Fisheries Management in the Maritimes Region 1990-2005

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Note
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EXECUTIVE SUMMARY

The historic fishing industry of the Scotia-Fundy Fisheries Sector, Maritimes Region, Fisheries and Oceans Canada, saw great changes in the 1990-2005 period. The groundfish fishery went through a serious resource decline in the early 1990s and most stocks have yet to recover. However, shellfish increased in value and its increased importance carried the industry through this period, with many areas prospering. Today, the fishing industry in Scotia-Fundy is a strong sector valued at over a billion dollars annually.

During this time period, there were many changes in how the fishery was managed. Among the major factors: the industry in many instances found new sources of supply, developed new products, and readjusted its marketing. The spread of individual transferable quotas increased the industry's ability to adjust to changing circumstances. First Nations found a bigger place in the commercial fishery. Conservation consciousness grew with new emphasis on biodiversity, habitat protection, ecosystem-based management, and a precautionary approach.

Underlying much of the progress was the spread of co-management or "shared stewardship," building on the already existing advisory committee system. Through various arrangements, fishers and their organizations took more direct responsibility for research, enforcement, and management. Among other examples, a community quota system put more responsibility in local hands. Participants in the lobster fishery took a stronger role in management. A Fishing Industry Round Table regularly brings together industry representatives, First Nations, and provincial governments. And, in keeping with Canada's *Oceans Act*, a pioneering venture saw representatives of the fishing, transport and oil industries, government agencies, environmental groups, and other interested parties agree on an ocean-management process for a major offshore area.

The Scotia-Fundy fishery remains one of the world's strongest and recent changes, though sometimes daunting, appear to have strengthened shared management for the future.

THE SCOTIA-FUNDY FISHERY - ONE OF THE WORLD'S STRONGEST

Canada's most valuable sea fishery, and one of the world's strongest, takes place in the Scotia-Fundy Fisheries Sector. Part of the Maritimes Region of Fisheries and Oceans Canada (DFO), Scotia-Fundy runs from the northern tip of Cape Breton to the United States border in Southwest New Brunswick.

Fish and shellfish harvests from the Scotia-Fundy wild fisheries provide nearly one-third of the landed value of aquatic products for all of Canada. In recent decades, this area also introduced salmon farming to North America, pioneering an industry that has spread to both coasts.

Change has been a constant for the modern fishery. The period of 1990-2005 began with a deep crisis in the fishery for cod, haddock, and other such species that would transform much of the Scotia-Fundy fishing industry. The following years saw the approach of a new style of fishery management, with more respect for the ecosystem and a growing partnership between managers, scientists, and Aboriginal and non-Aboriginal fishers.

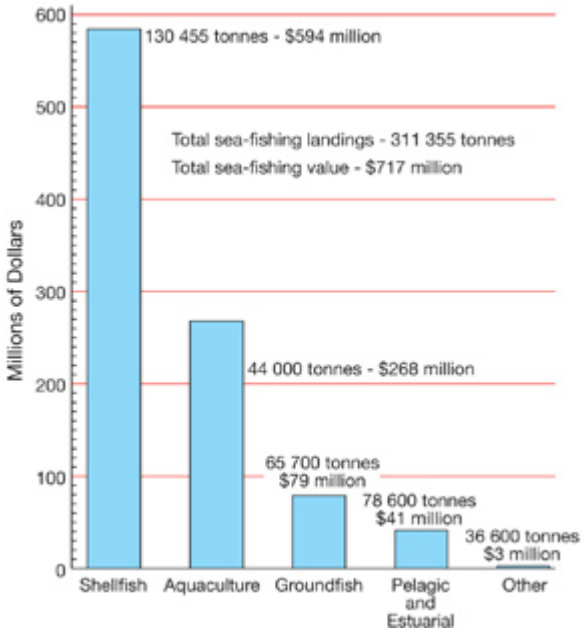
DIMENSIONS OF THE FISHERY

Scotia-Fundy's land boundaries encompass the Atlantic shore of Cape Breton, most of the Nova Scotia peninsula, and the southwest side of New Brunswick, including the Saint John River. Seaward boundaries take in the Bay of Fundy and such famed offshore fishing banks as Banquereau, Western, Sable Island, Emerald, LaHave, Roseway, and Browns Bank, and part of Georges Bank.

A billion-dollar industry

Scotia-Fundy landings out-value those in the rest of the Maritime provinces and Quebec combined. Landings in 2005 came to 311,305 tonnes and were worth $717 million. Aquaculture production, as of 2005, was $268 million.

Landings and Landed Values, Scotia-Fundy Fisheries, 2005



Processing and handling further raise value. Fish and seafood exports to other countries from Scotia-Fundy in 2005 came to roughly $1.3 billion.

Some 13,800 registered fishers operate the large fishing fleet. Handling and processing fish and seafood in roughly 100 processing plants provides work for up to 4000 people. Building boats, transporting fish, supplying and repairing engines and electronics, and generally servicing the fishing industry and its people create thousands more jobs.

A major fishing fleet

The fishers of Scotia-Fundy run some 4,500 vessels of varied length and gear types. These enterprises operate under some 16,500 licences granted for different fisheries.

Smaller and medium-size boats, by far the most numerous, tend to pursue two or more fisheries. For example, some switch from lobsters, when the season closes, to inshore groundfish or herring. Modern engines, mechanical gear haulers, and electronic devices give even small boats impressive fishing power and range that earlier vessels lacked.

Licensing policy distinguishes between fisheries by vessel length. The great majority

Dennis Point wharf, Lower West Pubnico, Nova Scotia.

of fishing enterprises conducted from vessels less than 65 feet in length belong to independent fishers, who must operate their vessels (owner-operators). Many enterprises pass from parents to the next generation. DFO generally respects the wishes of retiring fishers as to who should receive their licence upon transfer. An enterprise generally consists of a boat and licence, but fishers holding a licence may also use it on a boat belonging to someone else.

Processing companies are restricted by DFO policy from holding the fishing licences for vessels under 65 feet. For longer vessels, processing companies commonly hold the licence and own the craft.

THE FISHERY BY AREA

Eastern Nova Scotia

Starting at Sambro, just west of Halifax, the Eastern Nova Scotia Area takes in most of the eastern Nova Scotia mainland, including the upper Bay of Fundy and the Atlantic side of Cape Breton Island. The Eastern Nova Scotia Area has about 3,600 fishers and 1,300 vessels, more than half of them in Cape Breton. Many families have followed the fishing trade from generation to generation, reaching back to the early days of settlement by Acadians, Scots, and others. More recently, First Nations in the Bras d'Or Lakes area have increased their stake in the commercial fishery.

In the 1980s, large frozen-fish plants, each employing hundreds of workers to process cod and other species, dotted this coast in ports such as North Sydney, Louisbourg, Petit de Grat, Canso, and Port Bickerton. Today, after a resource decline in groundfish, none operate at anywhere near the same scale. Yet, growth in the crab, shrimp, and lobster fisheries has kept the fishery vigorous, though processing has declined. In this diversified Area, DFO and industry collaborate yearly on management plans for 35 different stocks or species.

Southwest Nova Scotia

This part of the Scotia-Fundy sector begins near Halifax and runs along Nova Scotia's South Shore. It includes fishing communities with only a few hundred people, such as Peggy's Cove, Port Mouton,

The Scotia-Fundy Fisheries Management Sector, Maritimes Region.

and Lockeport, and larger towns of up to a few thousand, such as Lunenburg, Liverpool, and Shelburne. At the southwest tip of Nova Scotia, for Clark's Harbour and other towns of Cape Sable Island, fishing is the backbone of the local economy.

As the shoreline curves west and north towards the Bay of Fundy, French Acadian communities become frequent, especially in the Pubnico/Argyle region and the Clare Shore between Yarmouth and Digby. Along the Fundy coast, lobsters are the pervasive mainstay, but substantial fisheries take place

FIRST NATIONS OF THE SCOTIA-FUNDY SECTOR

In the 1980s, few of the first fishers in Canada, the Aboriginal people, held commercial fishing licences. But recent years saw them gain a significant place in the fishery.

The transformation began in 1990, when a Supreme Court of Canada ruling, the *Sparrow* decision, affirmed Aboriginal fishing rights for food, social, and ceremonial purposes. DFO's Aboriginal Fisheries Strategy (AFS), launched in 1992, put the food fishery on a solid basis and enlisted Aboriginal people in such activities as monitoring river fisheries for scientific and conservation purposes. The AFS also began placing some commercial fishing licences in the hands of First Nations.

Another Supreme Court ruling, the 1999 *Marshall* decision, found that Treaties signed in 1760 and 1761 by Mi'kmaq and Maliseet communities in the Maritimes and Quebec include a communal right to fish commercially in pursuit of a moderate livelihood. DFO launched a major and successful effort to strengthen the Aboriginal fishery. Officials worked out fishery agreements with 15 of the 16 First Nations in the Scotia-Fundy Sector.

The *Marshall* decision sparked initial controversy among many non-Aboriginals. But fishers also showed flexibility. In Southwest Nova Scotia, the richest lobster-fishing area, their discussions with the Acadia First Nation led to an early resolution and a productive Aboriginal fishery. Often, non-Aboriginal fishers helped train Aboriginal entrants to the fishery.

The snow crab fishery is just one of many new commercial fisheries open to First Nations since the *Marshall* decision.

With around 100 boats, First Nations in the Scotia-Fundy Sector are finding their place in the lobster, crab, scallop, groundfish, and other fisheries. Creating hundreds of jobs and often a new confidence among community members, the entire *Marshall* effort stands out as a historic step forward for Aboriginal people in the Maritimes.

for scallops, herring, haddock and other groundfish, clams, marine worms, and other species. Saulnierville in particular sends offshore scallop draggers and herring seiners to distant fishing grounds. Digby dominates the Bay of Fundy scallop fishery.

With ice-free waters and diverse species, Southwest Nova Scotia enjoys the single richest fishery, for its size, of any place in Canada. Some 8,300 fishers ply their trade with about 2,600 inshore boats hauling in profitable landings. Lobster Fishing Area 34, running from near Shelburne to near Digby, by itself provides 20-25 per cent of North American lobster landings.

Southwest New Brunswick

Between the headwaters of the Bay of Fundy, with the world's highest tides, and the American border at Passamaquoddy Bay, a varied fishery takes place. About 1,900 registered fishers run some 600 vessels. Fishery landings in 2005 came to 45,000 tonnes worth $39 million.

As elsewhere in Scotia-Fundy, lobsters are vital, and scallops, clams, and groundfish are important. But the most characteristic wild fishery is for herring, caught mainly in the 70 or so active weirs – large wood-and-twine fish traps - in the hidden coves and bays. These catch mainly juvenile herring,

In the air or on the water, Fishery Officers use a variety of methods to monitor fishing activity.

sold as sardines. Most go to North America's largest herring canning plant at Blacks Harbour, which dominates the canned-sardine market in Canada and supplies many other countries.

Over the last three decades, Atlantic salmon farming has become a major industry. Sea-pens line the shore, mostly in the Passamaquoddy area near the American border.

MANAGING THE SCOTIA-FUNDY FISHERIES

Fishery management has many dimensions. It requires understanding of the resource and industry, and a system to set and enforce rules. Then come the complex questions of the best way to use the fish. For example, what degree of exploitation should take place, who should get the fish, and how to ensure good product quality?

While the provincial governments of Nova Scotia and New Brunswick licence processing plants and aquaculture sites in the Scotia-Fundy Sector, DFO has jurisdiction over fishing itself. Fishery Officers work on the front lines, operating midshore and inshore patrol craft, and carrying out land-based patrols. An offshore surveillance group utilizes chartered aircraft and satellites to monitor the areas of fishing. More than two dozen local offices and detachments report to the three Area headquarters at Sydney, N.S., Yarmouth, N.S., and St. George, N.B. Besides conservation and protection, the Area offices deal with aquaculture, fish habitat, and ocean management. Staff in the Area offices also assist in the management of 283 core fishing harbours, in conjunction with more than 244 local Harbour Authorities.

The number of staff working on the management and enforcement for commercial fisheries and aquaculture in Scotia-Fundy comes to approximately 225. Staff in the Area offices include Fishery Officers and employees working for Resource Management, Small Craft Harbours and Ocean and Habitat. The Area Directors connect with Maritimes Region headquarters in Dartmouth, which in turn, reports to the DFO's national headquarters in Ottawa.

Scientific research, which includes fisheries research, takes place at the Bedford Institute of Oceanography in Dartmouth, and at the St. Andrews Biological Station in Southwest New Brunswick, Canada's oldest marine-research institute.

Fishery management has never been simple. Scientific understanding of fish, shellfish, and their environment, though constantly increasing, remains incomplete. Human influences add more layers of complexity to the changing fisheries and aquaculture industries.

The Bedford Institute of Oceanography, Dartmouth, Nova Scotia.

Since the wild fishery is a common property, the industry is inherently competitive. Disputes often arise among fishers operating from different areas or using different sizes of boat or types of gear. Unrestrained fishing with modern technology can bring rapid stock depletion or even collapse.

Though most fishers behave responsibly, conservation rules can suffer from non-compliance. Even when fishers follow the rules, their skills at tracking fish, combined with natural predation and ecosystem cycles, can cause additional pressures on stocks and species.

Resource and other problems in the 1990-2005 period brought home to both industry and government the need for care and co-operation in fishery management. The biggest changes came in the oldest commercial fishery - for cod, haddock, and other groundfish - which suffered a major decline.

The *Oceans Act*, coming into force in 1997, gave new impetus to a precautionary approach in management. It set forth the principle that ocean resources, including fishery resources, would be managed under an eco-system based approach. It also created the ability to establish Marine Protected Areas to safeguard critical ecosystems and habitats, such as those for unique deep-sea corals.

The *Species at Risk Act*, (SARA) in 2003 provided further ecological protection. SARA requires fishery managers to enhance the regulatory protection for designated species, such as Inner Bay of Fundy Atlantic salmon, leatherback turtles, and the northern and spotted wolffish. Such measures often affect the conduct of other commercial, recreational, and Aboriginal fisheries, adding further complexity to the challenges of fishery and ocean management.

The *Fisheries Act*, with roots before Confederation, remains the fundamental legislation governing Canada's fisheries, giving great authority to control fishing, set conservation rules, and otherwise influence the industry. The *Act* also constitutes the nation's strongest environmental law, especially after amendments in the 1970s increased protection for fish habitat. A proposed updating would, among other changes, increase industry participants' influence in management, set out clear principles regarding sustainable development, and establish a new sanctions system to enhance enforcement and compliance.

THE FISHERY BY SPECIES

The coasts and banks of Scotia-Fundy nourish dozens of commercial species. Most fall into the categories of shellfish, such as lobster and crab; groundfish, such as cod and haddock; or pelagic and estuarial species, such as herring, swordfish, and gaspereau. All three groupings saw major changes in the 1990-2005 period.

Groundfish: the foundation fishery

Cod, haddock, pollock, redfish, hake and other groundfish – white-fleshed species that feed near the ocean floor – provided the main fishery of the Scotia-Fundy Sector for centuries. The traditional trade in split and salted groundfish, dried outdoors on wooden platforms ("flakes"), dominated until the Second

Baskets of fresh fish from schooners being weighed, Halifax, Nova Scotia, 1939.

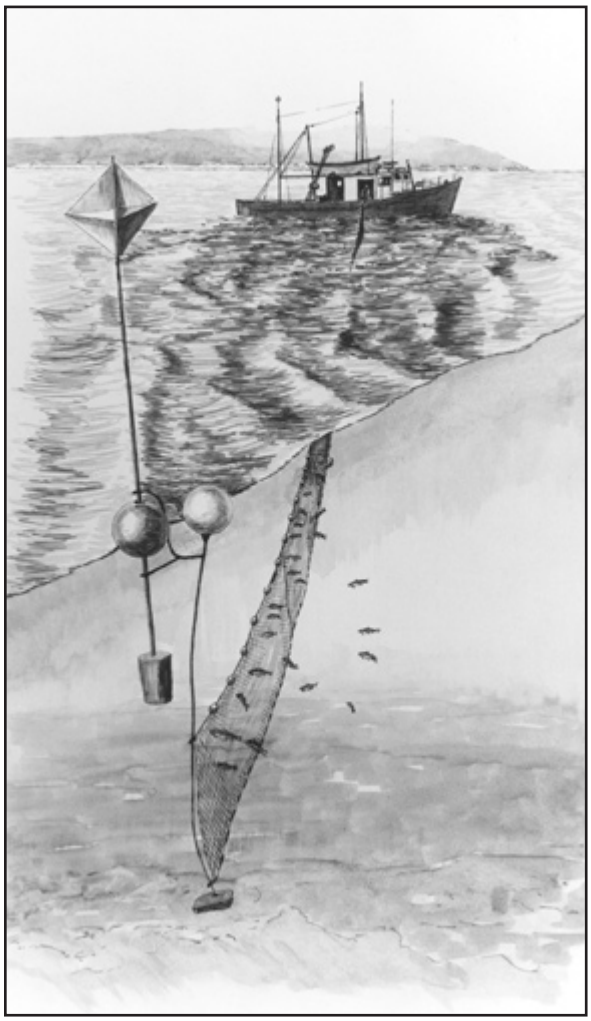
World War. Groundfish still get sold in salted and smoked form, often to markets in southern regions. But the fresh and frozen trades now dominate.

Despite a steep decline in the early 1990s, groundfish remain an important regional fishery. About 3,000 fishing enterprises hold

licences. Most fishers take groundfish by hook and line, especially the longline, with its long array of baited hooks set near bottom.

Gillnets, which capture fish through net entanglement, are popular in some coastal areas. Nearshore and midshore vessels (roughly those between 45 and 100 feet long), and a few larger, offshore vessels (more than 100 feet long) often tow large, conical trawl-nets along the ocean floor. Vessels over 100 feet using such nets are usually called trawlers, while those under 100 feet are called draggers.

Fewer than 100 processing plants for all species now operate in the Scotia-Fundy Sector, a marked decline since the 1980s. In groundfish plants, frozen product may leave the plant as fillets or blocks for further processing elsewhere, or as prepared dishes complete with seasonings. The prime markets for fresh and frozen groundfish are the restaurant, food-service, and retail trades in North America.



Gillnet.

The groundfish fishery has seen the most striking changes in management, some by DFO, and some by the fishing industry itself. Changes in groundfish management have often filtered into other fisheries. This evolution has been complex, often controversial and far-reaching in its effects.

Historical background

After the Second World War the groundfish fleet made huge gains in fishing power. Larger boats made use of radio, radar, sonar, and other electronic devices for locating fish, while modern engines and hydraulics made it easier to haul them in. In the 1950s and 1960s, federal and provincial governments sponsored exploratory fishing, promoted new technology, and often aided vessel or plant construction through subsidies or loans.

Atlantic-wide, about 150 large trawlers, belonging to a handful of major fishing corporations, combed the offshore banks, bringing in large quantities of cod, pollock, haddock, redfish, and flounder. In the Scotia-Fundy Sector, trawlers and smaller craft fed large frozen-fish plants in such ports as North Sydney, Louisbourg, Petit de Grat, Lunenburg, Riverport, and Lockeport. Each provided year-round work for several hundred people, producing mainly frozen fillets and blocks exported to the United States for further processing.

Scores of smaller plants also processed groundfish, whether frozen, fresh, salted, or smoked. Although lobster often rivaled groundfish in landed value, the cod and its cousins provided by far the most processing jobs and product value.

Meanwhile, foreign vessels added fishing pressure. From the mid-1950s until 1977, factory freezer trawlers and their satellite vessels caught huge quantities of groundfish for processing and freezing on-board. By the 1970s, foreign and Canadian fishing pressure was causing conservation problems, which ICNAF (the International Commission for the Northwest Atlantic Fisheries set up in 1950) had failed to resolve. In 1974-75, resource and market weakness brought on a

major crisis in the Canadian fleets, requiring emergency aid through price and market support initiatives. This became a catalyst for the Canadian extension of fisheries jurisdiction in 1977 from 12 out to 200 nautical miles from the coast.

Around the same time, the department limited the number of fishing licences and the size of fishing craft. The aim was better conservation, higher average incomes, and more stability. Scientific research increased, to keep better track of year-class abundance.

The department set quotas on every major stock (population) of groundfish, subdividing them among vessels of different sizes and types. Meanwhile, it encouraged fishers to organize in groups and associations. New industry advisory committees gave fishers and processors a bigger voice in shaping regulations and yearly fishing plans.

With the 1977 extension of fisheries jurisdiction, foreign vessels could enter the zone only under Canadian licence, to take fish surplus to Canadian needs. The rapid drop of foreign fishing and the new conservation measures boosted Canadian catches and revenues. The groundfish industry, which had known chronic crises, seemed to be reaching a new plateau. Vessels developed higher fishing power, in spite of length restrictions. Better times brought new expansion in the late 1970s and early 1980s.

Even so, a cost-price squeeze in 1981-83 put the large-trawler companies into peril once more. But another federal financial intervention and a corporate consolidation brought recovery. Landed values kept climbing for most of the 1980s. For the Scotia-Fundy Sector, the large-trawler fleet usually took close to half the groundfish landings, some coming from waters off Newfoundland and in the Gulf of St. Lawrence.

With an apparently healthy resource, an elaborate management system, and consumers paying more for fresh, healthy fish and seafood, everyone looked forward to stability combined with progress. But this was only a prelude to a coming groundfish crisis.

The conservation challenge

The elaborate system of vessel quotas when it first spread in the 1980s, had few defences against misreporting the location or even the composition of catches. Scientists had no accurate data on undersized fish or unwanted species discarded during fishing. The improved catch rates, which seemed a sign of greater abundance, derived partly from improved efficiency. Scientists initially overestimated the growth of the stocks. Industry sectors fought for bigger shares of a resource that, by the later 1980s, was actually shrinking due to overall resource declines.

Vessels of every class had increased their fishing capacity. Fish-finding sonars and "rockhopper" trawlers able to fish rough bottom left few refuges. Fishers often targeted older and larger fish, the best ones for spawning and reproduction. Environmental changes in the late 1980s and early 1990s, signaled on Canada's east coast by colder temperatures, made it harder for cod and other groundfish to survive and grow.

As scientists gained a more accurate picture, DFO began cutting back quotas, against heated resistance from some industry members. The year 1989 saw great controversy, as conservation restrictions forced the dragger fleet to tie up early in the fishing season. The same year, a Task Force on Scotia-Fundy Groundfish recommended several conservation measures, such as 100 per cent observer coverage on trawlers and bigger mesh sizes in trawls. Although some proposals got watered down by opposition, the Task Force resulted in the dragger fleet switching to Individual Transferable Quotas. Meanwhile, some plants in the larger-than-ever industry began to cut back and temporarily lay off employees.

In 1992-93, scientists warned that all along the Atlantic coast, the historic groundfish fishery was close to collapse. Most groundfish fisheries in Newfoundland and Labrador and the Gulf of St. Lawrence closed. In Scotia-Fundy, DFO shut down fishing for cod, haddock, pollock, and all major groundfish populations east of Halifax, formerly a prime ground for trawlers in

SECURE SHARES OF THE FISHERY

The recent history of groundfish and other fisheries has often involved Individual Quotas (IQs) and Individual Transferable Quotas (ITQs).

In the 1970s, as overall quotas (Total Allowable Catches, or TACs) for fish stocks became common, the federal fisheries department began subdividing them into separate quotas for fleets from different areas or using different gear types or size of vessel. The herring purse-seine fleet, in consultation with the department, went a step further.

In a first for Canada, the Bay of Fundy fleet in 1976 established Individual Quotas for each vessel, based mainly on catch history. Before, fishers had raced to catch the biggest share of the overall quotas. Now, they had fish to depend on, and could operate at their own pace.

In 1983, the herring seiners went to another stage: Individual Transferable Quotas (ITQs). Operators could buy up one another's quotas permanently. Guidelines limited the percentage of the catch that a single enterprise could acquire.

IQs and their variants soon spread to other fisheries, often when overcapacity was an issue. Enterprise Allocations (EAs) applied from the early 1980s for the offshore groundfish fleet, mainly trawlers more than 100 feet long. EAs granted allocations by company. A corporation could then manage its fleet, or even reduce its numbers, to make the best use of a known allocation. The 1983 report of the Task Force on Atlantic Fisheries (*Kirby Report*), commissioned during the 1981-83 trawler crisis, encouraged the permanent use of EAs in the trawler fishery, and promoted their use in other fisheries.

The offshore lobster fishery went to EAs in 1985, and offshore scallopers did so in 1986. All Atlantic groundfish vessels of 65-100 feet in length, many of them processor-owned, switched to EAs in 1988. Between 1990 and 2005, many smaller-vessel fleets adopted IQs or ITQs. For the Scotia-Fundy Sector, these included groundfish mobile-gear vessels (draggers) less than 65 feet long; groundfish fixed-gear (longline and gillnet) vessels 45-65 feet long; and fleets fishing inshore shrimp, Bay of Fundy scallops, swordfish by longline, and snow crab.

The Department of Fisheries and Oceans, as it became in 1979, tended to look on IQs and ITQs with cautious favour, treating them on a case-by-case basis and introducing them in fleets where it was clear that the majority of licence holders wanted them. Typically, government–industry discussions developed quota-sharing formulas based on catch history and vessel size, and regulations prohibited single enterprises from acquiring more than a specified, low percentage of the Total Allowable Catch. As well, restrictions generally applied on transfers between areas or provinces.

The new quota arrangements pioneered in Scotia-Fundy offered many advantages. Fishers and vessel-owning corporations could scale their investments in vessels and operations to their expected catch, and pace their fishing to get the best market value. Theory also held that secure quotas would instill a greater sense of ownership and promote better conservation.

Opponents pointed out disadvantages. Some charged that so many different quotas would be hard to enforce, fostering non-compliance. Enterprises could misreport fish caught in a low-quota area as coming from neighbouring waters. Or, they might discard smaller fish and unwanted species, to bring in the highest value for their quotas. Critics also feared that the best financed operators would accumulate quotas, gaining undue control and perhaps concentrating their operations in single areas, to the detriment of other coastal communities.

Midwater trawl vessel.

particular. The Scotia-Fundy trawler fleet (vessels over 100 feet in length) shrank in following years; today it has only six vessels, with much lower per-vessel catches than in the 1980s.

Groundfish fisheries stayed open in Southwest Nova Scotia and the Bay of Fundy and on Georges Bank, but only at low levels. Already declining at the end of the 1980s, Scotia-Fundy groundfish landings dropped further, from 217,000 tonnes in 1990 to 76,000 tonnes in 1995. Landed value in those years fell from $166 million to $84 million. Although some stocks such as Georges Bank haddock have improved, there are still no signs of full recovery.

Atlantic-wide groundfish measures

In the 1990s, a series of special federal programs, including the Atlantic Fisheries Adjustment Plan (AFAP), The Atlantic Groundfish Strategy (TAGS), and the Canadian Fishery Adjustment and Restructuring Program (CFAR), attempted to buffer the crisis. Special measures included financial assistance for groundfish fishers and certain communities. Under voluntary licence retirement programs, fishers retiring their licences, rather than transferring them to other harvesters, received compensation payments. The number of fishing craft for all species in Scotia-Fundy dropped from 5,800 in 1990 to 4,500 in 2005.

Meanwhile, other approaches gave more stability to the fishery. In a major change for vessels less than 65 feet long, the "core fisher" policy designated those fishers – about one in four of those registered – who headed an enterprise, held certain key licences, and had a solid attachment to and dependence on the fishery. From 1996 on, only core fishers could acquire most licences from other fishers. As less active fishers sold off their licences to core fishers, the total number of enterprises could gradually diminish. Enterprises with a long-term stake in the industry would become dominant.

Scotia-Fundy groundfish measures

The Maritimes Region took its own measures for the Scotia-Fundy Sector. At first, in the early 1990s, these often provoked industry resistance. But DFO-industry workshops and other efforts would gradually build co-operation.

Cod

Following the 1989 Task Force on Scotia-Fundy Groundfish, mobile gear (draggers) less than 65 feet long in 1991 adopted a system of ITQs. Though this was a difficult move at the time, the new system of buying and selling quotas gave the fleet new ability to "self-rationalize." Operators could now buy and sell quotas to suit their operational needs during the fishing season, or could permanently transfer quotas to others. With more than 400 dragger licences (although fewer were active), that power-packed fleet had been hard to control. Transfers of quota reduced their numbers to fewer than 100 active vessels, and the security of quotas let them moderate the race for the fish. Some enterprises diversified into other species.

The 1989 Task Force report had also noted that the departmental rules that restricted increases in vessel size and fish-hold capacity were less than effective. Attempts to tighten the rules caused controversy. But by 1993, the department arrived at a new system that applied for the whole Atlantic coast. Generally, if a fisher was replacing a vessel of 35 to 65 feet, its length, beam, and depth were multiplied to arrive at a "cubic number." The replacement vessel could not exceed the previous vessel's cubic number.

From conflict towards co-management

The decline in groundfish stocks left fishers discontented, and in some cases disbelieving. Disputes about dividing up quotas grew sharper. New policies to safeguard conservation, like the vessel-replacement rules, often aroused resentment.

As more vessels switched to individual quotas, fishers were obliged to pay for dockside monitoring programs (DMPs) provided by private companies. Vessels now radioed the DMP company on leaving or returning to port. Upon landing, dockside observers verified catch quantities and species. DMPs meant better compliance with rules, and better statistical information for fishery managers and scientists. But they also meant another expense to fishers.

Fish weighed as part of the dockside monitoring program.

Annual fishery-management plans evolved into more complex Conservation Harvesting Plans, for which the industry had to take more responsibility. With many changes taking place, some smaller operators feared that the department was out to hurt or eliminate them.

The mid-1990s proved to be a turning point. Southwest Nova Scotia still had a significant groundfish fishery, with about 2,400 licences (out of some 3,000 in the Region) for draggers, longlines, gillnets, and handlines. These represented far more harvesting capacity than needed to catch all the available fish.

New restrictions were tightening the bycatch quotas on hook and line fishers. One clash over the fishing rules caused a port blockade that made national headlines. In 1995-96, along with other controversies, changes in licensing policy initially did not provide core status for many of the smaller-scale, handline fishers who could not meet the minimum income threshold.

Frustrations boiled over. Fishers in early 1996 staged occupations of DFO offices. In one demonstration, 3,000 marched behind one another carrying a long section of rope through downtown Halifax. The Minister of Fisheries and Oceans relaxed the core status rules for handliners. And regional officials convened a major three-day conference bringing together fishers and community representatives, where people could express their opinions and make suggestions.

Out of the commotion came a higher degree of co-management between fishers and DFO fishery managers. In a key change, the Scotia-Fundy Sector made another innovation: community-based quotas and management boards.

Community-based management

In 1995, fishers from the Sambro area near Halifax had approached DFO for a separate groundfish quota for their area, based on their collective catch history. After the 1996 demonstrations and conference, this idea caught on. Eleven Community Management Boards came into place, backed by DFO.


Silver hake.

These covered the whole Scotia-Fundy sector, often on a county basis. The initial trial setup included all fixed-gear vessels up to 45 feet long: more than 2,500 in all. Each area or group (some "communities" were defined by gear) got its own quota to depend on.

The new arrangement worked. Elected management boards now regulate such matters as suballocations of the community quota and transfers of quota between management boards. Within the community quotas, they can self-impose trip limits, as well as seasonal or fleet quotas, and even Individual and Individual Transferable Quotas. They may also review catches, apply sanctions against rule-breakers, and deal with business matters.

The boards brought progress on many fronts. Conflicts and fears decreased, because each area had secure fish to manage for itself. DFO's advisory committees worked better. Conservation improved as fishers, more conscious than ever of the resource's vulnerability, had more say in managing their fishery. In 1997, the Minister of Fisheries and Oceans, based on strong support from inshore fishers, made the community-based management system permanent.

Becoming more involved in the management of the fishery would become a pattern in Scotia-Fundy. To a large extent, this was a natural evolution, in both industry and government. Fishing interests began to contribute their resources to useful projects such as defraying the costs for dockside monitoring and observer coverage, and to take on more responsibility in general.

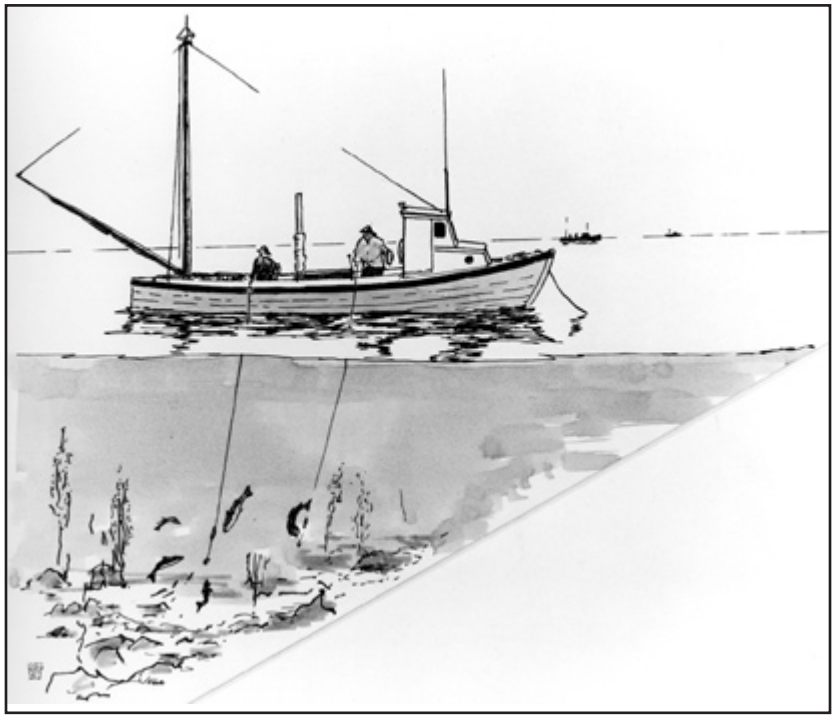
Co-management, an ideal since the 1970s, began to work better in practice. Though never without controversy, fishery management became more of a dialogue, towards conservation, efficiency, and the common good.

New products, new markets

Meanwhile, the industry showed great adaptability on the business side. Fishers worked to land higher-quality, better-handled products, for better prices. Some diversified into other species.

Silver hake, a tough-skinned, hard to handle species, was a notable example. It had been thought that harvesting silver hake required huge factory freezer trawlers, as in the days of foreign fishing. Instead, in recent years, Scotia-Fundy fishers demonstrated that smaller draggers less than 65 feet long could catch silver hake along the edge of Nova Scotia's continental shelf.

The 20-odd draggers in this year-round fishery now produce about $8 million in landed value. Boxed in ice to prevent spoilage, and exported fresh, the hake reach European markets as a higher-value catch within three days of harvesting.


Handline.

Meanwhile, the fixed-gear (longliners and gillnetters) groundfish fleet between 45 and 65 feet switched to ITQs in 1997, bringing about a fleet reduction. With defined quotas, vessel size became less of a factor. A rule change in 2001 allowed fishers in this fleet to move up to larger vessels when they replaced them, as long as they stayed below 65 feet and applied other capacity restraints.

On the processing side, the formerly dominant large-trawler corporations sharply reduced their operations. The largest such firm in the Scotia-Fundy Sector sold off most of its trawlers and Enterprise Allocations, switching its emphasis to processing, often of raw material acquired abroad, and to marketing. Although large firms still play a major part in the fishery, especially in shellfish, family-owned firms regained some of their pre-war dominance.

Earlier, Scotia-Fundy firms had been among the first to freeze whole, gutted fish at sea and thaw them quickly for further processing on shore. Now, many firms searched out foreign suppliers of frozen groundfish for processing. At the same time, businesses sought out new market niches in the fresh and frozen trades, often for higher value markets.

Processing redfish aboard a factory freezer trawler.

The new groundfish fishery

Processing plants today are fewer, and the most powerful and efficient groundfish vessels, the draggers and trawlers, have dropped to less than half their strength in 1990. The large groundfish-processing companies that used to operate several dozen trawlers sold most of them off; only six trawlers now fish in Scotia-Fundy. These companies, with much lower quotas than before, turned to contracting smaller vessels to fish their quota. Inshore draggers now catch about 80 per cent of the offshore groundfish quotas.

Even if stocks one day recover their old abundance, as appears to be happening with haddock, the groundfish industry will likely remain smaller. Industry and government alike have learned important lessons about over-capacity and overfishing. More than ever, conservation comes first.

The new groundfish industry remains profitable for most participants. Less industrial but more entrepreneurial, it has met challenges and found new markets for higher-quality, higher-priced products. Above all, the industry has assumed far more responsibility in research, management, and enforcement, bringing shared stewardship from an aspiration to a growing reality. And changes in the groundfish industry encouraged co-management on a wider scale.

Today, four major mechanisms exemplify shared management in the Scotia-Fundy fisheries. First, the advisory committees for various fisheries, and the fishers and organizations they represent, have increased their influence on DFO management. Besides working out annual fishing plans with the department, they often help manage the fishery during the season. Since the early 1990s, their meetings have been open to the public.

Second, industry groups carry out far more management on their own. The Community Management Boards controlling most of the inshore fixed gear groundfish fleet provide a chief example. However, many other fleets set in-season harvesting rules for themselves, in one form or another.

Third, what are known as Joint Project Agreements (JPAs) now exist for many fisheries. In JPA arrangements, groups of independent fishers or vessel-owning corporations contribute work or funding towards

research, data collection, enforcement, or other aspects of management. For example, they might sponsor a stock assessment survey or other such research efforts beyond what DFO could normally supply. Or, they might devise rules, backed by DFO, which adjust the number of participants or level of fishing effort in their fishery to the level of resource abundance.

Fourth, in 1999, DFO initiated the Scotia-Fundy Fishing Industry Round Table, which meets two or three times a year. This broad-based forum brings together more than 40 groups, including fishers', processors', and First Nations' representatives and provincial governments. Recent round-table discussions have included such subjects as ecosystem-based management, coral conservation strategies, species at risk, region-wide enforcement approaches, owner-operator issues, and inter-fleet gear conflicts. Comparing notes on the bigger picture, participants educate one another and influence the development of government policies.

All told, the regional industry now takes far more responsibility than ever before in fishery management. Although frictions never disappear in this competitive and cyclical industry, they have lessened as top-down management eases off and co-management grows. Many industry members have devoted countless hours to making the fishery work better, for today and for future generations.

Shellfish: the top-value fishery

The shellfish fishery has become the dominant force in the Scotia-Fundy fishery. In the wild fishery, as distinct from aquaculture, shellfish generate far more money for fishers than all other species combined. This marks a historic change from the period before the 1990s, when groundfish such as cod and haddock supplied the most jobs.

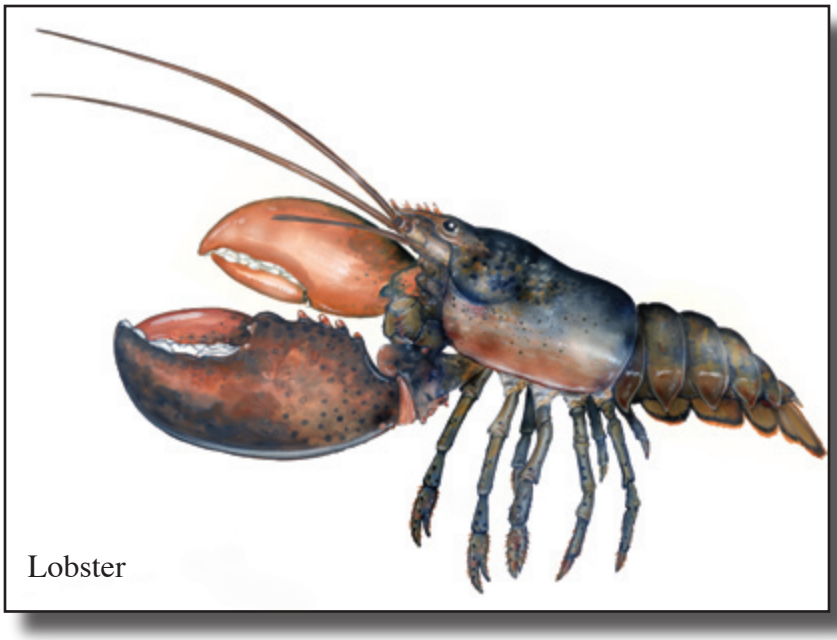
Shellfish catches have surged in recent years, helped by conservation measures and possible changes in the ocean environment. From 1984 to 2005, shellfish landings more than tripled, and landed value more than quadrupled.

Lobster, scallops, crab, and such species rose from 12 per cent to 43 per cent of landings by volume. And they went from 51 per cent to 83 per cent of landed value.

Lobster

Lobster provides two-thirds of shellfish value, and more than half the value of Scotia-Fundy fisheries in their entirety. This most famous of crustaceans lives on the bottom, and usually stays fairly close to its home. Across the Scotia-Fundy sector, around 3,000 boats pursue lobster. Most fishers leave port before daylight to haul baited traps during the open season for their area. They fish mainly from boats less than 45 feet long, and generally stay fairly close to shore. However, a growing number now fish out to the midshore areas between 25 and 50 miles from land. Coloured buoys on the surface mark the location of traps set on bottom. Until recent decades, fishers used wooden traps; now most use metal, "wire" traps. A few larger vessels trap lobsters on offshore banks outside 50 miles.

Fishers and buyers often hold lobsters in floating crates or corral them in enclosed pounds. Southwest Nova Scotia entrepreneurs pioneered the "dry-land pound," holding lobsters on land but in a salt-water environment. Some lobsters go into canned or frozen products, but the great majority



Lobster

THE INTERNATIONAL DIMENSION

Improving Canada-U.S. transboundary management

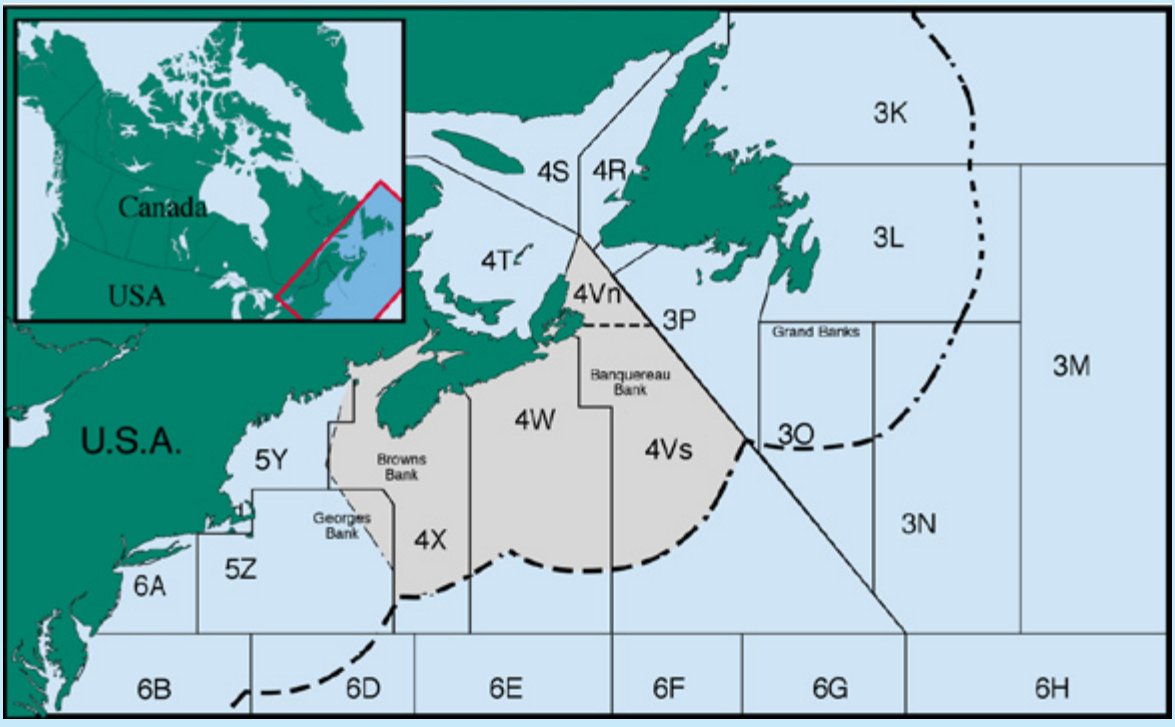
The establishment of the 200-mile limit in 1977 ended foreign fishing problems off Scotia-Fundy, with one exception: our nearest neighbour.

The Scotian Shelf (the continental shelf off Nova Scotia) with its fishing banks lies well within the 200-mile zone. There is no comparison to the situation off Newfoundland, where the Nose and Tail of the Grand Banks extend beyond the zone, and foreign vessels can fish the straddling stocks that cross the line. In Scotia-Fundy waters, after 1977, overseas vessels stayed well under control. At first, Canada licensed some to fish for surplus stocks, such as silver hake, within the zone, but all such allocations ended in 1998.

The exception, in the early days, came on the southwestern edge of the Scotia-Fundy sector. Both Canada and the United States laid claim to Georges Bank. In 1984, a panel of the International Court of Justice at The Hague, the Netherlands, drew a boundary – referred to by fishers on both sides as the "Hague Line"– giving Canada the northeast third of the bank.

But American vessels sometimes slipped over the line, seeking abundant scallops and other stocks on the Canadian side. From 1984 to 1988, DFO's patrol vessels of the day, the *Cygnus* and *Chebucto*, arrested about two dozen American vessels, bringing operators to trial in Halifax. Tensions heightened late in 1988, when the *Cygnus* fired warning shots across the bow of a fleeing American vessel. The next year, a Canadian navy vessel working with DFO fired a similar volley in another incident. For a time, DFO made use of a Navy submarine at the Hague Line.

American authorities recognized the seriousness of the situation. The two countries in December, 1991, signed a reciprocal enforcement agreement. Each country undertook to impose penalties for home-state vessels transgressing the other's



The Scotia-Fundy Fisheries Management Sector extends to the "Hague Line" on Georges Bank and to the 200-mile limit, past the Scotian Shelf. The North Atlantic Fisheries Organization (NAFO), an intergovernmental science and management body, is responsible for the management of fisheries outside of the 200-mile zone.

fisheries regulations. The U.S. Coast Guard added its strength to Hague Line policing at that time, and only 77 boundary-line occurrences have been detected since then, of which 59 were in 1992-93. In later years, American incursions virtually ceased.

The enforcement agreement foreshadowed a new era of Canada-U.S. co-operation on transboundary fish stocks.

International co-operation restores haddock abundance

A succulent species closely identified with Nova Scotia and New England, haddock traditionally supported much of the fresh-fish and frozen-fish trade. In the late 1960s, haddock were becoming scarce on Georges Bank. International quotas came into effect. After the 200-mile limit, Canada enacted even stricter quotas for its own fishery on the Scotian Shelf and for the boundary-straddling stock on Georges Bank. American regulations, though different in nature than the Canadian ones, also curtailed their haddock fishery on Georges Bank.

Juvenile haddock.

Yet haddock got caught up in the general groundfish crisis of the early 1990s, becoming very scarce on both sides of the Hague Line. Both countries kept the fishery open, but at very low levels.

Fishery managers on the two sides began taking measures in common. In 1994, Canada further reduced its quotas on Georges Bank and lengthened its seasonal closure in the area. The U.S. also applied new restrictions.

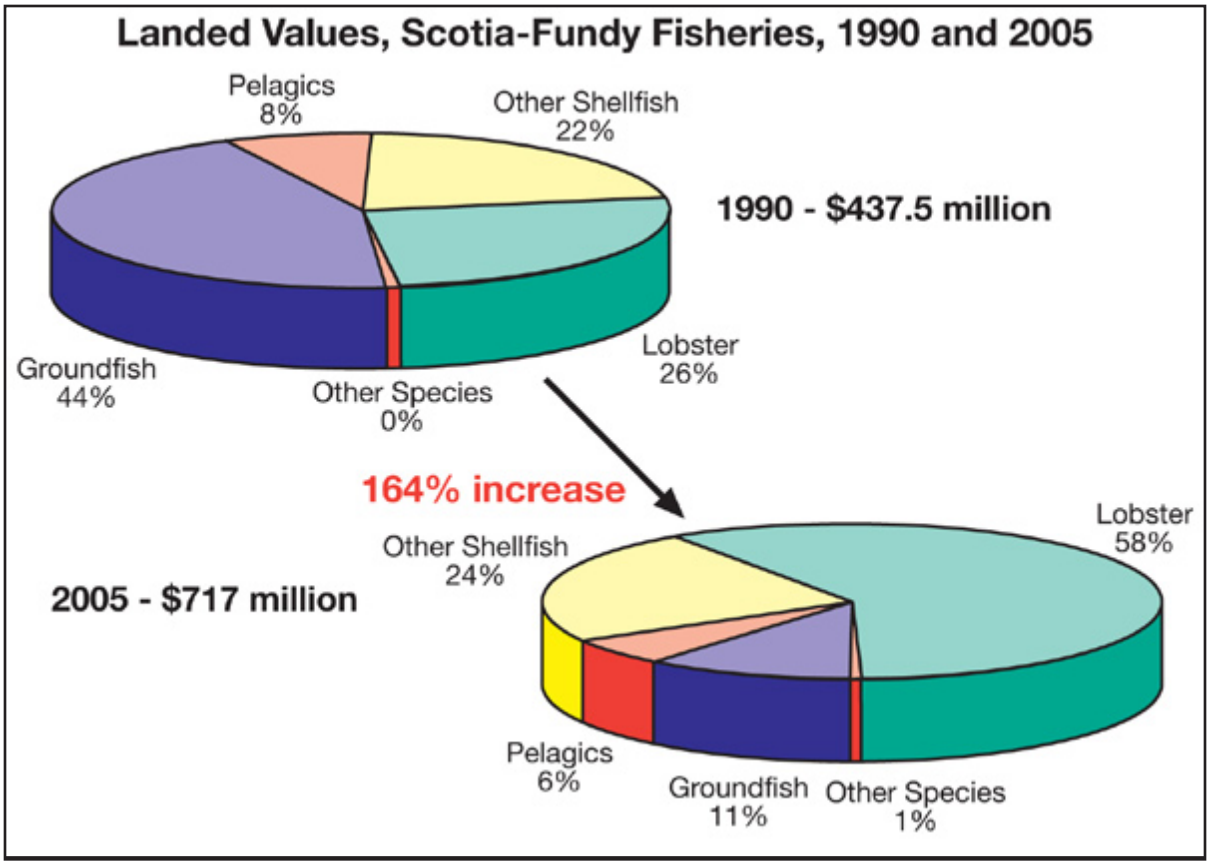
A bilateral arrangement starting in 1995 increased co-operation, particularly on the science level. A regional Canada-United States Steering Committee led the process by creating a Transboundary Resources Assessment Committee (TRAC) committing the two countries to work together to assess transboundary fish stocks, starting with cod, haddock and yellowtail flounder. Through a second body, the Transboundary Management Guidance Committee (TMGC), industry, scientists, and fishery managers, compared notes on recovery strategies to rebuild stocks. Although each country set its own quotas and other regulations, they took more account of each other's views to arrive at a consensus.

In 2003, co-operation became stronger yet, with a new resource-sharing agreement. The two sides together began setting the Total Allowable Catches for haddock, cod, and yellowtail flounder, and portioning out the national shares.

That same year, earlier conservation measures clicked to bring a fishery bonus. The 2003 year class (all of the fish in a stock that were spawned in a particular year) of haddock was the largest on record. As those fish mature, biomass in the water and allowable catches for fishers will reach levels unseen since the 1960s.

The Gulf of Maine Advisory Committee, a pre-existing Canadian group co-chaired by DFO and the fishing industry, now fits into the overall Canada-U.S. structure. Canadian and American fishery managers have also begun closer collaboration on pelagic fisheries, ocean management, and species at risk.

In the world of international fisheries, shared management generally comes from the top down. Usually, after a long period of disputes, countries sign treaties, systems get set up, and co-operation follows over time. Scotia-Fundy and the New England regional authorities did it from the bottom up, getting the job done without waiting for a treaty.



is sold fresh. These go to markets in North America, Europe, and as far away as China and Japan.

Historical background

After the development of canning technology, lobsters from the mid-1800s on provided a major fishery everywhere in Scotia-Fundy. Gasoline engines, becoming common after 1900, boosted this fishery. Most fishers harvested lobster during the regulated season for their area, usually several months, and fished other species between times.

The lobster fishery after the Second World War presented problems. It was widespread and important, but often produced less than satisfactory incomes. In the late 1960s, lobster became the first major fishery to come under "limited entry" – that is, a limit on the number of licences. The intention was to ease fishing pressure, close off access to "moonlighters," and preserve the fishery for those who most depended on it. Limits on the number of traps also aided conservation. Through a voluntary licence-retirement program, or "buyback," in the 1970s, hundreds of fishers left the fishery in return for compensation. Today, about 3,000 fishers hold licences in the Scotia-Fundy Sector.

The lobster resource still worried scientists in the early 1980s. But that decade saw the beginning of a rapid rise in abundance. Landings climbed in the 1980s, stayed high in the 1990s, and reached record levels and continue to show strong landing trends in the early 2000s.

The surge in landings

It appears that the many conservation measures such as fleet reductions, trap limits, and lobster size limits, worked together with changes in ocean conditions to bring a fishery bonanza. By the early 21st century, lobster licences were changing hands for as much as a million dollars in Southwest Nova Scotia. Three neighbouring Lobster Fishing Areas –LFA 33 (on the South Shore), LFA 34 (where the coast curves round into the Bay of Fundy), and LFA 35 (in the upper Bay of Fundy from Digby Gut to Alma, N.B) – enjoy the highest lobster landings per vessel of any place in the world.

Regulated lobster seasons vary by area. Because landings come in bunches, fishers and buyers store them until markets are ready. Besides corralling lobsters in marine pounds, many enterprises started storing them in dry-land pounds. Southwest Nova Scotia alone has more than 200 lobster pounds. In a pioneering venture, a major firm in the mid-1980s began holding lobsters in an elaborate system, resembling enormous filing cabinets, where cold water keeps them in a dormant state. Other enterprises use tanks, and often store lobsters within tubes that prevent them damaging one another. Lobster dealers also began taking samples of blood protein to gauge the animals' health and fitness for shipping.

Most lobsters go live to the restaurant and retail trade, in North America, Europe, and even the Far East. Some get shipped to canneries in other parts of the Maritimes. And, in a new development, some enterprises freeze them raw, in so-called "popsicle packs," for shipment to high-end restaurants.

With less groundfish and more lobster available, many plants diversified or switched entirely into lobster. Fishers in LFA 34 built wider boats that could carry more traps in a single trip and fish safely up to 50 miles, to get to the best spots on "Dumping Day," the first day of the lobster season when fishers head out to set their traps. They extended their fishing grounds to the mid-shore (out to 50 miles) and now spend more time at sea, hauling traps more often. Such developments have raised new concerns over conservation.

Inshore lobster vessel.

In 1995, the DFO-affiliated Fisheries Resource Conservation Council (FRCC) concluded that Atlantic fishers coast-wide were taking too many lobsters out of the water before they had a chance to reproduce. DFO and the industry needed to work together to increase the amount of eggs in the water, reduce the percentage of lobsters caught, and improve enforcement, science, and management in general. The FRCC spelled out a long list or "tool box" of actions that different areas could take, such as improving enforcement, reducing the number of fishing days, raising the size limit, and creating lobster refuges where fishing was forbidden.

In Scotia-Fundy, some Lobster Fishing Areas experimented with such measures as "V-notching" the tails of egg-bearing lobsters to identify them as known producers that should be returned to the water. As well, fishers began taking part in anti-poaching patrols, helping Fishery Officers to locate and confiscate illegal traps.

Lobster co-management and co-research

Fishers in LFA 34, the richest lobster ground of all, have set up a management board to collaborate with DFO. In 15 port "clusters," lobster fishers elect a representative and an alternate. In local advisory committee meetings, the members share information and discuss policies and regulations. Topics include such matters as licence regulations, controlling fishing effort, and interactions with other fisheries. Then, when it comes time for DFO's regular advisory-committee meeting, co-chaired by DFO and a fisher, the harvesters are able to speak with one voice.

Fishers in LFA 34 have given great effort to creating the management board. In other areas as well, grassroots management is getting stronger. Besides formulating annual Conservation Harvesting Plans, advisory committees now take part in in-season management, influencing such matters as opening dates for the season.

Co-research has also grown. Again, LFA 34 provides an example. In past years, when

An egg-bearing female lobster.

advisory committee meetings discussed science, they sometimes got bogged down over questions of basic facts and terminology. Now, in LFA 34, fishers and DFO scientists hold extensive discussions beforehand, to share information and consider research directions. The Fishermen and Scientists Research Society (FSRS), a group composed of fishers, scientists and other industry members, often carries out lobster studies across the Scotia-Fundy Sector. The FSRS has played a particularly strong role in supporting science in data collection and research projects in Eastern Nova Scotia LFAs.

Besides the huge inshore industry, a much smaller offshore lobster fishery takes place 50 nautical miles from shore. Five to seven vessels take part in Atlantic Canada's only year-round, quota-controlled lobster fishery. This fleet also demonstrates a high degree of responsible management, and the offshore grounds have a closed conservation area. This fishery was the first to introduce sea-bed mapping.

Fishers must ensure that the back of the lobster (carapace) is within the regulated size.

Throughout the Scotia-Fundy lobster fishery, co-research and co-management have reached a new level. But problems remain. Poaching of undersize or out-of-season lobster continues, despite growing disapproval by fellow fishers. Changes in the ocean environment have caused intermittent quality problems with soft-shelled lobsters. Landings could drop from current high levels. And scientific knowledge remains limited. Yet, the promise of a sustainable fishery for generations to come is growing, with participants themselves ensuring resource protection and fair management.

Scallops

This bivalve (hinged-shell) mollusk propels itself along the seabed by clapping its two fan-shaped shells together to eject water. Fishing boats harvest scallops by towing metal drags resembling chain-link sacks along the bottom. Despite many attempts at mechanization, fishers generally shuck the scallops by hand. About 500 enterprises hold licences, although active participants in a given year are considerably fewer.

Most vessels are less than 65 feet long. The biggest inshore fishery takes place in the Bay of Fundy, where Digby, Nova Scotia, is the leading port. A small fleet of less than 30 larger draggers, most more than 100 feet long, works out of such ports as Lunenburg, Riverport, Liverpool, Shelburne, and Saulnierville in Southwest Nova Scotia.

Scallops, one of the higher-priced seafoods, are sold mainly in fresh and frozen form. Many vessels now freeze scallops at sea. The restaurants and homes of North America provide the main market.

Inshore scalloping

Fishing for scallops became common in the early 20th century, after the coming of the gas engine. Fishing took place mainly in the Digby area, but exploratory fishing by the federal fisheries department, and fishers' own ventures, spread the fishery to other areas. Scalloping intensified after the Second World

War. In the 1970s and 1980s, licence limitations and other controls began to apply more strictly.

In today's inshore fishery, about 100 vessels, generally in the 45-65 foot range, hold "full-Bay" licences for the Bay of Fundy. These are the biggest producers. Another 210 vessels, usually 30 to 45 feet long and based mostly in New Brunswick, hold "mid-Bay" licences to fish out to the middle of the Bay of Fundy; this excludes them from the main grounds of the Digby fleet. The Upper Bay fleet holds 16 licences. Vessels on the Atlantic side of Nova Scotia and in Cape Breton hold about 180 licences, making some 500 in total, although some licence-holders take no part in the fishery.

Open and closed seasons apply to inshore scallop fishing areas, partly for conservation purposes and partly to avoid gear conflicts during lobster season. Many scallopers fish other species between seasons.

The chief inshore fleet of about 100 full-Bay licensees ran into rough water in the mid-1990s. Following a sharp resource decline, quota controls came into force in 1997. In 1999, the Bay and adjacent waters got subdivided into several areas, each with its own Total Allowable Catch.

At the same time, the full-Bay fleet adopted Individual Transferable Quotas. As some fishers sold their quotas to others, the number of active vessels dropped by about half, reflecting the lower level of the resource at that time. With guaranteed shares of the catch, operators began moving to smaller, more cost-effective vessels.

Through conservation measures and the ocean's own cycles, landings in the early 2000s more than doubled over mid-1990s levels.

As with any fishery, there are always some problems. Abundance is cyclical and biomass has dropped in the last couple of years. But overall, the inshore scallop fishery has become more stable and viable, with increasing industry participation in research and management.

Offshore scalloping

In the 1940s, large draggers began scalloping on offshore banks. By the early 1970s, more than 70 offshore vessels operated from such ports as Lunenburg, River-

ENFORCING THE RULES

Compliance with conservation regulations emerges partly from enforcement, partly from attitudes. It is generally thought that cheating, while still present, has dropped significantly since 1990. However, non-compliance continues to be a problem in the Scotia-Fundy lobster fishery

There are approximately 130 Fishery Officers in DFO's Conservation and Protection branch in the Maritimes Region. These officers make use of three medium-size patrol boats, ranging from about 40 to more than 70 feet long, and many smaller craft, including rigid-hull inflatables. Trailers move the smaller craft for launching where most useful to surprise offenders. DFO's Canadian Coast Guard operates many larger vessels in the area; these vessels share fisheries patrol duties as needed. Fishery Officers carry out frequent surprise inspections, at sea and in port. While continuing the traditional stakeouts where wrong-doing is suspected, they also undertake detailed forensic accounting investigations of fish harvesters and processors, looking for cases of non-compliance.

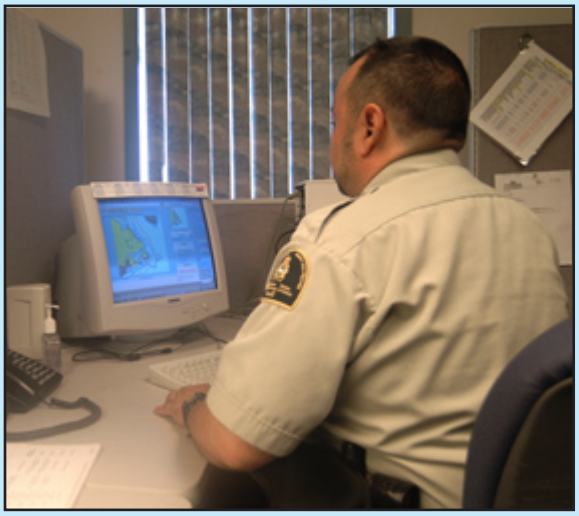
In the sky, chartered surveillance aircraft monitor vessels for hundreds of miles around, using computer software especially designed for DFO. And aboard hundreds of fishing vessels themselves, industry-purchased Vessel Monitoring System (VMS) devices report their precise locations to DFO computers operated 24 hours a day. Offshore fleets including vessels for groundfish, lobster, swordfish, tuna, scal-

lops, mackerel, clam and northern shrimp must carry VMS systems. In addition, inshore fleets such as the Bay of Fundy scallopers, herring seiners, swordfish longliners, tuna vessels, Lobster Fishing Area 38b (off Grand Manan, New Brunswick) boats and most crab vessels must use VMS as well as vessels in many of the newer fisheries including sea cucumber, inshore quahog and sea urchin.

Many fishing vessels also carry observers, again at industry cost. Groundfish vessels longer than 45 feet, scallopers, herring seiners, swordfish and tuna vessels, all crab vessels, and all offshore lobster vessels – in fact, all major fisheries except inshore lobster vessels and groundfish fixed-gear vessels under 45 feet – come under the observer program. Private companies supply the 30-40 observers, trained to DFO standards, who work in the sector.

The level of coverage depends on the fishery. Some vessels, such as offshore groundfish trawlers, carry observers on every trip. In other fisheries, coverage varies according to sensitivity of the fishery. Generally speaking, larger boats get the most coverage. In fisheries with only partial coverage, when DFO suspects misreporting, dumping of fish, or other offences, it assigns a trained observer for a few trips, with the aim of changing behaviour.

The industry-funded dockside monitoring program provides a rigorous system of reporting and has led to more complete, timely and independently verified information on landings. Vessels must hail out, hail in, and, as appropriate, have a monitor inspect their catch. Dockside monitoring applies to most fisheries, the major exception being the inshore lobster fishery, which keeps track of landings via lobster catch and settlement reports submitted directly to DFO. Dockside monitoring companies must be certified in accordance with the Canadian Manufacturing and Standards Board. For many fisheries, the monitoring companies collate and electronically deliver the catch and effort data directly to DFO.



Fishery Officers use VMS to track the location of fishing vessels, in real time, 24 hours a day.

port, Liverpool, Yarmouth, and Saulnierville. Some belonged to independent operators; most, to a handful of family-owned companies.

Offshore vessels fish several offshore banks, most notably Georges and Browns, off Southwest Nova Scotia. As so-called inshore boats took on more fishing power in the 1970s and 1980s, they began encroaching on what offshore fishers considered to be their grounds. After consultations with the scallop fleets in 1986, DFO drew a line near Yarmouth to separate the inshore and offshore fleets.

That same year, the offshore fleet worked with DFO to adopt a system of Total Allowable Catches, divided into Enterprise Allocations, with secure shares for each company. By the year 2000, the active fleet dropped to fewer than 30 vessels, consistently profitable.

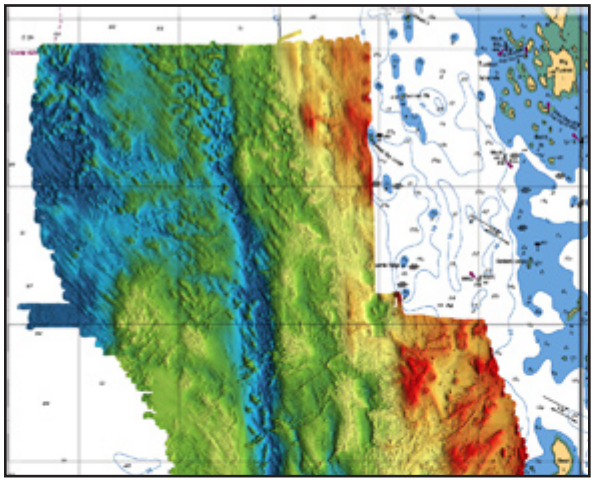
The offshore scallop fishery provides more than half of Scotia-Fundy scallop landings, and supports about 500 fishing and 250 full-time processing jobs. Several offshore vessels now freeze the catch on board, for a top-quality product.

Working with DFO, this small group of companies developed a high degree of co-management. Besides quotas, conservation regulations include size limits (calculated

in average number of meats per pound) and gear restrictions. The offshore firms fund at-sea stock-assessment research, dockside monitoring, and data analysis. Because scallops do not move a great deal on the ocean floor, counting the young can yield reliable estimates of future abundance. The Offshore Scallop Advisory Committee plans quotas and operations accordingly, towards long-term productivity of the resource.

Scallops brought aboard a Scotia-Fundy vessel.

In co-operation with DFO's Canadian Hydrographic Service, the industry funded and outfitted a vessel to conduct sea-floor mapping of Georges Bank and Browns Bank. Fishers had always carried a mental map of bottom areas and types: hard, muddy, rocky, sandy, and so on. But the sophisticated multi-beam sonar surveys added greatly to their fishing knowledge and to Canada's general stock of ocean data. The detailed delineation of the bottom and its habitat help vessels to protect nursery areas, harvest the mature scallop grounds, and avoid disrupting other areas. Underwater camera observations have fostered gear modifications to avoid by-catches of other species and reduce ecosystem impacts of scallop dragging. While the seabed gets more protection, towing times and fuel costs drop, improving economic performance.



Sea-floor map of Browns Bank, off Southwest Nova Scotia.

Crab

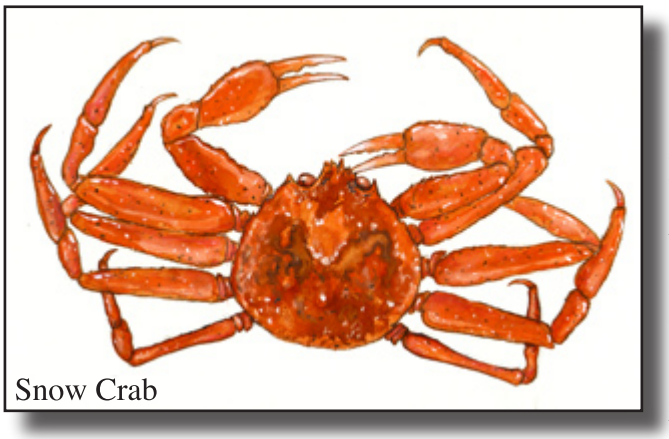
Of all areas in the Scotia-Fundy sector, Eastern Nova Scotia suffered most from the groundfish decline. Large plants in North Sydney, Louisbourg, Canso, and other ports operated at a fraction of their former levels. The area also had less lobster and herring than Southwest Nova Scotia and the Bay of Fundy. But as ocean conditions changed, Eastern Nova Scotia gained most from the growth in crab and shrimp.

Federal and provincial governments in the 1960s and 1970s sponsored exploratory fishing for crab on various parts of the Atlantic coast. Cone-shaped traps set on the bottom catch the ten-legged crustaceans. The Gulf of St. Lawrence and Newfoundland and Labrador proved most productive for the new fishery.

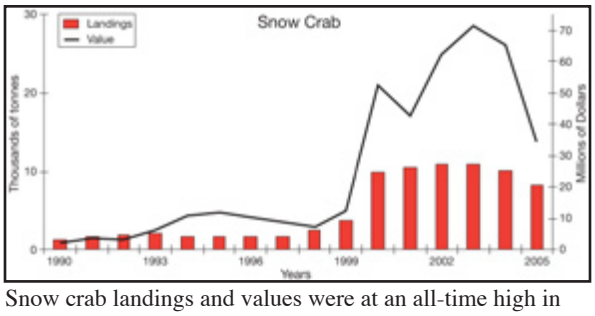
In Scotia-Fundy, the main fishery takes place east of Halifax on the Eastern Shore, and on the Atlantic side of Cape Breton. Landings stayed low until the late 1980s. Then, snow crab landings shot up from 1,100 tonnes in 1990 to about 11,000 tonnes in 2004. Value rose in those same years from $2.3 million to an astounding $66 million. Although catches dropped in 2005, scientific surveys suggest that good year classes are waiting in the wings.

Meanwhile, the snow crab fishery has spread into new grounds further offshore so that all grounds with commercial concentrations are fished. A small fishery for snow crab has also developed in Southwest Nova Scotia, with notable participation by First Nations. Fishers have expanded into related species, including rock crab and Jonah crab, in Eastern Nova Scotia and other areas of Scotia-Fundy. North America and Japanese markets take most crab, often in frozen, precooked "sections" of claws and smaller legs.

As of 1996, fewer than 125 enterprises held crab licences. With catches rising, others pushed for access. Following many consultations, DFO in 2000 began granting temporary quotas to about 700 temporary participants, using up to 120-odd vessels. To qualify for access, these temporary participants had to meet criteria on such matters as their history in the fishery.


Snow Crab

Both abundance and demands for access kept rising, but there was no industry consensus on a long-term sharing arrangement. This prompted the Minister of Fisheries and Oceans to appoint an Independent Panel on Access and Allocation in the Snow Crab Fishery, established to provide advice on a long-term allocation scheme. The Panel's recommendations were accepted by the Minister and, in 2005, resulted in a stable sharing arrangement of roughly half and half between original licence holders and the additional entrants.



Snow crab landings and values were at an all-time high in the late 1990s and 2000s. The decline in landings by 2005 shows the cyclical nature of the stock.

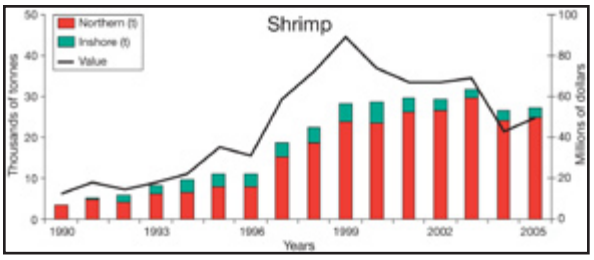
Meanwhile, several organizations sprang up to represent the growing fishery and provide their views on management. Since 2005, the fishery in all areas operates by Individual Transferable Quotas within an overall quota. The many conservation measures include limits on the numbers and sizes of boats, size regulations on trap meshes and on crab themselves, and at-sea and dockside monitoring programs.

Shrimp

Northern shrimp are found off Cape Breton. But the main fishery takes place by large trawlers in distant waters off Newfoundland and Labrador, and in the Davis Strait between Canada and Greenland.

Scotia-Fundy shrimp landings rose seven-fold after 1990, reaching as high as $69 million in 2003. The shrimp fishery also surged during the 1990-2005 period, thanks in part to both ocean conditions, and new technology.

Shrimp vessels (trawlers or draggers) tow conical trawl-nets along the seabed. The small meshes needed to trap shrimp used to bring in unwanted catches of groundfish. For years, protective regulations for groundfish hindered the shrimp fishery. Then, in the early 1990s, DFO introduced fishers to a trawl-mouth device, the Nordmore grate, which deflects groundfish but admits shrimp. This transformed the fishery. The grate, which became mandatory, made possible a fishery for approximately 30 shrimp draggers, primarily fishing April through June under an ITQ program.



Shimp landings have increased drastically in Scotia-Fundy since 1990.

With abundance high, additional vessels have gotten temporary access. In 2006, a new, multi-year co-management plan came into place to stabilize allocations and provide permanent access to temporary licence holders.

A smaller number of fishers trap shrimp in fall and winter at Chedabucto Bay, between mainland Nova Scotia and Cape Breton. Fishers are allocated 8 per cent of the shrimp quota on a competitive basis but they are likely to move toward an ITQ program in the future.

Overall, yearly shrimp catches from Scotia-Fundy waters in the 2000s have totaled several thousand tonnes annually. Landed values have exceeded $5 million in recent years.

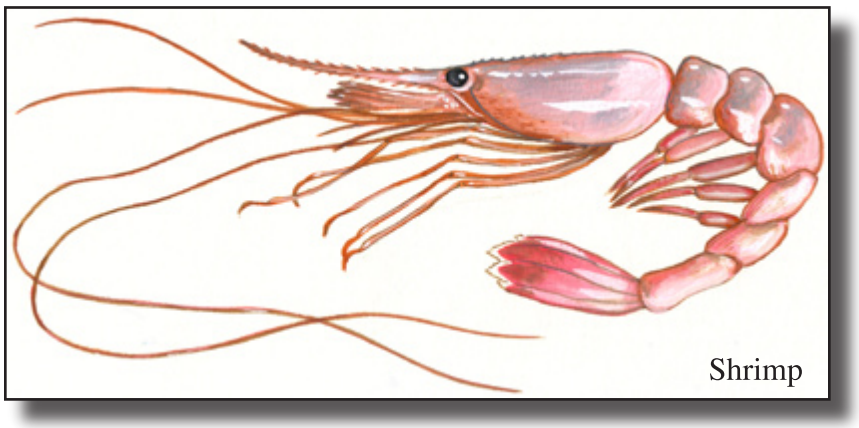
However, the bulk of shrimp landings in Scotia-Fundy come from the northern shrimp fishery off Nunavut and Newfoundland and Labrador. Large trawlers with double crews stay at sea for weeks or even months at a time, freezing the catch in raw or cooked form. Of the dozen or so vessels active in this fishery, four work out of Scotia-Fundy. This high-value fishery, like that for offshore scallops, has a high degree of co-research and co-management.

All told, shrimp landings by Scotia-Fundy-based fishers went from 4,000 tonnes in 1990 to 22,000 tonnes in 2005, down from a peak of 31,000 tonnes in 2003. Landings went from $12 million in 1990 to $69 million in 2003, dropping back to $35 million in 2005.

Clams

Like that for shrimp, the clam fishery has a local and offshore component. Traditional clam diggers remain a familiar sight in the Scotia-Fundy sector, especially on the tide flats of the Bay of Fundy. Some 1,600 participants are licensed. Inshore clams get sold mainly in fresh markets.

Most production now comes from surf clams and quahogs harvested offshore, from Banquereau Bank off Eastern Nova Scotia



Shrimp

and the Grand Banks of Newfoundland. DFO researchers helped establish this fishery, which commenced in the 1980s. This offshore fishery occurs in relatively deep water with large expensive vessels. Dredges fitted with water jets are towed very slowly by the large vessels to loosen the clams from the bottom.

Landings rose in the 1990s and are now being maintained below the conservation limits set forth by DFO as a result of market demand. A Total Allowable Catch and many other conservation regulations apply to this Enterprise Allocation. As with offshore scallops, the industry has developed sea-bed maps, funds research into stock and distribution of abundance, and helps share management policies. The surf clams get frozen and sold mostly to Japan, where they are known as *hokkigai*. Quahogs go principally into canned markets in North America.

Sea urchins

The sea-urchin fishery also began in the 1980s and grew fast in the 1990s. The nearly 90 licences scattered around the Scotia-Fundy

A harvester digs for clams on local tidal flats.

sector include almost 30 held by First Nations. In Southwest New Brunswick, some fishers are permitted to use drags; otherwise, divers gather the urchins. Landings of these pin-cushion-like animals typically run to 1,500-2,000 tonnes during the fall and winter period when their roe ripens. Processing extracts the roe for shipment mainly to Japan.

Other shore fisheries take place for such species as sea cucumbers (related to the sea urchin), whelks ("moon-snails"), and periwinkles. In addition, aquaculturalists grow important quantities of mussels and oysters, mostly in Eastern Nova Scotia.

Pelagic fisheries: diverse and dynamic

Pelagic, anadromous, and estuarial fish have darker flesh, live near the surface, and often migrate widely. Traditionally, pelagic species have followed groundfish and shellfish in their significance to the Scotia-Fundy fisheries.

Herring

Herring provide the biggest pelagic catch. In the Bay of Fundy, small herring are harvested mainly by weirs on the New Brunswick shore. Elsewhere, the main take is of larger, older herring caught for roe or fillet markets in Asia and Europe. The largest share goes to purse-seiners, generally using vessels longer than 65 feet. Seiners working along the shore or on offshore banks, circle schools of fish with a large net, then close ("purse") up the bottom like a floating bowl before pulling back the net. Gillnetters working close to shore from smaller boats take a smaller share of the total catch.

Herring get sold in canned, smoked, and other forms. As well, herring roe goes to Japanese and other Asian markets. A smaller, closely related fishery takes place for mackerel; these most often get sold fresh or frozen for bait.

Historical background

The widespread and well-known Atlantic herring has supported a commercial fishery for centuries. Early fishers caught herring mainly by nets, but would sometimes use lighted torches to attract fish at night, to be dipped out of the water.

In the Bay of Fundy, the biggest herring producing area, the main fishing method came to be herring weirs. More than 500 of these structures lined Fundy coves and inlets during the 1930s, most of them in the Passamaquoddy Bay region of Southwest New Brunswick. Weirs caught mostly juvenile herring, marketed as sardines. At the factories, rows of women packers working at high speed snipped heads and tails from the sardines and put them in cans. Larger herring went into salted, pickled, or smoked products.

After the Second World War, Passamaquoddy fishers became pioneers in using sonar for purse-seining. Fishers there and elsewhere had already used echo-sounders, which sent a sound pulse straight down. The Passamaquoddy innovation was to use surface-scanning sonars, developed for anti-submarine use in the war, which sent the pulses out horizontally. Their method spread round the world.

Purse-seiners from the New Brunswick and Nova Scotia sides of the Bay of Fundy began taking major quantities of herring, mainly from inshore and offshore waters off Nova Scotia. Larger than the juveniles

CO-RESEARCH MOVES AHEAD

As management became more participatory, so did fisheries science. Fishers themselves began pursuing research projects, testing theories with precise observations.

Traditionally, research was the domain of DFO's technical experts. In fisheries such as groundfish and herring, scientists and technicians would sample the sizes and ages of fish taken in commercial catches and research surveys. Calculations enabled them to estimate the size of different year classes, and thus the Total Allowable Catch for each stock. Besides this "population dynamics" work, which increased after the 1960s, researchers investigated feeding, migrations, and other aspects of fisheries biology, which remains mysterious in part.

The groundfish crisis made clear both the limited state of knowledge and the need to involve fishers, the closest people to the fish. The scientific Regional Advisory Process for different fisheries, where scientists discussed their calculations of abundance, opened up to fishery representatives. Researchers made special efforts to reach out to fishers.

One such initiative created a new research partnership. In 1994, a series of more than 20 community meetings initiated by DFO's Communications and Science Branches prompted the formation of the Fishermen and Scientists Research Society (FSRS). An initial group of fishers along the Eastern Shore worked with scientists to share information and learn basic techniques of measuring and sampling to support long-term monitoring. Training also involved conservation ethics and communication skills, with scientists and fishers working together. Captains and crews began collecting fishery data in an accurate and precise form that scientists could use.

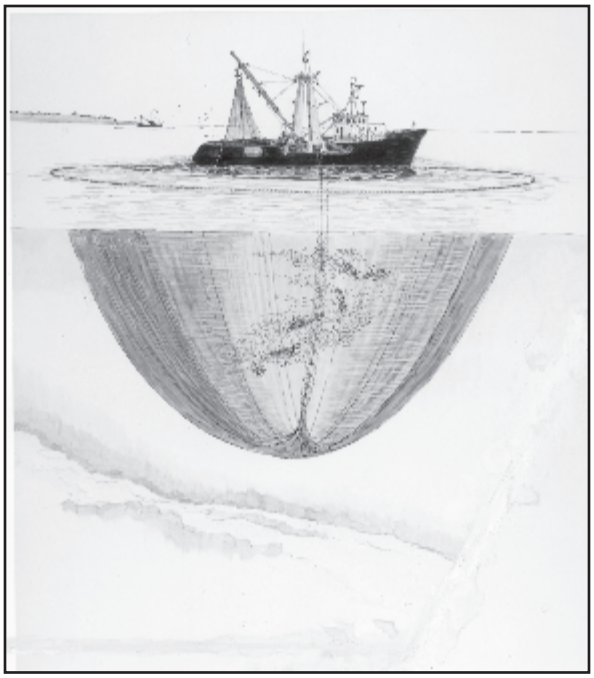
The FSRS grew into an independent organization, working closely with DFO. It soon attracted members from across the Scotia-Fundy sector. The Society has taken part in dozens of research projects on groundfish, lobsters, and other species. Annual meetings, seminars, a regular newsletter, and other forms of dialogue encourage the growth in knowledge. Often, fishers can use their own research to prove a scientific point. The first fisherman-scientist venture of its sort in Canada, the FSRS has drawn international attention and has sustained itself in vigorous fashion.

Dozens of other co-research initiatives have sprung up. Fishers provide funding or participate directly in research, most frequently in surveys of stock abundance. As noted earlier, some fishing companies work with DFO's Canadian Hydrographic Service to make detailed maps of the sea floor in offshore shellfish areas. From major species such as lobster, swordfish, herring, and halibut to lesser-known ones such as dogfish and sea cucumber, co-research now reaches across the Scotia-Fundy Sector.

As co-research has increased, a broader conservation consciousness has developed. Fishers, scientists, and managers all pay more attention to ecological complexities.

In the 1960s and 70s, DFO tended to manage each species in isolation, estimating the numbers in each year class, and forecasting on that basis. With the 1980s, they took more account of bycatches (incidental catches) and discards.

In recent years, considerations have become far more complex. The fisheries management plans are beginning to incorporate fish habitat, biodiversity, and other influences. No one pretends to have all the answers for ecosystem management, but as industry and government ask better questions and work together for the answers, understanding is growing.

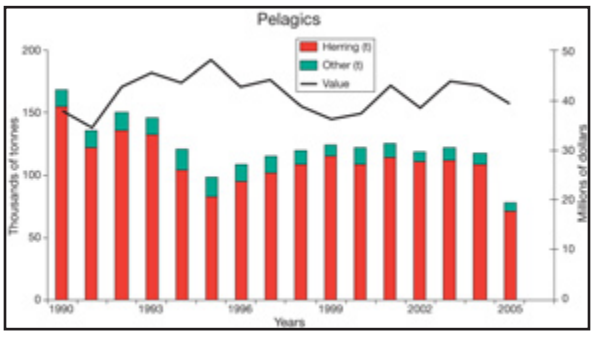


Purse seine.

caught in weirs, these herring mostly were ground up and cooked in "reduction" plants for fertilizer and fish meal. Some 50 boats, about half on each side of the Bay of Fundy, took very high volumes.

In the 1970s, the highly competitive fishery ran into resource and market problems. In 1976, the seiners and the federal fisheries department set up the first Individual Quota (IQ) system in Canada's sea fisheries. Each boat got a percentage share of the Total Allowable Catch, with guidelines preventing over-concentration of ownership.

Rather than racing to catch the herring for low-value uses, fishers could now supply the plants at a measured pace. Production of food and roe increased, and value shot up. Government ended the catching of herring for fish meal. In 1983, DFO and the fishers took the next step, pioneering Individual Transferable Quotas (ITQs). The fleet would eventually drop to less than half its former size.



The herring fishery comprises most of the pelagic landings in the Scotia-Fundy fisheries.

Pioneering in management

Innovations in fishing and management failed to solve all problems for herring seiners. The high catches of the 1960s, dependent on strong year classes of the day, never returned in a sustained way. TACs and markets had their ups and downs. In the 1990s, some licence-holders sold off their quotas, to concentrate on other fisheries or leave the industry. By the mid-2000s, the number of active seining vessels dropped to about 20.

Challenges remained in the fishery itself. At first, the expert seiners, able to take big catches, sometimes failed to report all landings. But DFO kept strengthening the dockside-monitoring system, and obliged seiners to carry VMS devices to monitor vessel locations. Rule-breaking seemed to fade. As well, seiners became highly involved in acoustic surveys and catch sampling, as part of the stock-assessment process.

Still, the Total Allowable Catch for this fleet's main herring stock dropped from 100,000 tonnes in 2000 to 50,000 tonnes in 2005. Only the shrinking of the fleet through ITQs kept the fishery viable. Today, licence holders are contributing to science efforts and hoping for an early resource recovery.

The weir fishery also shrank. In the Passamaquoddy area, the number of sardine plants fell from five or more in the post-war period to only one at present. Weirs dropped to fewer than 80. Yet, many weirs continue to do well; the fishery usually takes 10,000 to 15,000 tonnes. Output remains high at the one remaining sardine plant, where mechanization has taken over some of the packing.

Gillnetters form a growing part of the herring fishery. In the past, they generally provided a supplementary fishery around the Nova Scotia coast. More recently, gillnet fisheries for herring and their roe have expanded in the Cape Breton, eastern mainland, and South Shore areas of Nova Scotia, ac-

Fishing weir.

counting for landings of up to 10,000 tonnes in some years. About 1,100 fishers hold gillnet licences, not all in use. Gillnets and weirs together account for some 30 per cent of total herring landings.

Mackerel provide a related fishery. Gillnets, traps, and handlines take the great majority of the catch. Scotia-Fundy fishers hold about 2,000 mackerel licences, almost all on the Nova Scotia shore. Total landings in this supplementary fishery run less than 5,000 tonnes. An experimental midwater-trawl fishery has been underway since the fall of 2005, but with little success to date.

Swordfish

Swordfish have provided a commercial fishery for more than a century. These large animals often weigh more than 100 kilograms. Swordfish migrate into Scotia-Fundy waters from the south, following warmer temperatures as the year advances.

Before the Second World War, fishers took swordfish mostly by harpoon. In the 1960s, longlining became the main fishing method. The restaurant trade in the northeast United States has traditionally provided the biggest market.

Internationally, swordfish management comes under the International Commission for the Conservation of Atlantic Tunas (ICCAT), with Canada an active member. In 1991, ICCAT countries adopted minimum size limits on swordfish. National catch quotas were introduced in 1995. Canada generally is allocated about 10 per cent of the catch in the North Atlantic. In 2005, Canadian fishers landed about 1,600 tonnes worth $13 million for Scotia-Fundy fishers.

Vessels work mainly out of South Shore ports west of Halifax and elsewhere in Southwest Nova Scotia. In 2000, Canada began dividing up the quota by fleet sectors. Ninety per cent goes to the longline fleet. In 2003, the longline fleet adopted Individual Transferable Quotas, in order to fish more to market conditions (avoiding the competitive race to fish) and to avoid past tendencies of overrunning the swordfish TAC. Of the 71 licence holders, only 40 or so now take an active part in the fishery.

Swordfish

The remaining catch goes to harpoon fishers. Of the more than 800 harpoon licence holders, fewer than 200 fish in a given year.

Tunas

Bluefin are the biggest of Atlantic tunas, in physical size, volume of landings, and importance to fishers. The commercial fishery was for a long period an incidental and intermittent one, but has became more prominent in recent decades.

Like swordfish, bluefin tuna migrate into Scotia-Fundy waters during the warmer summer months. Dealers air-freight bluefin, which can weigh two-thirds of a tonne, in fresh form to Japan. There, depending on timing and quality, a single fish can fetch up to tens of thousands of dollars.

Internationally, ICCAT manages bluefin tuna, with Canada both influencing inter-

national regulations and enforcing these rules in domestic waters. Catches increased sharply in the 1990s. Canada's allocations in recent years have usually been between 500 and 600 tonnes annually.

Working with its industry advisory committees, DFO divides up the quota among different fleets, including those from other DFO Regions. Catches come from both inshore and offshore waters. In St. Margarets Bay on Nova Scotia's South Shore, about two dozen fish traps take bluefin. Elsewhere, about 40 Scotia-Fundy vessels, and up to 100 vessels from other Regions, using tended lines or rod and reel, take tuna from inshore and offshore waters in such areas as Canso, Halifax, the Bay of Fundy, and the Hell Hole area between Browns and Georges Banks.

Besides quotas, typical management measures apply, including limited entry, industry-funded observers and VMS devices, and dockside monitoring. Fishers must tag every tuna landed. Similar rules control smaller fisheries that have developed for yellowfin, bigeye, and albacore tunas.

Other Pelagics

Small estuarial fisheries, often using trapnets, take such species as gaspereau, shad, smelt, and the catadromous (sea-spawning, river-living) American eel. The famed Atlantic salmon, an anadromous (river-spawning, sea-living) species, remains a significant conservation challenge. DFO no longer allows a commercial fishery for Atlantic salmon. Inner Bay of Fundy Atlantic salmon populations, in particular, have declined by 90 per cent or more in recent years, putting this fish at risk of extinction.

Other Marine Harvests

In Scotia-Fundy's hundreds of bays, coves, and inlets, smaller fisheries take place and others are still developing. Whelks, snail-like creatures known for their spiral shells, are a delicacy in Asia. DFO has recently issued new fishing licences for this species. Sea cucumbers are also attracting new interest for Asian markets. Moreover, the green crab, an invasive species, may support a new fishery. To date, DFO has issued exploratory licences.

Harvesters dig for marine worms mainly in the wide tide-flats of the Bay of Fundy's Minas Basin. These get sold as bait for use by recreational fishers. Several decades old, this fishery grew in recent years to a value of more than $4 million. Concern over depletion brought scientific studies and management attention. DFO set up an advisory committee of elected harvesters and others. New conservation measures came in, along with licences. The number of harvesters dropped to a more sustainable level.

The same cautious approach marks emerging fisheries and sea harvests in general, such as that for grey seals. These large animals, the males weighing well over 300 kilograms, have recently spread from Eastern Nova Scotia into new areas. Besides being fierce predators, they can bring a parasite, the sealworm, which infects certain groundfish. Currently, industry members, through the Grey Seal Research and Development Society, are trying to develop a commercial trade and a pilot harvest has been established.

There has historically been a small directed commercial fishery for porbeagle and shortfin mako sharks. These sharks, as well as blue sharks, can also be caught as a bycatch or in the small recreational fishery. Sharks are slow-growing and low-producing and caution is the order of the day. For example, the current harvesting plan for porbeagle proposes to greatly constrain any directed commercial fishery.

Rounding off the sea harvests, private interests in Southwest Nova Scotia pioneered the cultivation of marine plants, which had a landed value of $3 million in 2005. Since 1990, controlled harvesting of wild seaweed has provided new jobs in Southwest New Brunswick, where value can exceed a million dollars yearly. At Grand Manan, N.B., a seaweed known as dulse provides a delicacy.

But most plants and seaweeds get used in food additives. One well-known seaweed, Irish moss, has long provided a small harvest off southwest Nova Scotia. Today, seaweed producers are also cultivating this plant for the high-value restaurant trade. In another

Marine plants cultivation site, Charlesville, Nova Scotia. - Courtesy of Acadian Seaplants Limited.

venture, snow crab and lobster shells, which formerly went to waste, are now finding use in non-prescription health products known as nutraceuticals, and providing considerable added value.

AQUACULTURE- A MAJOR NEW INDUSTRY

In less than 30 years, aquaculture in Scotia-Fundy has reached a production value of more than $268 million. Handling and processing increase that value. Aquaculture provides more than 2,000 direct jobs in coastal towns and villages of the Scotia-Fundy area.

A dynamic private sector drives the industry, backed by federal and provincial research and regulation. Aquaculture in Scotia-Fundy first grew strong by raising Atlantic salmon. Other farmed species in the region include trout, Arctic char, mussels, oysters, scallops, and more. Experiments in cod and halibut aquaculture are underway with some fish already sent to market.

Farmed salmon: a North American first

The bulk of Atlantic salmon production takes place at more than 90 aquaculture sites, chiefly in the Passamaquoddy Bay area of Southwest New Brunswick. It was here that researchers from the Biological Station in St. Andrews with provincial and private-sector partners pioneered salmon farming in North America.

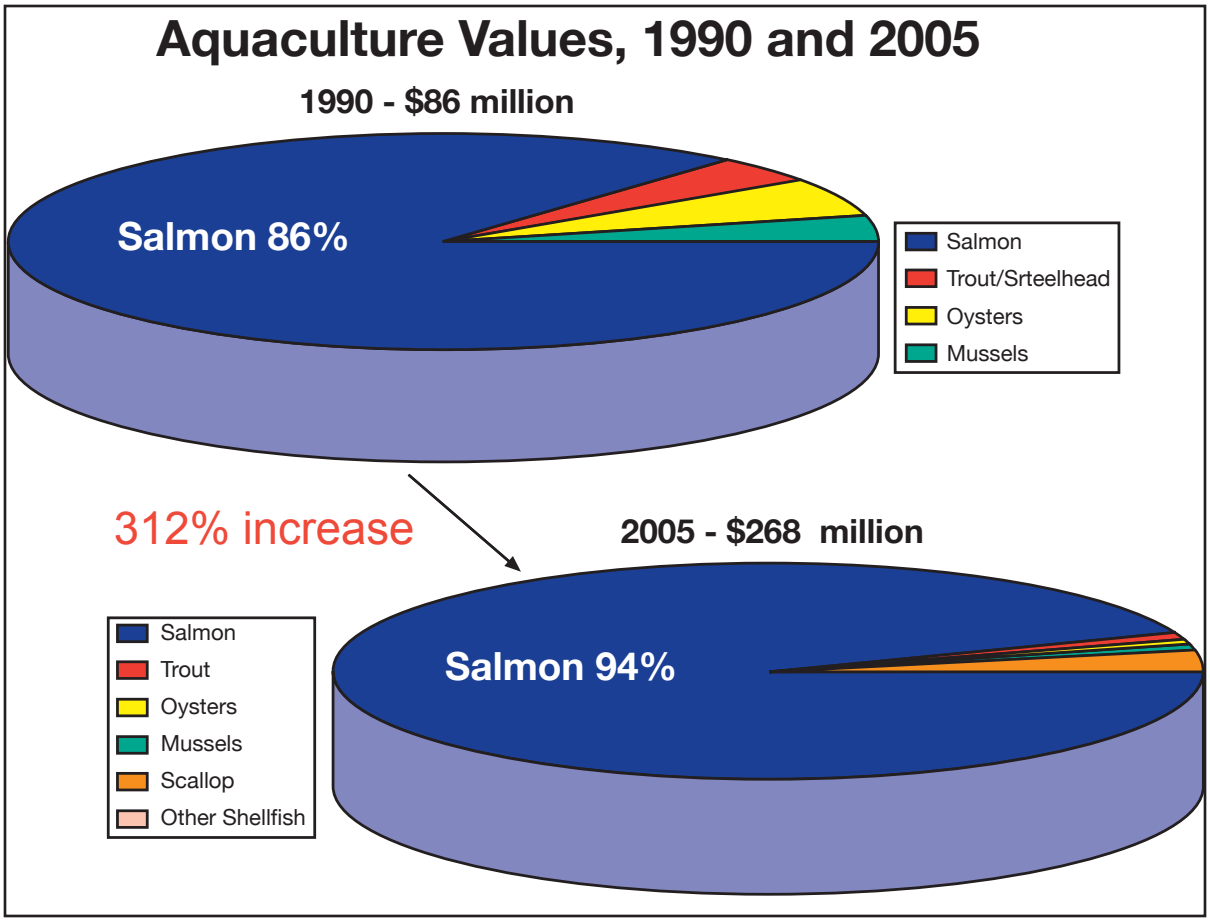
A single salmon site can have more than a dozen sea-pens holding hatchery-bred fish as they grow to market size. The salmon farms of Southwest New Brunswick in 2005 produced a farm-gate value of $225 million.

Historical background

In the late 1970s the Biological Station researchers and their partners first succeeded in overwintering Atlantic salmon in net cages. Biological Station scientists further aided the industry with research on nutrition and other matters. For example, they found ways to speed growth by adjusting exposure to light in hatcheries.

As aquaculture grew, a comprehensive regulatory structure came into place across Canada. In Scotia-Fundy, federal-provincial Memoranda of Understanding (MOUs) and interagency committees provide collaborative guidelines for management, with a strong voice for industry members.

Provinces lead the handling of licensing and site applications and the market development of aquaculture products. DFO heads up the efforts of federal agencies dealing with research, environmental monitoring, and other matters. Federal research, development, and regulatory work culminated in the 1995 Federal Aquaculture Development Strategy (FADS), which laid out a framework for co-operation and progress. And in 2001, a $20-million Aquaculture Collaborative Research



and Development Program began supporting privately-initiated research with federal funding and expertise.

Despite a high degree of consolidation in the New Brunswick industry, some smaller enterprises retain a place. Salmon site operators may feed fish by hand or use computer-controlled, video-monitored systems that tailor the amount of feed to the appetites of the salmon. Benthic (seabed) monitoring takes place regularly below the cages. To counteract spread of disease, sites hold only a single year class and lie fallow for periods between each production cycle.

Nova Scotia provides diversity

Although farmed salmon from the Bay of Fundy is the dominant aquaculture species, bio-entrepreneurs of Southwest New Brunswick have also ventured into other species, such as cod, scallops, and shortnose sturgeon.

But the greatest diversity shows up on the Nova Scotia side of Scotia-Fundy, where the more than 300 sites include state-of-the-art mussel farms, pioneering halibut operations, and enterprises raising more than a dozen other species. Cape Breton and the Eastern Shore have scores of oyster and mussel farms. Other farmed shellfish around the coast include bay and sea scallops, bay quahogs, bar clams, and sea urchins.

As the South Shore begins to curve towards the Bay of Fundy, finfish sites become more numerous. Species include rainbow and speckled trout, Arctic char, cod, halibut, and, still the leader as in New Brunswick, Atlantic salmon. Trout and salmon in 2003 provided $32 million of Nova Scotia's $40 million aquaculture production. But the variety of other species shows the vitality of Nova Scotia's innovative industry.

Developments in research and management

DFO science continues to support aquaculture. For example, under the Fish Health Protection Regulations, officials monitor

Aquaculture cages, Passamaquoddy Bay, New Brunswick.

Scotia-Fundy's many hatcheries for the presence of fish diseases and parasites. Aquaculturists need a permit to bring certain species into the country or to move them across provincial borders. DFO also works with other agencies to prevent the spread of such diseases as ISA (Infectious Salmon Anemia), and to monitor environmental effects of chemicals used, for example, to combat sea lice or to prevent bio-fouling of nets. A National Aquatic Animal Health Program (NAAHP), announced in 2005, will strengthen both research and enforcement.

Meanwhile, the St. Andrews Biological Station that launched salmon farming continues research and development work on other species, ranging from the small sea urchin to the large Atlantic halibut. The latter fish, like Atlantic haddock, is highly valued. Scientists laid the groundwork for commercial production of both halibut and haddock. Their work included use of DNA "fingerprinting" to identify broodstocks with optimum characteristics for cultivation. They have also developed methods, using natural chemicals, to promote production of female halibut, which grow faster than males.

A recent experiment in integrated aquaculture, or "polyculture," may point the way to future progress. Researchers at the Biological Station, with private-sector and University of New Brunswick partners, have begun culturing salmon, mussels, and kelp in close proximity to each other. Within this semi-natural ecosystem, the mussels take up some of the escaped feed and other organic matter. The kelp, a form of seaweed with a commercial market, absorbs excess nutrients from the water. The whole interaction leaves the water cleaner for the salmon.

Like their counterparts in farming and fishing, aquaculturists meet obstacles along the way. For salmon farming in particular, competition from foreign producers, currency fluctuations, and losses from disease have all recently cut into revenues. In 2005, a Federal-Provincial Salmon Aquaculture Task Force investigated and provided advice to Atlantic Fisheries and Aquaculture Ministers on strategies to support industry restructuring, addressing both financial pressures and structural problems of farm management.

In general, though, Scotia-Fundy aquaculture with its energetic entrepreneurs and industry-government collaboration remains strong, and continues to strive for progress.

FISHERIES MANAGEMENT – MOVING TOWARDS STABILITY

The fishery never runs out of challenges. Yet the Scotia-Fundy industry in recent years has moved from turbulence towards longer-term stability.

Responding to the groundfish crisis, fishers and processors found new markets and produced higher-quality products for better prices. International fish and seafood exports from Scotia-Fundy totaled about $1.3 billion in 2005.

Despite the ups and downs inherent to the fishery, the industry is more profitable than ever. The industry has become smaller and more self-reliant. Aquaculture has steadily grown, and First Nations have found a solid place in the regional fishery.

Quotas and other safeguards apply more strongly than ever, and conservation has become embedded in industry consciousness. Today, fishers themselves often remind each other and DFO to follow a precautionary approach.

As understanding and the flow of information increased, advisory committees and industry organizations have taken on new

strength. Controversies have diminished, and demonstrations and office occupations have nearly died out.

Meanwhile, co-research and co-management have reached the highest levels to date. All told, fishing-industry participants have moved closer to fully shared stewardship for a sustainable and prosperous fishery.

THE OCEAN ORIENTATION – THE FUTURE OF FISHERIES AND AQUACULTURE MANAGEMENT

Bordered by three oceans and possessing the world's longest coastline, Canada holds a great marine legacy. The waters around us represent not only natural beauty but also economic potential, in old industries like the fishery and newer ones like ecotourism. Our oceans also represent a responsibility for Canadians.

In 1997, Canada legislated the world's first *Oceans Act*. Both a statement of principles and a guide to management, the *Act* wove together three fundamental threads: integrated management, sustainable development, and a precautionary approach. The challenge was to put those concepts to work.

The *Oceans Act* accelerated two major efforts already under way in the Scotia-Fundy Sector. The first was to better understand the myriad of complex oceanic and ecosystem interactions. The second was to bring together the many parties concerned with the bordering ocean, the industries that it supports, and its benefits to life on earth.

The Maritimes Region, at the Bedford Institute of Oceanography (BIO) and the St. Andrews Biological Station, includes Canada's biggest concentration of marine biologists, oceanographers, and hydrographers. Shared research among the different disciplines has brought new insights.


Finger coral.

In one example, satellite-based studies at BIO have produced significant research on the interactions of the ocean, the plankton that the waters nourish, and the fish dependent on the plankton. Scientists have related the timing and abundance of seasonal plankton blooms directly to the abundance of fish. In another example, biologists and oceanographers interpreted that reduction in abundance of commercial sea-fish species – usually near or at the top of the ocean's food chain – can set off reactions that ricochet right down to the lowest levels, including plankton and their nutrients.

The breakthrough research on the top-down, cascading effects of fishing emerged in part from a pioneering project known as ESSIM – the Eastern Scotian Shelf Integrated Management Initiative. To make the concept of ocean management a reality, DFO initially concentrated on waters off the Eastern Shore and Cape Breton. The department brought together users, regulators, and other parties, including oil and gas explorers, fishery organizations, environmental groups, shipping interests, undersea cable companies, and federal and provincial agencies. Patient discussion brought about a comprehensive agreement on how all concerned would approach ocean projects, using agreed guidelines and processes that serve the principles of the *Oceans Act*. This has led to a unique integrated governance process and the first draft Integrated Ocean Management Plan (for a large ocean area) in Canada. Ministerial approval is expected in early 2007.

Within the ESSIM area, east of the Sable Island Bank - renowned both for its fish and its many shipwrecks - lies what is known as the Sable Gully. Some 65 kilometres long, the Gully is the largest marine canyon in eastern North America. It shelters a profusion of plants, including many deep-sea corals. The Gully also provides crucial

Right whales, Bay of Fundy.

habitat for many species of fish and marine mammals, including the northern bottlenose whale, which is listed as endangered under the *Species at Risk Act*.

In 2003, DFO created a Marine Protected Area (MPA), the first on the Atlantic coast, to protect the Sable Gully. New regulations curtailed fishing and other activities. Research continues here and elsewhere on such matters as the effects of seismic testing on whales and other species. Another MPA has recently been designated in a tidal estuary near Saint John in Southwest New Brunswick.

Research has also intensified on deep-sea corals. Scientists have mapped major concentrations in Scotia-Fundy waters of as many as 30 different species. To protect corals, DFO closed the Stone Fence, near the mouth of the Gulf of St. Lawrence, and a large area northeast of Georges Bank, to all bottom-impacting gears such as trawls, longlines, and lobster traps. Pelagic fishing, in which gear floats well above the bottom, is still allowed in those areas. Additionally, corals as well as other species are protected as a result of DFO's closure of the core part of the Sable Gully to all fishing activity.

Cross-disciplinary and public-oriented work towards integrated management and sustainable development shows up in scores of other activities. For example, BIO has created a Centre for Marine Biodiversity, which provides a forum and focus for genetics and related research.

The increasingly ocean-oriented, ecosystem-conscious approach involves more than looking towards future challenges. Dangers are present here and now. At sea as on land, some species have become vulnerable or even endangered.

INDUSTRY RESPONDS TO *SPECIES AT RISK ACT*

The *Species at Risk Act* has brought many changes to the way in which fishing and other ocean industries operate. The North Atlantic right whale provides an example. Once plentiful on the Atlantic coast, it is now a rare and endangered species. A few hundred of the remaining right whales migrate each year into the Bay of Fundy. Among other protective measures, in 2003 the federal government won agreement to change shipping lanes to avoid the whales. The fishing industry has co-operated in trying to avoid entangling whales with fishing gear. For example, in 2006 the presence of a relatively large number of right whales on the New Brunswick side of the Bay of Fundy shore posed a problem at the November opening of lobster season, when tens of thousands of buoyed traps go into the water. Fishers' organizations, DFO, and whale-watching operators set up a process to avoid entanglements, complete with a hotline to report whale whereabouts and a buffer zone between traps and whales. Bay of Fundy fishers have also collaborated to head off damage to harbour porpoise.

East of Sable Island, a Marine Protected Area encompassing an ecologically rich marine canyon known as The Gully prohibits fishing and other disturbances, thus protecting the endangered Scotian Shelf population of the northern bottlenose whale. And in the swordfish fishery, which sometimes takes accidental catches of leatherback turtles, fishers adopted "de-hooking" kits to enable returning them to the sea in good shape, and helped work out an overall recovery strategy for the endangered population.

Canada's 2003 *Species at Risk Act* forbids killing, harming, harassing, capturing, or destroying the habitat of species at risk. For fisheries scientists and managers, protecting threatened species involves complex research and associated considerations. The effects of fishing and the relationships between species, though better understood now than in the past, can still defy exact analysis and quantification. DFO and the fishing and other sea-based industries must now assess risks more thoroughly than ever, and put special precautions in place for every threatened species.

Another threat comes from invasive species. Although no Atlantic invaders have done as much damage as zebra mussels in the Great Lakes, problems are showing up. International shipping or other means have allowed several new species into Maritime waters. In one counter-effort, DFO and the five First Nations adjacent to Cape Breton's Bras d'Or Lakes are working together, under a Memorandum of Understanding, to research and protect the lakes' ecosystem, where an invading parasite has damaged the oyster fishery. The First Nations operate under the Unimaki Institute of Natural Resource's laboratory housed at the Eskasoni First Nation.

The increased collaboration in ocean management mirrors the rise in shared stewardship of the fishery. As Canadians become more conscious of the sea's importance to their climate, food chain, and the very air they breathe, the ocean orientation is likely to increase. With its scientific research reaching into the Atlantic, the Arctic and other parts of the world, the Maritimes Region of DFO stands in the forefront of the nation's efforts to understand and manage the ocean frontiers.