana and Arkansas. By 2002 the yearly catfish crop was worth more than \$400 million, nearly half the total value of the U.S. aquaculture products.

Aquaculturists also started to raise marine fish and shellfish on both the East and West coasts, including salmon, sturgeon, clams, abalone and mussels. But neither wild fisheries nor the nascent U.S. aquaculture industry could keep up with consumer demand, and U.S. seafood imports rose from \$260 million in 1960 to \$3.6 billion in 1980.

In the 1980s, global aquaculture expanded rapidly, driving prices down for popular seafoods. Shrimp farming, grew rapidly in Asia and South America, while commercial salmon farming became established in Norway, Chile, Scotland, Canada and Japan, as well as in Maine and Washington state. Shrimp and salmon, which had been rare delicacies for most Americans a few decades earlier, became year-round mainstays on restaurant menus.

### Troubled Waters

As the industry grew, evidence mounted that poorly operated fish farms were spreading disease and competing with wild fisheries. Some of the first alarms came from the Pacific Northwest, where the Department of the Interior began listing wild salmon runs as endangered in the early 1990s. Competition between hatchery fish and their wild cousins, as well as overfishing and changing ocean conditions, caused Northwest salmon fisheries to collapse starting in the 1970s despite massive government investments in hatcheries.

From 20 to 40 percent of the Atlantic salmon caught in the North Atlantic between 1989 and 1996 were of farmed origin. By 1997, escaped farm salmon were successfully breeding in the wild in the waters off Norway, Ireland, the United Kingdom and eastern North America. Alarmed,

Alaska banned fish farming in state waters in 1989 to protect its wild salmon fishery, although salmon farming continued next door in British Columbia. In 2000, U.S. officials listed Atlantic salmon runs in eight Maine rivers as endangered, partly because of genetic mixing with escaped farm salmon.

Concerns also arose about the potential for fish farms to spread aquatic diseases to wild fisheries. Epidemiological patterns indicated that salmon farms promoted the spread of sea lice, infectious salmon anemia and whirling disease to wild populations in Europe and North America. Fifty-six shrimp farms were also highly susceptible to disease. For example, white spot syndrome virus wiped out entire aquaculture operations in some parts of Asia and South America and threatened to spread to wild shrimp and other crustaceans via escaped shrimp, flooding, pond discharges or bird predation.

Environmentalists also criticized marine fish farms as serious pollution sources and argued that the problem could grow worse as aquaculture expanded. They focused on waste discharges from ocean pens and cages, including feces, unconsumed fish food, antibiotics, and pesticides.

In 2003, a U.S. district court fined two Maine companies for operating salmon farms without Clean Water Act discharge permits and ordered them to suspend operations for two to three years while surrounding area recovered and to stop stocking European strains of Atlantic salmon. The court also denounced federal and state environmental regulators who had let the farms operate without permits.

“In the absence of any regulatory effort, inertia has reigned supreme, and the entities causing the environmental harm have been given a free pass to continue their heedless despoiling of the environment,” wrote Judge Gene Carter.

Consumer demand for seafood kept growing in spite of these debates as Americans sought alternatives to red meat, and researchers touted fish as a good source of lean protein. As debate widened over the risks and benefits of eating seafood, wild as well as farmed, buying fish became complicated. To help consumers and chefs make sustainable choices, ocean advocates and conservation groups published guides that typically endorsed farmed shellfish and vegetarian finfish, such as tilapia, but warned users away from salmon and shrimp.

Some health experts worried that these mixed messages, coupled with government warnings about mercury in some species of wild-caught fish, could turn consumers away from seafood altogether.

“An advisory is like a medication,” and Joshua T. Cohen, a senior research associate at Harvard University’s School of Public Health. “It has a therapeutic effect, but it also has side effects.”

Cohen and colleagues calculated that if mercury warnings made people who were not pregnant cut their seafood consumption by one-sixth, risks of heart disease and stroke would rise.

In the early 2000s, two commissions carried out the first broad reviews of U.S. policies related to ocean use and conservation in more than 30 years. The Pew Oceans Commission, funded by the Pew Charitable Trusts, focused on new laws and ways to strengthen existing laws in its 2003 report. The government-funded U.S. Commission on Ocean Policy, which issued its findings in 2004, stressed better coordination between federal agencies and bigger roles for states and communities in managing ocean resources. Both groups, however, found that the oceans were in crisis as a result of overfishing, marine pollution, coastal development, and poor coordination between government agencies responsible for managing ocean policies.

### Current Situation: Offshore Legislation

Congress is considering the national Offshore Aquaculture Act of 2007, which would authorize fish farming in federal waters. The NOAA-sponsored bill directs the secretary of commerce to develop a process for permitting offshore aquaculture facilities in the U.S. Exclusive Economic Zone, which stretches from three to 200 miles offshore, and to establish environmental requirements for marine fish farms.

“America is at a crossroads,” says Michael Rubino, director of NOAA’s aquaculture program. “We’re importing more than 80 percent of our seafood, and a lot of that is farmed. The choice is between growing some of that domestically or importing an increasing volume. The U.S. has very crowded coastlines, and we value them for other uses, but there’s lots of space in federal waters.”

Deepwater aquaculture is challenging because currents and storms are stronger, fish are more exposed to predators and it costs more to transport crews and equipment to farm sites. On the positive side, waters are cleaner, ocean currents carry wastes away from fish cages quickly and there are fewer conflicts with other activities, such as recreational boaters.

“It’s more expensive to farm offshore than to do it right next to the dock in calm water,” says University of Alaska economist Gunnar Knapp.

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Tilapia

## Embargo: Yellowfin Tuna

Yellowfin tuna are found with dolphins in the eastern tropical Pacific (ETP). Because dolphins surface for air, fishermen use schools of dolphins surfacing to locate the yellowfin tuna that swim below. Using fishing vessels with purse seines, fishermen encircle dolphins and tuna alike. Dolphins are killed in the process.

In 1990, the United States banned the use of such tuna fishing methods among domestic fisheries and embargoed all tuna and tuna product shipments from countries that fished for tuna using purse seine nets, or that processed and sold tuna caught in this manner. Mexico filed a complaint with the World Trade Organization (WTO), stating that they should not be subject to the same fishing techniques required by U.S. laws. The WTO agreed, but also stated that the U.S. could embargo shipments of products that did not meet their standards of quality. The U.S. imposed a “dolphin-safe” label, and requires that countries can attest to the dolphin-safe status of their tuna shipments.

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## Quotas: Alaskan Halibut

Alaskan halibut has not always been as popular among consumers as it is now. Although Alaskan halibut fishermen have long supported catch limits low enough to protect the stock, overfishing occurred because the fishery was open to anyone, allowing an unlimited number of boats to participate. With so many boats competing, the fishing season for halibut became a frantic race—a fishing “derby.” Fishermen began to fish in unsafe weather conditions and at a dangerous pace.

Today, the number of halibut that can be caught in a season is predetermined by weight. A vessel cannot fish in the area unless its skipper or crewmembers own a share of the total allowable catch—called an individual fishing quota, or IFQ (which are sometimes called ITQs: Individual Transferable Quotas, as well). Initially allocated to skippers with a history in the fishery, the quotas can now be bought and sold like private property. A fisherman can enter the fishery only by purchasing quota from someone who wants to sell a preexisting share.

ITQs are controversial because people claim that fishing companies with more money, oftentimes large corporations, can buy up all the quota shares and create a monopoly over the fishery and the supply of fish. The Alaskan halibut fishery has taken steps to prevent ITQs from accumulating in fewer hands, but many fishermen argue that ITQs will not work in other areas.

## Subsidies: Fishing

Basic economic theory would seem to say that fisheries should be self-sustaining—when fish populations (stocks) get low and/or the cost of fishing rises, fishing will be less profitable, and people and capital assets will move out of the business, allowing the fish populations (stocks) to recover. However, if a large part of a community’s economy relies on fishing, the community cannot afford to wait (or have people starve) while the natural system replenishes the stock. In these situations, the government often pays the companies affected to stay in business. This giving of subsidies has enabled fleets to continue fishing, even when it is not profitable—or good for the natural system—to do so.

At the beginning, the more subsidies a country gave to the fishing industry, the more catch it got, often because at that time fish stocks were large. Time and technology have changed things. Stocks are now too small for all fishing companies to make a profit, and too many opportunities exist for technologies to over exploit what stock remains. Today’s subsidies now typically contribute to overfishing.

Governments around the world continue to subsidize their fisheries in the belief that without financial support, the fishing industry and fishing communities will suffer in the short term, withdrawing their political support and cutting into the countries’ financial reserves in the long term. Governments are also motivated by the need to stay competitive in the global fishing industry.

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## Moratorium: Striped Bass

The decline of Atlantic striped bass was so alarming that, by 1979, the U.S. Congress enacted an Emergency Striped Bass Act. The act initiated a study to assess the size of the migratory stock, investigate the causes of the decline, calculate its economic importance, and recommend measures for restoration.

From this research, scientists from the U.S. Fish and Wildlife Service, state agencies and universities discovered new information about striped bass to assist them in restoration. Careful assessment of the stock showed that, because of overfishing, the striped bass population was much more susceptible to natural stresses and pollution.

The study team also concluded that reducing fishing pressure would have an immediate positive effect by enabling females with eggs to spawn.

In 1985, Maryland imposed a total moratorium on fishing for striped bass. Virginia followed by banning striped bass fishing in spawning areas. Four years later, Virginia further imposed a complete ban on striped bass fishing. However, fishery managers knew that harvest restrictions alone would not permanently restore striped bass to the Chesapeake Bay.

## Trade Agreement: Pacific Salmon

Countries around the world develop trade agreements to control the production and distribution of goods. Most trade agreements focus on the use and management of shared natural resources, such as the border areas between countries, or goods like fish.

In 1985, the United States and Canada signed the Pacific Salmon Treaty, which provided for the co-management of the Pacific salmon whose habitat includes both countries. Since then, this treaty has been amended with several trade agreements that establish management practices for both countries. These management practices are developed by the Pacific Salmon Commission, but must be approved by both the U.S. Congress and Canada.

In recent years, the Pacific salmon population has been devastated by overfishing, making this natural resource scarce along North America's west coast. Since the salmon migrate from waters off the coast of Oregon and Washington to waters off the coast of British Columbia and Alaska, the two countries have come to a consensus on better ways to manage this resource through these trade agreements. Both the United States and Canada have agreed to "safe" harvest amounts, and both also give aid to the fishing industries that rely on salmon. The goals of these trade agreements are to allow the salmon supply to rebound and promote a sustainable salmon industry in both countries.

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## Tariff: Taxes on Fish

Tariffs are taxes on goods. Goods imported into the U.S. are taxed as a way to favor the products of domestic suppliers. For example, if a foreign country can produce a good at a cheaper price and import the good to the U.S., then consumers in the U.S. would buy this good over more expensive domestic goods. By applying tariffs to imported goods, domestic suppliers are protected, since the tax on imported goods keeps their prices more competitive. The U.S. imposes import tariffs on goods from some countries, but also has trade agreements with other countries, like Canada and Mexico, that have eliminated tariffs.

According to the U.S. Tariff Schedule, most fish imported into the U.S. are tariff-free (not taxed). Other countries have import tariffs on fish, though. For example, the European Union has imposed tariffs as high as 15% on imported sea bass and 23% on sardines. Japan has imposed tariff rates generally between 5–10% on all fish caught by non-Japanese companies. These tariffs cause prices to rise on imported fish in the stores so that domestically-produced fish products are cheaper than imported fish, and therefore more appealing to most consumers.

## Zoning: The EEZ

In 1983, U.S. President Ronald Reagan declared that the ocean areas from the baseline (coast) extending to 200 nautical miles from the United States and its territories (Puerto Rico, American Samoa, Guam, the Northern Mariana Islands and others) to be zones in which the United States had exclusive rights to any and all marine resources, for use or for exploration. A year earlier, the concept of EEZs was presented to the international community at the United Nations Convention on Law of the Sea (UNCLOS), but was not ratified. By declaring the United States' ownership over these areas, President Reagan not only increased the territory of the United States by 3.9 billion acres (in effect doubling its size), but in one fell swoop eliminated all international competition with US industries for the fish, minerals, oil, and gas deposits that exist in those areas.

Other countries with coastal access soon declared their own EEZs. The United States has the largest EEZ (including its territories), followed by France and Australia.\* China's EEZ is the smallest, about 80% of the size that the U.S. controls. Where the EEZs of neighboring countries overlap, they negotiate trade agreements to prevent conflicts. There are still many disputes in places where permanent ice shelves extend beyond the baseline (coast).

*\* Today, the EEZ of the European Union is shared, making it the largest EEZ in the world.*

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