BCS 312: Land and Environments of the Circumpolar North II

Module 5: Living Aquatic Resources

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Overview

This module examines the economic importance of the Arctic's living aquatic resources, including fish, seabirds and marine mammals. Subsistence and commercial harvesting of key aquatic species is discussed, including an analysis of the conflicts between fish farming (aquaculture) and the harvest of wild fish, and the practice of commercial whaling and its effects on Arctic whale stocks.

Learning Objectives

Upon completion of this module, you should be able to:

1. Identify key fisheries species and explain the economic importance of fisheries for northern countries.
2. Analyze the conflicts between fish farming and wild anadromous species.
3. Identify the main species of harvested marine mammals and seabirds in the waters of the circumpolar North and explain the economic importance of these harvests for northern countries.
4. Summarize the practice of modern commercial whaling of Arctic nations and the effects of commercial whaling on Arctic whale stocks.

Required Readings (including web sites)

Arctic Flora and Fauna: Status and Conservation. pp67-73: Use of Living Resources (excluding sidebars), p87: Economic importance of harvests. Available online: http://arctic-council.org/filearchive/AFF%20Status%20and%20Trends.pdf

The Encyclopedia of Earth. Mixed economies in the Arctic. Available online: http://www.eoearth.org/article/Mixed_economies_in_the_Arctic

Ruegg, K., E. Anderson, C.S. Baker, M. Vant, J. Jackson and S.R. Palumbi. 2010. Are Antarctic Minke Whales Unusually Abundant? Lenfest Ocean Program Research Series. Available online:

http://lenfestocean.org/publications/Lenfest%20RS%20Minke%20FINAL.pdf

Nagoda D. and M. Esmark. 2003. Fish farming in the Arctic. GRID-Arendal Polar Environment Times No.3. p5. Available online: http://www.grida.no/_res/site/File/publications/environment-times/poltimesp5.pdf

The Greenland Home Rule. 2009. Management and utilization of seals in Greenland. pp 1 and 4 (read to the end of "Historical Exploitation of Seals in Greenland" section). Available online by searching for "Management and Utilization of Seals in Greenland 2009".

Key Terms and Concepts

- Anadromous
- Baleen
- Biomass
- Commercial Fishing
- Echo Sounders
- Exclusive Economic Zone (EEZ)
- Fish Stocks
- Fishing Quotas
- Formal Economy
- Gross Domestic Product (GDP)
- Groundfish
- Informal Economy
- Large Marine Ecosystem (LME)
- Moratorium
- Pelagic
- Purse Seine
- Seabirds
- Sport Fishing
- Stock
- Subsistence Harvest
- Total Allowable Catch
- Transgenic
- Trawl

Learning Material

Introduction

The Arctic's living aquatic resources, which include fish, seabirds and marine mammals have historically provided circumpolar Indigenous peoples with foods and materials for survival. Although northern life has dramatically changed in the past century, subsistence harvests continue to play an important role in the **informal economy** of many communities. Commercial harvests today allow northern peoples to participate in the **formal economy**, which provides income necessary to live a modern lifestyle. However, historical harvests conducted on an industrial scale have proven detrimental to many **stocks** of fish and marine animals. This module discusses the harvest of key

aquatic species (fish, seals, walrus, seabirds and whales) with emphasis on commercial harvesting. This includes an analysis of the conflicts between fish farming (aquaculture) and the harvest of wild fish.

5.1 Key Fisheries Species and the Economic Importance of Fisheries for Northern Countries

Arctic Fisheries

Though vast expanses of the Arctic are fished very little or not at all, a large portion of the world's marine catch is taken in Arctic waters. Fish are the regions largest and most profitable living resource and the harvest of fish contributes significantly to the economies of Arctic nations.

Local communities, including Aboriginal peoples who have traditionally relied on Arctic fisheries for food, share this resource with large **commercial fishing** fleets. In areas where the bulk of Arctic fish are caught, many fish populations have been depleted or harvested to the point of collapse. Ecological changes brought on by climate change will also impact these fisheries.

Diligent management is needed to ensure Arctic fisheries continue to supply a rich quantity and diversity of species for harvest. The long-term economic health of Arctic fisheries will rely on sustainable fishery policies and good management of the marine environment.

Given the huge economic importance of fishing to Aboriginal peoples, efforts are being made to address the problems that threaten fisheries they rely upon. Some of these are based on the traditional practices of Aboriginal fishers.

For the purposes of this section, Arctic fisheries will be described by country or **large marine ecosystem (LME)**. LMEs encompass coastal areas, including river basins and estuaries, to the seaward boundaries of continental shelves and outer margins of major ocean current systems (Figure 1).

Subsistence fisheries

In Arctic regions, local economies rely on a mix of subsistence harvest and cash income. Subsistence activities are part of the informal economy. In the Arctic, this refers largely to hunting and gathering of wild plants and animals by communities and families. These activities are as crucial to Arctic economies as the formal (cash) economy, which is driven by paid work that also includes the harvest and sale of wild food resources such as fish.

While the **subsistence harvest** of fish is largely done for personal consumption and trade between individuals and communities, the commercial harvest provides cash these communities need to buy consumer goods, fishing and hunting equipment, and live a modern lifestyle.

Fishing is the main source of direct income for many Arctic Indigenous communities. Many operate sustainable commercial harvests alongside subsistence fisheries. However, as increased demands of large-scale commercial fisheries are introduced, large-scale fisheries have the potential to deplete valuable **fish stocks**. While Indigenous communities welcome the influx of cash, commercial fisheries can also conflict with the use of traditional fishing grounds and the allocation of the fish harvest.

Reconciling the requirements of both fisheries while managing the fish harvest has been challenging and often contentious.

Most subsistence fishing is done in coastal areas and river deltas for **anadromous** species. Anadromous fish, such as some whitefishes (genus *Coregonus*) and salmon, live mostly in the ocean and breed in fresh water. Freshwater fisheries are relatively small, though very important to Arctic subsistence economies. Small sport, commercial and subsistence fisheries exist throughout the North American Arctic for such species as Arctic char, Arctic grayling (*Thymallus arcticus*), lake trout (*Salvelinus namaycuch*) and northern pike (*Esox lucius*). A limited commercial fishery for vendace (*Coregonus albula*) and whitefish (*Coregonis lavaretus*) exists in Finland, while Arctic char and northern pike are popular sport fish in Norway.

Canada – Much of the fishing done in the Canadian Arctic is for Aboriginal subsistence use, most importantly for Arctic char (*Salvelinus alpinus*) and to a lesser degree, Atlantic salmon (*Salmo salar*).

Russia – The Kara Sea, Laptev Sea and East Siberian Sea LMEs are relatively species-poor with the bulk of subsistence catches consisting of “whitefishes” (six species of the genus *Coregonus*, subfamiliy *Coregoninae*, family *Salmonidae*). These are typically caught in the lower reaches of rivers, estuaries and surrounding coastal areas.

United States (Alaska) – Similarly to the above LMEs, Alaskan small-scale fisheries catches in the Beaufort Sea LME have been historically dominated by Arctic whitefish (*Coregonus autumnalis*) and broad whitefish (*C. nasus*) with lesser catches of dolly varden (*Salvelinus malma*). Marine subsistence fisheries are an important component throughout the Chukchi Sea with target species including chum salmon (*Oncorhynchus keta*), whitefishes and dolly varden. Overall, catches in the Beaufort Sea LME (Alaskan and Canadian) have been dominated by whitefish (*C. autumnalis* and *C. nasus*) and dolly varden.

Learning Highlight 1

Fishing is the main source of direct income for many Arctic Indigenous communities. Many communities operate sustainable commercial harvests along with subsistence fisheries.

Learning Activity 1

Identify the most important subsistence and commercial fish species harvested near you.

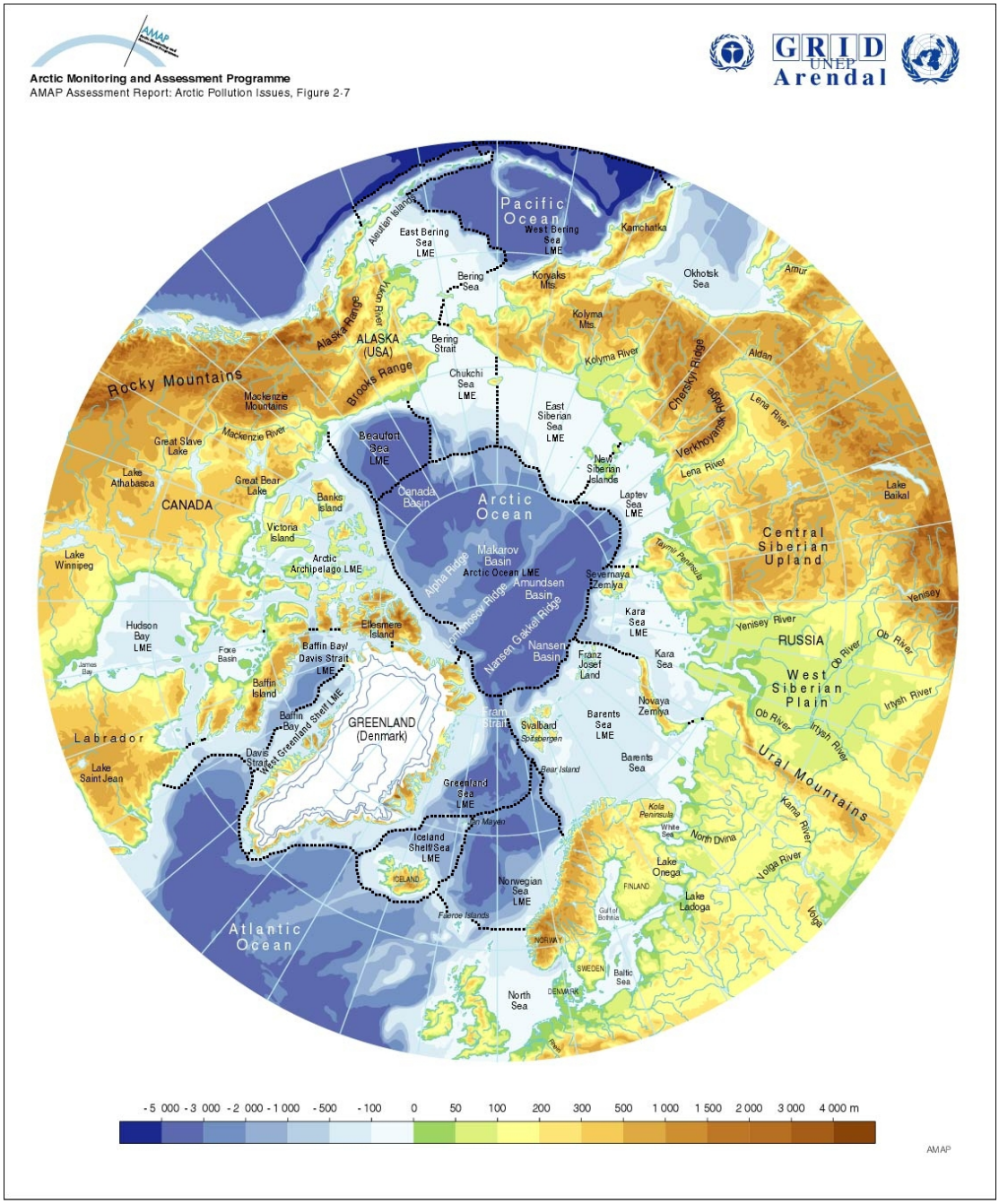

Figure 1. Large Marine Ecosystems (LMEs) of the Arctic Circumpolar Region.

The use of fish for human consumption has dropped as arctic diets have changed to include imported foods. Important to a healthy, traditional diet, the loss of fish and other wild foods and the increase in imported southern foods have had indirect negative economic effects of increasing health-related costs linked to obesity and diabetes.

Commercial Fisheries

Two main areas of the Arctic contain rich fishing grounds that produce the bulk of the Arctic catch. These are the Barents Sea and Bering Sea LMEs. Russia and Norway are

the main nations fishing the Barents Sea, while Russia and the United States are the primary nations fishing the Bering Sea.

The Greenland, Iceland and Faroe Islands economies rely heavily on commercial fishing in North Atlantic waters.

Commercial fishing of marine species in Russian LMEs is currently limited to pink salmon (*Oncorhynchus gorbuscha*) and dolly varden, which occur in commercial quantities in rivers discharging into the East Siberian Sea LME.

In contrast to the above regions, much of the Arctic Ocean is ice-covered and fished little or not at all. There is little commercial fishing potential in much of the Canadian Arctic due to:

- low productivity of its fisheries,
- distance from markets, and
- dangers posed to fishing vessels by unpredictable weather conditions.

Nonetheless, Arctic sea ice is receding due to climate change, bringing increased interest in commercial fishing. As of 2009, the Canadian government was considering closing its Arctic waters to commercial harvest until its potential impact on marine ecology can be studied. The United States government closed its Arctic Ocean territory to commercial fishing in 2009 for the same reason.

The North Pacific

The Bering Sea is one of the world's richest fishing grounds. In 1976, with the extension of the United States' and Russia's 200-mile **exclusive economic zones** (EEZs), the fishers of these two nations came to dominate its three million square kilometre area. Commercial fishing in this region is managed by a set of international agreements with the Russian and American governments setting the **total allowable catch** (TAC) for fish harvested within their own waters.

As of 2000, the Bering Sea's 25 commercially fished species made up 56 percent of the United States' fishery and up to 5 percent of the global fish and shellfish catch. Between 60 and 70 percent of Russia's annual fish harvest is taken in the waters of the Russian Far East (RFE), which include the Sea of Japan, the Sea of Okhotsk and the Bering Sea.

Groundfish, primarily Pacific halibut (*Hippoglossus stenolepis*) and yellowfin sole (*Limanda aspera*) continue to represent 30 percent of the total Bering Sea catch. However, the sea's greatest bounty has been pollock (*Theragra chalogramma*). It is the largest United States fishery and represents one third of the United States' total annual fish harvest. In 2009, one million metric tonnes were harvested, producing over US$1 billion in fish products.

In 2010, the total Russian catch was the world's sixth largest, producing approximately 4.2 million tons of processed fish, much of it coming from the Bering and Barents Seas.

Depletion of several Bering Sea fish stocks occurred in the latter half of the 20th century. Overfished species included yellowfin sole, Pacific halibut, Pacific Ocean perch (*Sebastes alutus*), sablefish (*Anoplopoma fimbria*), shellfish species and pollock. Since the breakup of the Soviet Union, the RFE has modernized its fleet and massively increased its catch capacity. This, coupled with illegal fishing operations, reduced populations of the region's high-value fish species such as salmon, crab, pollock and

sturgeon. Should these fish stocks continue to decline or collapse, the fishing industry will meet a similar fate. This will have a devastating effect on the economy of the RFE, which heavily depends on fisheries income.

Both nations now practice **sustainable fisheries management**. As a result, between 2010 and 2011, the total **biomass** of pollock in the Bering Sea is estimated to have doubled to 9.6 million tonnes from 4.6 million tonnes.

The North Atlantic

Norway and Russia are the predominant fishing nations in the Northeast Atlantic, which includes the waters around Iceland, east of Greenland, the Norwegian and Greenland Seas, and principally, the Barents Sea.

Norway and Russia have harvested cod (*Gadus morhua*) and herring (*Claupea harengus*) in the Barents Sea for the last 1,000 years. Around 1900, small-scale, localized Arctic fisheries began to give way to modern fishing fleets with the harvest of cod in coastal Norwegian waters and the Barents Sea. Large-scale Arctic commercial fisheries took shape in the northeast Atlantic after the Second World War. From 1900 to the late 1970s, the use of efficient fishing technologies instead of small-scale boats and gear brought vast increases in catches of cod, capelin, herring and other species. **Echo sounders** were used to better locate fish and **trawls** and **purse seines** were used to catch fish in great quantity.

Overfishing in the 20th century caused the collapse of several fish stocks in the Northeast Atlantic. Sustainable fisheries management is now practiced within and between nations. Norway and Russia jointly manage the Barents Sea fish stocks. Key stocks of haddock (*Melanogrammus aeglefinus*) and North Atlantic cod, traditionally Northern Europe's most important commercial fish, are increasing as a result. Capelin (*Mallotus villosus*) and herring also remain important commercial fish. In 2007, Norway was the world's second largest seafood exporting nation at 37 billon kroner (US$4.9 billion). In 2009, the country exported a record 7.2 billion kroner worth of herring, mackerel (*Scomber scombrus*), horse mackerel (*Trachurus trachurus*), capelin, sardines (several species of small oily fish) and other **pelagic** species.

Several important North Atlantic fish stocks have been depleted, most notably Atlantic salmon. Atlantic salmon aquaculture has become a major portion of the Norwegian commercial fishery (Module 5.2) and has increased Iceland's salmon production.

Greenland – The fishery employs 20 percent of Greenlanders and fish represents 95 percent of exports. Greenland has also negotiated trade agreements allowing other nations to fish in its waters in exchange for access to those countries' restricted marketplaces.

Royal Greenland, a fisheries corporation owned by the Greenland government, earned 4.2 billion krone (US$800 million) in 2009-2010 and is the world's biggest producer of coldwater shrimp. Other key species of the Greenlandic fishery include cod, Atlantic salmon and halibut.

Iceland – Fishing is the country's most important industry, employing 6.5 percent of the population. Fish products represent 70 percent of Icelandic exports. Key species include cod, haddock, saithe (*Pollachius virens*), redfish (*Sebastes mentella*), herring and capelin.

Faroe Islands – The sale of fish products accounts for 95 percent of Faroe Islands merchandise exports and 20 percent of its **gross domestic product** (GDP). Among its

most important harvested stocks are herring, blue whitting (*Micromesistius poutassou*), mackerel, cod, haddock and saithe. Aquaculture is also a growing part of the fishery, producing Atlantic salmon and rainbow trout (*Oncorhynchus mykiss*).

Sport Fishery

Sport fishing has become increasingly important to Arctic economies, bringing cash and employment. Although it has put additional pressure on fish stocks, it has increased economic benefits. For example, Alaskan sport fisheries, which target such species as Pacific salmon (*Oncorhynchus nerka*), halibut, Arctic char and inconnu (*Stenodus leucichthys*) are worth approximately US$500 million annually.

In the 1990s, the Atlantic salmon sport fishery grew quickly in Norway and Iceland. Believing that the economic returns per fish from sport fishing exponentially outweigh returns from commercial fishing, Icelandic recreational organizations launched the North Atlantic Salmon Fund which bought and retired commercial **fishing quotas** from Icelandic, Greenlandic and Faroese fishers.

5.3 Potential Conflicts Between Fish Farming and Wild Anadromous Species

Aquaculture

Aquaculture is the farming of aquatic organisms. Currently, one third of the world's seafood production comes from aquaculture (Vancouver Aquarium, 2011). Aquaculture has been practiced for thousands of years but the rearing of northern fish species, i.e., fish farming, has evolved recently (Rabanal, 1988). Although the Arctic has no history of aquaculture, fish farming has become important to some Arctic nations in recent decades. Atlantic salmon and Arctic char are two examples of anadromous northern species that are commercially farmed.

Atlantic salmon 

Of the salmonid species commercially farmed worldwide, Atlantic salmon is the most important (Laird, 1996). In response to the ongoing depletion of wild salmon stocks, Norwegian scientists began culturing salmon for use in fish farming in the 1960s. Atlantic salmon were raised in marine net cages and selectively bred for desirable characteristics. What resulted was a domesticated salmon, *Salmo domesticus*, which grew much faster than wild Atlantic salmon. In 2003, 1.4 million tonnes of *S. domesticus* was produced worldwide, triple the wild salmon harvest (Fisheries and Oceans Canada, 2011). Norway leads the world in farmed salmon production.

Arctic char

No freshwater fish is found as far north as Arctic char. Arctic char resemble salmon in appearance but have a milder taste than Atlantic salmon (Freeman, 2011). Canadian research into Arctic char aquaculture began in the late 1970s, with farm production of Arctic char recently emerging beyond the development stage. In winter, wild Arctic char congregate in small pockets of unfrozen fresh water. Their natural tendency to tolerate crowded conditions makes them ideal for tank rearing in aquaculture facilities. They are commercially farmed in Canada, the United States, Iceland, Norway and other European countries (Freeman, 2011).

Issues Associated with the Aquaculture of Northern Species

Aquaculture is touted as a way to help meet consumer demand and reduce pressure on over-exploited wild fish stocks. Aquaculture can also provide long-term employment in remote regions, but it can have undesirable effects on the economics and health of northern wild-stock fisheries.

Economic Conflicts

In a competitive market, the price of a particular item will vary until reaching an economic balance of price and quantity. In simple terms, if supply increases but demand remains the same, the price of the item goes down. Commercial fish farming increases the supply of fish. If consumer demand does not increase, fish farming can negatively impact fish prices and the profitability and viability of wild fisheries. For example, in 1980, farmed salmon accounted for only one percent of world salmon supply; however, production increased dramatically to more than double that of the world's capture fisheries by the year 2001 (Figure 2) (Knapp et al., 2007). The export price of salmon and trout decreased substantially over the same period (Figure 3).

Learning Highlight 2

Atlantic salmon is the most economically important salmonid species commercially farmed worldwide.

Learning Activity 2

Are there any aquaculture facilties near your community? If so, which species are cultured?

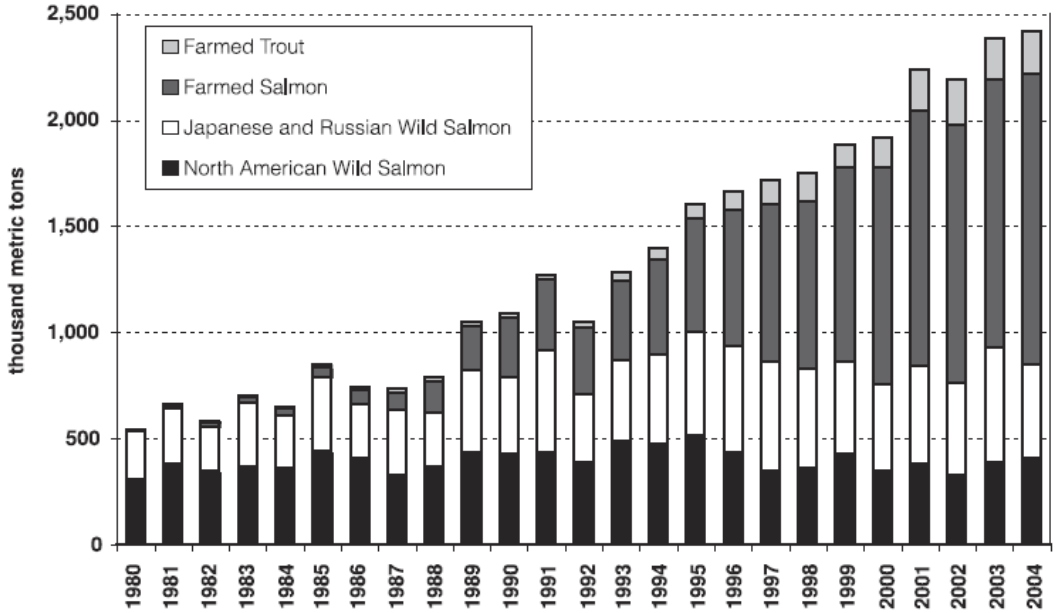

Figure 2. World salmon and trout supply (1980-2004).

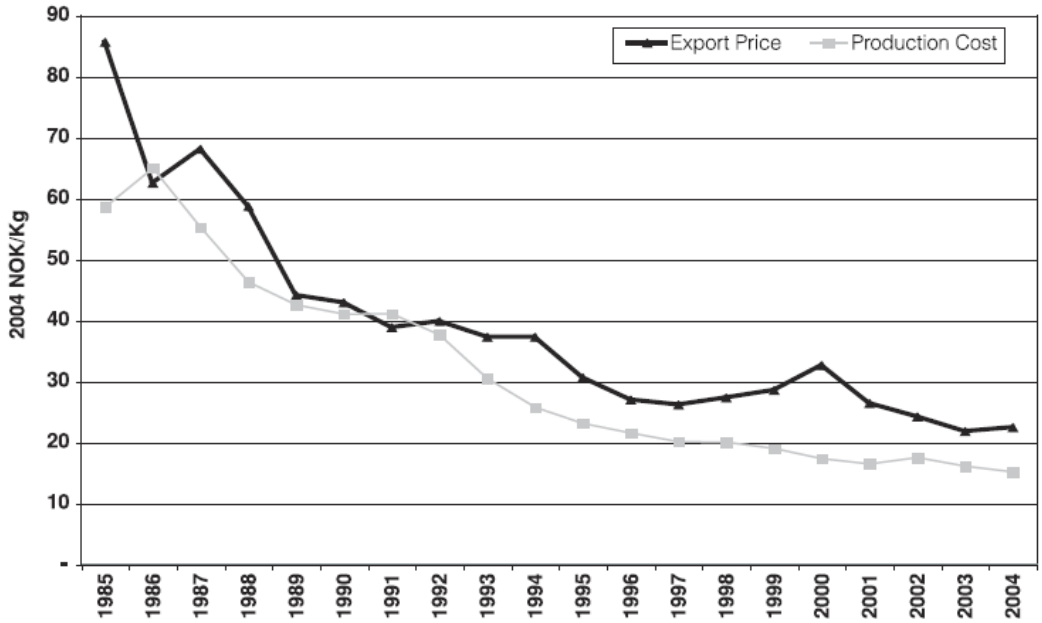

Figure 3. Export price and production cost of Norwegian Atlantic salmon (1985-2004).

Although, the decrease in salmon prices was not entirely due to the increase in supply of farmed salmon, it likely was linked. Additional factors influencing salmon supply and demand during this period included:

- increased world harvests of wild salmon,

- demand for canned salmon declined, and
- salmon consumption in Japan decreased (Knapp et al., 2007).

Globally, seafood processing, distribution and retailing has changed in recent years to favour farmed fish. A few large retail and foodservice buyers now dominate the seafood market. These buyers want consistent, reliable, year-round supply of large volumes of seafood at low, stable, competitive prices. Farmed fish better meet the needs of these buyers than wild fish (Knapp et al., 2007). Globalization of the seafood industry can add to the economic influence of fish farming on traditional wild fish markets.

Wild salmon have become a smaller, specialized part of the salmon industry. The limited supply of certain coveted species of wild salmon is increasingly sold in high-quality restaurants and fish stores where people are willing to pay more. In this way, premium wild salmon compete less directly with farmed salmon and are less affected by the low wholesale price of farmed salmon (Knapp et al., 2007).

Environmental Issues Associated with Salmon Farming

The issues discussed below are not unique to salmon farming. However, given the importance and relevance of salmon aquaculture to northern economies and ecosystems, salmon aquaculture is used in the following subsections as an example to highlight issues that can bring aquaculture into conflict with northern wild stocks and fisheries.

Nutrient Pollution (habitat degradation)

Many species of fish are fed artificial feed in pellet form. This feed is tossed onto the water surface and consumed by the fish. However, not all the feed is eaten and the excess can settle to the ocean bottom. Nutrients released from fish excretion, fecal waste and the breakdown of excess feed can stimulate algae blooms near intensive fish farming operations. Once these blooms die decaying algae robs surrounding water of oxygen potentially harming marine organisms (Emerson, 1999). In addition, certain algal species in these blooms are noxious or toxic to marine organisms and humans. For example, dinoflagelates can produce toxins that can kill other organisms or create a serious health risk to people consuming contaminated filter-feeding shellfish (e.g., paralytic shellfish poisoning).

Attempts have been made to reduce the environmental footprint of fish farms. Nutrient release from operations in the Barents Sea have been drastically reduced in the last decade (Greenberg, 2010). Management areas have been set up in the Bay of Fundy, New Brunswick, Canada to reduce salmon farm and fish density. New low-phosphorus feeds, such as soybean meal, are also being developed to replace traditional domestic feeds. (Opstvedt et al., 2003). Salmon manure is also being investigated for use as a soil fertilizer (Teuber et al., 2005; Celis et al., 2008).

Land-based Arctic char rearing systems, which remove particulate matter and effluent prior to releasing water into the environment, are touted as being among the most environmentally responsible fish farming designs. Waste sludge is provided to terrestrial farmers for use on crops (Canadian Aquaculture Industry Alliance, 2011).

Consumption of Wild Forage Fish

Farmed salmon must consume great quantities of fatty, protein-rich food. In 2003, three to four kilograms of wild-caught fish were required to produce one kilogram of farmed salmon. North Atlantic species, such as capelin, herring, Norway pout (*Trisopterus*

esmarkii) and blue whiting are used in fish feed (Nagoda and Esmark, 2003). Overfishing of wild forage fish populations may affect the entire marine ecosystem in unforeseen ways. Naturally, expansion of fish farming will increase the harvest of these wild species. To help address this issue, feed manufacturers are developing feeds composed of sustainable ingredients such as vegetables (Canadian Aquaculture Industry Alliance, 2011).

Disease and Parasites

High density fish farms may breed parasites and diseases that can spread to and affect wild fish. For example, sea lice (referring to several species of parasitic marine copepod) infestations can pass to and from wild salmon. Sea lice can proliferate in the close quarters of salmon pens. In high numbers, this parasite can be deadly to migrating young wild salmon. However, there is debate whether the transfer of sea lice from farmed salmon to wild salmon is on a sufficient scale to have an impact. Changes in farming methods and the use of chemicals can prevent and treat sea lice outbreaks (Aquaculture Association of Canada, date unknown).

Genetic Pollution

Genetic Selection

Fish species selected for use in aquaculture are typically bred for desirable traits, including faster growth, later sexual maturity, higher resistance to diseases (higher survival) and better flesh quality (lower fat-content, colour, texture) (Icelandic Ministry of Fisheries and Agriculture, 2011). As a result of this selection process, farmed fish are usually genetically different from their wild cousins. Escaped farm fish may adversely affect wild populations. In addition to competing with wild fish for food and habitat, escaped fish can interbreed with wild populations. This may diminish genetic diversity of wild populations and make them less resistant to environmental changes (The Cadmus Group, 2006). The extent of the effects of salmon farming on wild salmon populations are currently unknown (Greenberg, 2010). In Norway in 2002, 630,000 salmon and trout escaped from fish farms (Nagoda and Esmark, 2003). Storms off the coast of Scotland in 2005 resulted in the release of over 600,000 farmed salmon (Seafood Choices Alliance, 2005). To protect wild salmonid stocks in Iceland from possible genetic pollution and parasitic infestation, the rearing of salmonid species is prohibited in fjords and bays close to major salmon rivers (Icelandic Ministry of Fisheries and Agriculture, 2011).

Transgenic Fish

Transgenic technology, the insertion of DNA from one species into other, is currently being explored as a means to further develop fish with superior characteristics. For example, waters along the east coast of Canada are too cold for most fish species including salmon. Increasing cold tolerance in salmon by inserting Arctic cod genes would allow for expansion of the aquaculture industry along the Atlantic coastal region and other areas currently unsuitable for salmon farming. However, there is considerable concern among environmental organizations and consumer groups regarding the potential effects of escaped transgenic salmon on wild salmon populations (Reichhardt, 2000).

Introduction of Invasive Species

Farmed fish have the potential to escape into areas they are not native. If the escapees establish wild populations, they can compete with indigenous fish species or alter entire

ecosystems. For example, Atlantic salmon, native to the Atlantic Ocean, that escape from aquaculture operations in the Pacific Ocean could compete with native west coast salmon species.

5.4 The Economic Importance of Marine Mammals and Seabirds Harvested in Circumpolar Regions

Circumpolar peoples historically have harvested a variety of marine non-fish marine species, including whales, seals, walrus, seabirds and their eggs.

Seals

Traditional Uses – Seals have been harvested by Aboriginal peoples for thousands of years, including harp (*Pagophilus groenlandicus*), hooded (*Cystophora cristata*), grey (*Halichoerus grypus*), northern fur (*Callorhinus ursinus*), northern elephant (*Mirounga angustirostris*), harbor (*Phoca vitulina*), ringed (*Pusa hispida*), spotted (*Phoca largha*), ribbon (*Phoca fasciata*) and Steller sea lion (*Eumetopias jubatus*). Traditional and modern uses of seal include:

- highly nutritious food,
- skins used for waterproof jackets, boots, boats, tents and harpoon lines,
- fur used for warm coats, and
- blubber used for lamp fuel, lubricant, cooking oil and leather conditioner.

In Russia, the United States (Alaska), Canada, Iceland, Greenland and Norway various seal species are still harvested annually on a local, small-scale basis. Seals remain important to local subsistence economies; however, only harp, hooded and grey seals are hunted commercially.

Learning Highlight 3
Pelts are the main product of the commercial seal harvest with seal meat and oil having smaller, limited markets.

Commercial Circumpolar Sealing Nations

Harp, and to a lesser extent, hooded and grey seals are harvested commercially in the Atlantic Ocean mainly by Canada, Norway, Russia and Greenland, with Canada and Greenland harvesting the majority of the animals.

Seal pelts are the main product of the harvest, which are sold mainly to the clothing industry. Other limited uses of harvested seal include meat, used as dog food in some countries, and oil, which is a source of the essential fatty acid Omega-3, a health supplement (CBC News, 2009).

In July 2009, the European Union banned the commercial trade of all seal products with a limited exemption for Inuit products. Regulations implementing the ban were to come into force in August 2010, but the ban was suspended after Inuit leaders and other groups challenged its legality (Fisheries and Oceans Canada, 2011; CBC News, 2010). Although the proposed European Union ban exempted trade in seal products from Aboriginal groups, the Inuit argued that the seal market would collapse as a result of the

ban and their market would collapse with it. Canada sells 15 percent of its seal exports to the European Union and 80 percent to Norway (CBC News, 2009).

Canada

Newfoundland, Labrador and Quebec residents living adjacent to sealing areas are allowed to harvest six seals for their personal use. Aboriginal peoples and non-Aboriginal coastal residents residing north of 53°N latitude can harvest seals for subsistence purposes without a licence (Fisheries and Oceans, 2011). Although federal quotas include hooded and grey seals, most of the hunt is for harp seals (CBC News, 2009). In 2006, pelt prices spiked with pelts selling for over CDN$100 each. In 2009, prices dropped to approximately CDN$13.50 resulting in fewer seal hunt participants and smaller harvests than allotted quotas.

Value to the Economy

Demand for seal oil drove the early commercial hunt and large quantities were shipped abroad in the mid to late 1800's. By the late 19th century, the Newfoundland sealing industry was second to cod fishing in importance and provided critical winter wages for fishermen (Canadian Geographic, 2000). Harvesting seals can provide significant income for rural communities; however, relative to the overall Newfoundland and Canadian economies the annual seal hunt provides little. The landed value of seals exceeded CDN$16.5 million in 2005, a fraction of the Newfoundland fishery, which had a landed value of approximately CDN$500 million in 2007 (CBC News, 2009). In comparison, total GDP for Newfoundland was CDN$29.2 billion in 2007 and Canada's GDP was CDN$1.3 trillion in 2009; (Statistics Canada, 2011). Accordingly, without government subsidies, the viability of the Canadian sealing industry has been described as uncertain (Canadian Institute for Business and the Environment, 2001).

Norway

Harp and hooded seals are harvested yearly and grey and harbour seals are exploited by local hunters along the Norwegian coast (ACIA, 2005). Limited information is available regarding the value of the seal harvest relative to county and country economies. Compared to historic levels harvests are greatly reduced, i.e., 255 thousand seals harvested in 1950 versus 1,263 seals in 2008 (Statistics Norway, 2009). Due to the comparatively small number of animals harvested, the economic value of this fishery is likely limited to the local community level. The Norwegian sealing industry has been criticized as being non-viable without government subsidization (Seal Conservation Society, 2011).

Iceland

The seal population in Icelandic waters is comparatively small so sealing of harbor and grey seals has never been carried out on an industrial scale. Since the 1960s, the number of skins has varied between 1,000 and 7,000 annually (ACIA, 2005).

Greenland

In Greenland, five seal species are exploited with harp and ring seals by far the most important (ACIA, 2005). Greenland is the second largest sealing state in the world based on the number of seals harvested per year, i.e., commercial and subsistence. The Greenland harvest of northwest Atlantic harp seals ranged between 66.1 and 98.5 thousand animals from 2000 to 2007 (DFO, 2010). Seal hunting occurs year round in Greenland. Although the industry is not economically viable without a subsidy, sealing provides a significant amount of food and supplemental income to remote communities

(The Greenland Home Rule, 2006). About half of the harvested seal skins are traded and exported internationally (The Greenland Home Rule, 2006). In 2006, Greenland exported approximately €5 million of raw seal pelts. The export of seal fur products is approximately 1.7 percent of all Greenlandic exports (IFAW, date unknown). Compared to the overall economy, income from the seal hunt is minor relative to Greenland's GDP €1.7 billion in 2008 (World Bank, 2011).

Russia

The Russian seal hunt has not been well monitored since the breakup of the Soviet Union. In 2005, Russians harvested 14,277 harp seals from the Barents and White Seas. In Russia, walrus (*Odobenus rosmarus*) and spotted, ringed and ribbon seals are hunted in the northwestern Bering Sea. Their harvest has been low since the end of ship-based hunting operations. In Russian-controlled waters, the fur seal harvest was only 2,180 animals in 2000 (ACIA, 2005).

Learning Activity 3

Are any seal species harvested (subsistence or commercial) in your region? If so, which species? Have you eaten seal meat? If not, would you consider eating it? Why or why not?

Walrus

Three subspecies of walrus inhabit the Arctic Ocean and sub-Arctic seas of the Northern Hemisphere, Atlantic walrus (*O. rosmarus rosmarus*), Pacific walrus (*O. rosmarus divergens*) and Laptev Sea walrus *(O. rosmarus laptevi)*.

In addition to food, traditional uses for walrus include tools and handicrafts (tusks and bone), heat and light (oil), and rope as well as house and boat coverings (hide). Walrus meat remains an important part of local diets and the art of tusk carving and engraving continues (Wein et al., 1996).

Although heavily exploited in the late 1800's by American and European sealers and whalers for its blubber and ivory, commercial walrus harvesting is currently outlawed (Bockstoce and Botkin, 1982). Approximately 4,000 to 7,000 Pacific walruses are harvested annually in Alaska and Russia by subsistence hunters and several hundred are killed annually around Greenland (Chivers, 2002; Witting and Born, 2005).

Sea Birds

Seabirds spend the majority of their life at sea. In almost all circumpolar regions, seabirds and their eggs have been harvested for thousands of years. Historically, birds were hunted for meat, eggs, skins and down; however, it was not until the 20th century that modern harvest methods began to have widespread impact on seabird populations (Denlinger and Wohl, 2001).

Seabird harvests vary among circumpolar nations from small to largely unregulated harvesting. Commercial harvests are limited and serve local markets, making little

contribution to provincial, state or federal economies (Denlinger and Wohl, 2001). The information below refers to subsistence harvesting unless stated as being commercial.

Alaska

In 1996, an estimated 36,000 seabirds were harvested representing approximately 10 percent of the total migratory birds harvested in Alaska. The two most commonly harvested seabirds were crested auklets (*Aethia cristatella*) and common murres (*Uria aalge*). In 1995, the total estimated number of seabird eggs collected exceeded 115,000 most of which were gulls (Laridae), murres (*Uria*) and terns (Sternidae). Seabird harvests are now recognized and regulated under the 1999 Protocol Amendments to the Migratory Bird Conventions with Canada and Mexico (Denlinger and Wohl, 2001).

Canada

In addition to the long history of Indigenous seabird harvesting, European settlers brought a tradition of seabird hunting that has continued on the Atlantic coast for the past 500 years. With the exception of cormorants (*Phalacrocoracidae*), seabirds are managed under the Migratory Convention of 1916 and protected under federal legislation. Migratory birds and their eggs may not be sold in Canada. Auks and eiders (*Somateria*) are legally hunted by Aborginal people in all coastal regions. In Newfoundland and Labrador, residents legally hunt thick-billed murres (*Uria lomvia*) and common murres. In Labrador, Aborginal people harvest Atlantic puffins (*Fratercula arctica*), dovekies (*Alle alle*), razorbills (*Alca torda*) and black guillemots (*Cepphus grille*). Egging of auks and eiders is legal for Aborginal people and occurs in the Arctic and Labrador. The total annual bird harvest in Arctic Canada is approximately 25,000, half of which are common eiders (*Somateria mollissima*). The harvest of seabird eggs in Arctic Canada is low. The largest harvest of seabirds in Canada occurs in Newfoundland and Labrador where 200,000 to 300,000 birds mostly thick-billed murres are taken annually for human consumption (Denlinger and Wohl, 2001).

Greenland

Historically, seabirds were hunted for down, eggs and meat but all birds are now protected. There is an open season for 26 bird species and harvesting eggs is allowed for nine species. Bird hunting is licensed on a professional and leisure basis, and it is legal to shoot birds for personal use and local sale for both types of hunters. Common murres, thick-billed murres and common (*Somateria mollissima*) and king eiders (*S. spectabilis*) are the most commonly hunted seabirds in Greenland. Hunting statistics are limited, but the harvest of murres in Greenland could be as high as 390,000. Since 1990, the Home Rule Government has granted limited commercial harvests of murres in South Greenland municipalities. As of 2001, hunters sold an average of 18,000 murres each year to processing companies (Denlinger and Wohl, 2001).

Iceland

Eider is economically Iceland's most important seabird species with approximately three tons of eider down collected per year from nests worth US$2 million. Hunting data indicate that puffins are hunted in the largest numbers (185,000 to 233,000 per year) with between 86,000 and 113,000 common murres, thick-billed murres and razorbills collected annually (Denlinger and Wohl, 2001).

Norway

Norway has a long tradition of harvesting marine birds in the north Barents Sea region. Egging, down collection and harvesting of adults and chicks were traditionally important

for rural people, commercially and for personal use. Today harvesting has been reduced and strictly regulated (Denlinger and Wohl, 2001).

Russia

Seabird harvesting began with the colonization of northwest Russia and parts of the northeast. In the early 19th century, people in the Russian Barents Sea region used murres for their meat, feathers and skins. By the middle of the 20th century, more than 3,000,000 murre eggs and 500,000 adult birds were harvested annually. In northeast Russia, Indigenous people have traditionally harvested seabirds and continue today on a limited basis (Denlinger and Wohl, 2001).

5.4 Modern Commercial Whaling of Arctic Nations and the Effects of Commercial Whaling on Arctic Whale Stocks

History of Whaling

Indigenous communities across the North American Arctic have hunted the bowhead whale (*Balaena mysticetus*) for thousands of years. Bowheads grow up to 20 metres in length and can weigh 90 tonnes. Bowheads feed using a comb-like substance called **baleen** that hangs from its upper jaw and strains tiny food organisms (zooplankton) from the water.

Prior to contact with modern commercial whalers, productive Indigenous whaling villages were a key part of the trade and subsistence economy of Northwestern Alaskan and the adjacent Canadian coastal regions. Every part of the whale was utilized. Meat, skin, blubber and internal organs were used as food, and oil was used for heat and lamp fuel. Baleen and bones were used to construct dwellings, furniture and an array of tools and implements.

Whaling was of great economic value. Initially, blubber was rendered for whale oil used in European street lamps and as an ingredient in soap, paint, varnish and lubricants. As demand for these products decreased just prior to the 20th century, whales were harvested for their baleen. A prized and versatile commodity, it was used much like plastic is today. Baleen was utilized in manufacturing a huge range of items from carriage wheels and corsets to brush bristles.

Beginning in the 16th century, commercial whaling systematically depleted the bowhead's circumpolar populations. The United States was the main Arctic nation to harvest whales commercially in Arctic waters. Primarily American and British whalers depleted bowhead stocks in the northeastern Canadian Arctic, with the hunt peaking between 1820 and 1840. American whalers took to the Bering Sea in the mid-1800s, depleting bowhead stocks and pushing into the Beaufort Sea in 1889. Although the bowhead harvest was not banned until decades later, whaling in the North virtually ceased by the start of the First World War. The whale's scarcity made further harvest impractical. Petroleum-based products replaced whale oil and spring steel replaced baleen, rendering the once-great economic importance of whaling limited.

Whaling significantly impacted the way of life of the Inuit of northern Canada and Inupiat of Alaska. In exchange for European trade goods, whaling vessels employed them as crew members, hunters, dog drivers and seamstresses. Communities near whaling stations came to rely heavily on European trade goods because they had given up their semi-nomadic existence. The import of liquor by whalers led to the spread of violence

and the introduction of diseases such as typhus, scarlet fever and measles, which dramatically reduced Indigenous populations.

Although the bowhead had been hunted to near extinction by 1914, it was not globally protected until 1946. Scientific studies estimate the Greenland-Spitzbergen stock to have been 52,500 animals before commercial whaling. Its Beaufort Sea-Arctic Ocean population was estimated to have been between 14,000 and 20,000, having fallen to 7,500 by 1991. A small population of 250 existed in the Baffin Island region in 1991, down from a pre-whaling estimate of 10,000. The bowhead's 1991 total global population was estimated at 10,000 animals. The whale's population has grown steadily since whaling ceased, however, it remains an endangered species.

Whaling Today

The International Whaling Commission (IWC) is an 88-nation voluntary body that administers the International Convention for the Regulation of Whaling (ICRW), an international agreement signed in 1946. The organization monitors and regulates the whaling industry and studies whale populations. In 1986, the organization introduced a **moratorium** on commercial whaling that remains in effect today and allows harvest only for scientific study and Aboriginal subsistence. However, the IWC's ability to enforce its authority is limited. Member nations can effectively opt out of the ban by lodging a protest as Norway did in 1992. Anti-whaling groups claim the controversial scientific harvest of whales is in fact commercial whaling in disguise, although whaling by Indigenous peoples is more widely accepted.

The North Atlantic Marine Mammal Commission (NAMMCO) was established in 1992 by several Arctic whaling nations (Norway, Iceland, Greenland and the Faroe Islands) dissatisfied with the IWC whaling moratorium. Norway and Iceland have recommended that the IWC ban be lifted and some anti-whaling nations favour allowing a limited commercial harvest, although opponents of whaling are strongly against these proposals. The only whale now commercially harvested in the Arctic is the minke (*Balaenoptera acutorostrata*), which is used exclusively for food.

Learning Highlight 4

In 1986, the International Whaling Commission introduced a moratorium on commercial whaling that remains in effect today and allows harvest for scientific study and Aboriginal subsistence only.

Norway

Norwegian coastal fishers have harpooned whales in the North Atlantic almost continuously for 1,000 years. Prior to the golden age of commercial whaling, the minke whale was the main species harvested. Like the bowhead, the minke is a baleen feeder. Long and slender, this grey-black whale reaches an average length of just over seven metres and adults can weigh between four and five tonnes.

Norway's commercial whaling fleet harvested bowhead whales in Icelandic waters starting in 1883, moving on to the eastern Canadian High Arctic once these waters were depleted. Norway continued to harvest the minke throughout the 20th century. Following a short hiatus after the institution of the IWC moratorium, the country re-launched its commercial whaling industry in 1993.

Whale meat is consumed within Norway and Norway exports it to Iceland, the Faroe Islands and Japan. Although many Norwegians consider whaling to be part of their cultural heritage, the industry is declining as Norwegian and global demand for whale meat drops. Its harvest is of limited national economic value, providing income to a small number of individuals and businesses. The minke is not endangered but its harvest remains controversial. Norway argues whaling is sustainable and culturally important. The total world minke population is estimated at 300,000 to 400,000 animals and its pre-whaling population is estimated to have been 670,000.

Iceland

Icelanders have harvested whales since the early 12th century. During the late 19th century, Iceland benefitted economically as a base for Norwegian whaling operations. During the 20th century, Icelandic whalers harvested humpback (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), blue (*Balaenoptera musculus*), minke and fin (*Balaenoptera physalus*) whales. Iceland's scientific whale hunt took 386 fin and sei whales between 1986 and 1989, but its whaling activity paused until 2003. From 2003 to 2007, Iceland harvested 200 minkes for scientific study. Facing international pressure to cease its whale hunt and unhappy with IWC rejections of its harvest requests, Iceland withdrew from the IWC in 1992. It has since rejoined, but has exempted itself from observing the organization's whaling moratorium. The country has continued its scientific minke hunt and re-launched its commercial hunt in 2006. Iceland has been widely criticized for defying the IWC whaling ban and for harvesting the endangered fin whale. From 2009 to 2010, 273 fin whales were harvested.

Russia

The Soviet Union was the world's largest commercial whaling nation during the 20th century, but ceased whaling completely with its collapse in 1991. Limited information about Soviet whaling is available.

Traditional Subsistence Harvests

Aboriginal communities in Russia, Greenland and the United States (Alaska) continue to practice subsistence whaling. Native communities across the Arctic claim whaling as an important part of their cultures and whale meat as a necessary part of their traditional diets. The hunt is typically carried out during spring and fall. Small boats pursue whales in open water between shore-fast ice and moving pack ice. Dangerous and demanding, the hunt requires community cooperation. Once a whale is killed, it is towed to the ice, dragged onshore and butchered.

Managed by the Alaska Eskimo Whaling Commission, nine northwestern Alaskan Indigenous communities take part in the bowhead hunt in the Chukchi and Bering Seas. About 50 bowheads are harvested annually. One or two grey whales were taken each year until 1996 when their harvest was temporarily banned. Grey whales average 14 metres in length, can weigh 35,000 kilograms and eat tiny plankton-feeding organisms, worms and crustaceans.

Russians of the Chukotka Autonomous Okrug in the Russian Far East have harvested up to 131 grey whales annually from the Northeast Pacific between 1995 and 2006. Russians also harvest beluga and one to three bowhead annually.

Canada permits a limited subsistence bowhead hunt. Since 2004, Inuit whalers have harvested just one every two years from the Hudson Bay-Foxe Basin population and one every 13 years from the Baffin Bay-Davis Straight population.

Greenland's Inuit whalers annually harvest approximately 160 minke and 10 fin whales from the island's coastal waters. The IWC also granted Greenland a quota allowing the yearly harvest of two bowheads starting in 2009.

The Faroe Islands regulates its own long-finned pilot whale (*Globicephala melaena*) hunt as the IWC does not regulate the hunt of small cetaceans. Although critics say the hunt is cruel and unnecessary, islanders claim whaling as part of their cultural heritage. Each summer, approximately 950 of this dolphin species are taken by islanders in a non-commercial harvest. Atlantic white-sided dolphin (*Lagenorhynchus acutus*) and northern bottlenose whales (*Hyperoodon ampullatus*) are sometimes taken.

Indigenous peoples of the circumpolar regions have traditionally hunted the beluga (*Delphinapterus leucas*) and narwhal (*Monodon monoceros*). Weighing up to 1,500 kilograms, the beluga is a small-toothed whale that feeds upon fish, crustaceans and cephalopods. The narwhal, which can weigh up to 1,600 kilograms, feeds on Greenland halibut, squid and polar cod. Currently both are subject to a limited Indigenous subsistence harvest and neither species is considered endangered.

Learning Activity 4

Have whale species historically been hunted in your area? If so, which species? Are they still hunted?

Diminished Economic Value

Whaling is no longer of great economic importance to Arctic nations. The whale harvest is now of cultural and subsistence importance to a small number of Arctic nations and Indigenous peoples. Only Norway and Iceland maintain commercial hunts. While NAMMCO member nations advocate for expanded commercial harvest, markets and demand for whale products are limited and the practice of commercial whaling faces entrenched opposition including many IWC member nations and international environmental organizations. Indigenous Arctic whale populations have steadily rebounded since commercial whaling largely ceased in the region in the early 20th century.

Conclusion

For thousands of years, the subsistence harvest by Indigenous peoples has relied on a broad range of marine animals. The commercial harvest of Arctic animals is limited to a few species primarily fish. The economic benefits derived from almost all species aside from fish are limited. Fish are the most important living resource in the North. Although many fish species have been depleted, the introduction of sustainable fisheries

management practices is now an important part of their harvest. Aquaculture can help reduce pressure on wild fish stocks and provide long-term employment in remote regions. The potential negative impacts of fish farming on wild fish and fisheries include economic conflicts, e.g., competition for the marketplace and reduced fish prices, and environmental conflicts, e.g., disease transmission, habitat degradation, overfishing of wild forage fish, competition of escaped farmed fish with wild stocks and genetic pollution.

Discussion Questions

1. Compare the economic importance of subsistence fisheries to commercial fisheries in Arctic nations.

   The economies of Arctic nations rely on a combination of informal subsistence and formal (cash) commercial economies. Arctic Indiginous peoples traditionally relied upon subsistence fisheries for food and trade, but have become more reliant upon imported foods and income from commercial fisheries. Subsistence fisheries provide food for personal use and trade between individuals and communities. Commercial fisheries provide the income Arctic communites need to purchase goods, equipment and live a modern lifestyle.

2. The commercial sealing industry is in decline. Considering the opposition to the commercial hunt, should the commercial harvest of seals continue? Provide arguments for and against commercial seal hunting.

   For:
   - The hunt is a traditional activity in many communities.
   - The hunt provides supplemental income for rural/remote communities with limited economic opportunities.
   - Species such as the harp seal are not endangered and can be sustainably harvested.
   - Yearly harvesting of seals can help control population numbers.

   Against:
   - Without government subsidies commercial sealing would not likely be a viable industry in Greenland, Norway or Canada.
   - The sealing industry contributes little to the overall economies of sealing nations.
   - Given the strong international opposition to the hunt (e.g., the European Union), other options should be considered (e.g., ecotourism) that make the use of this resource more acceptable.

Study Questions and Answers

1. Which Arctic nations dominate the commercial fisheries of the Bering Sea and Barents Sea, and what key fish species do they harvest?

   Russian and American fishing fleets dominate the Bering Sea. The primary fish species harvested is pollock with other key fish species including Pacific halibut

and yellowfin sole. Norway and Russia dominate the commercial fishery in the Barents Sea with key fish species including haddock, North Atlantic cod, capelin, herring, mackerel, horse mackerel and sardines.

2. Why has sustainable fisheries management become important to Arctic nations?

   The key fish stocks in the north Pacific and north Atlantic were depleted by overfishing throughout the 20th century. These two regions include the Bering and Barents Seas, which produce the majority of the Arctic catch. Depletion or collapse of these important fisheries would have a devastating effect on the economies of Arctic nations that depend heavily on fisheries income.

3. What are the potential negative environmental impacts of fish farming on wild anadromous fishes and fisheries?

   - Nutrient pollution resulting in habitat degradation;
   - Overfishing of wild forage fish;
   - Disease transmission from farmed fish to wild fish stocks;
   - Genetic pollution caused by interbreeding of farmed fish and wild fish stocks; and
   - Introduction of invasive species.

4. Salmon prices decreased substantially after the mid 1980s. Briefly list reasons for this decline.

   - Salmon supply increased due to increased farmed salmon production;
   - Harvests of wild salmon increased worldwide;
   - Demand for canned salmon declined; and
   - Salmon consumption decreased in Japan.

5. Which seal species are currently commercially harvested in the north Atlantic?

   Harp, hooded and grey seals.

6. Which circumpolar countries continue to commercially harvest seals in the North Atlantic?

   Canada, Norway, Greenland and Russia.

Glossary of Terms

Abbreviations

EEZ – Exclusive Economic Zone

IWC – International Whaling Commission

GDP 羊 Gross domestic product

LME – Large Marine Ecosystem

RFE– Russian Far East

Terms

Anadromous: migratory fish species that live in the saltwater and breed in freshwater.

Baleen: comb-like substance on the upper jaw of some whale species that strains tiny food organisms (zooplankton) from the water.

Biomass: amount of living matter in a given habitat.

Commercial Fishing: commercial fishing involves catching fish and other seafood for commercial profit.

Echo Sounders: devices that use sound waves to measure water depth or locate fish.

Exclusive Economic Zone (EEZ): a zone within which the adjacent coastal state assumes jurisdiction over marine resources up to a 200 mile limit.

Fish Stocks: discrete subpopulations of fish that are somewhat genetically isolated from others of their kind.

Fishing Quotas: allow the quota holder to harvest a specified portion of a species-specific total allowable catch.

Formal Economy: the portion of an economy that is taxed, monitored by the government and included in gross national product.

Gross Domestic Product (GDP): refers to the monetary value of all final goods and services produced within a country in a given period.

Groundfish: bottom fish.

Informal Economy: in the Arctic, this refers largely to hunting, gathering, sharing and trading of wild plants and animals by communities and families.

Large Marine Ecosystem (LME): encompass coastal areas, including river basins and estuaries, to the seaward boundaries of continental shelves and the outer margins of major ocean current systems.

Moratorium: a delay or suspension of an activity.

Pelagic: species inhabiting open ocean or seas.

Purse Seine: a large net drawn around a school of fish and closed at the bottom.

Seabirds: considered to be birds that spend the majority of their life at sea.

Sport Fishing: fishing for pleasure or competition.

Stock: a “stock” of animals is usually defined as a management unit, i.e., a group of animals that can be managed independently of other groups.

Subsistence Harvest: the gathering of living resources for personal consumption and trade between individuals and communities.

Total Allowable Catch (TAC): annual quota intended to prevent the over harvest of a particular stock.

Transgenic: transgenic fish contain a gene or genes transferred from another species.

Trawl: a strong fishing net that is dragged along the sea bottom.

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