HYDRO DAMS BLAMED FOR DECLINE IN FISH STOCKS

I believe the driving force in the collapse of cod fisheries in the early 1990's in the Gulf of Maine, Gulf of St. Lawrence and Grand Banks of Newfoundland has been the proliferation of huge reservoir hydroelectric facilities by Hydro-Quebec on the rivers throughout the ecosystem of these three water bodies. The Daniel Johnson Dam discharges into the St. Lawrence Estuary and is the fourth largest in the world. It stores 142.0 cubic kilometers (km^3) of water, which is equivalent to 27 Moosehead Lakes. There were other large reservoirs built (see page 4) storing the water equivalency of an additional 63 Moosehead Lakes.

Dr. Hans Neu, a Senior Research Scientist at Bedford Institute of Oceanography, Dartmouth, Nova Scotia warned Hydro-Quebec, in a February 9, 1977 article in The *Sherbrooke Record*, that the proliferation of its reservoir hydroelectric facilities might be the cause of in the 1970's decline of fish stocks in Gulf of St. Lawrence, as shown in the below graph, and not overfishing.

In a 1982 report, "Man-Made Storage of Water Resources - A Liability to the Ocean Environment.? Part I and Part II," he made the following observations and prediction:

> "*Life as we know it in our coastal waters and its level of productivity has evolved over thousands of years in response to these seasonal variations. Changing this pattern by reducing the flow of fresh water during the biologically active season of the year, or even reversing the cyclic flow altogether, represents a fundamental modification of a natural system. Such a modification must have far reaching consequences on the life and reproduction cycle in the marine environment of the region affected."*
>
> and he made the following prediction in regards to Gulf of St. Lawrence
>
> *"The next big decline (in fisheries stock) probably will be in the early or mid-eighties*" and "*will be worse, since regulation will have increased further in the meantime."*

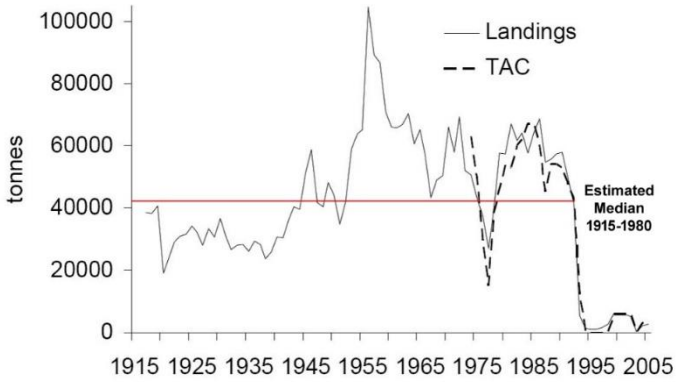

Figure 2: Landings and TAC (t) for the southern Gulf of St. Lawrence cod stock.
Source: Canadian Science Advisory Secretariat Science Advisory 2006/014

The above graph supports his prediction, and please note the following:

1. Dr. Neu predicted in 1982 that the next big decline after the 1975 decline would be worse because the Daniel Johnson Dam was coming on line. The decline was not only worse, but it has lasted 25 years and appears to be irreversible.
2. There was a sustainable median catch of 42,000 tonnes for the previous 80 years.

He also predicted a decline in the fishing stock off the Grand Banks of Newfoundland:

> *"Even if we cannot yet measure the effects with certainty in our own marine environment,* (Gulf of St. Lawrence SMK) *similar changes must already have happened to the coastal waters of Atlantic Canada and the effect must increase as regulation of our rivers continues. Of particular concern is the increased development of hydro-power-under construction or in the design stage – in Labrador, Ungava Bay, James Bay and Hudson Bay, which are bound to threaten the productivity of the Grand Banks of Newfoundland."*

The second collapse in the following graph supports this prediction. Shown below are two collapses of the Atlantic northwest cod fishery in the past fifty years. Both collapses have been analyzed as one and the cause blamed on overfishing and/or global warming by others

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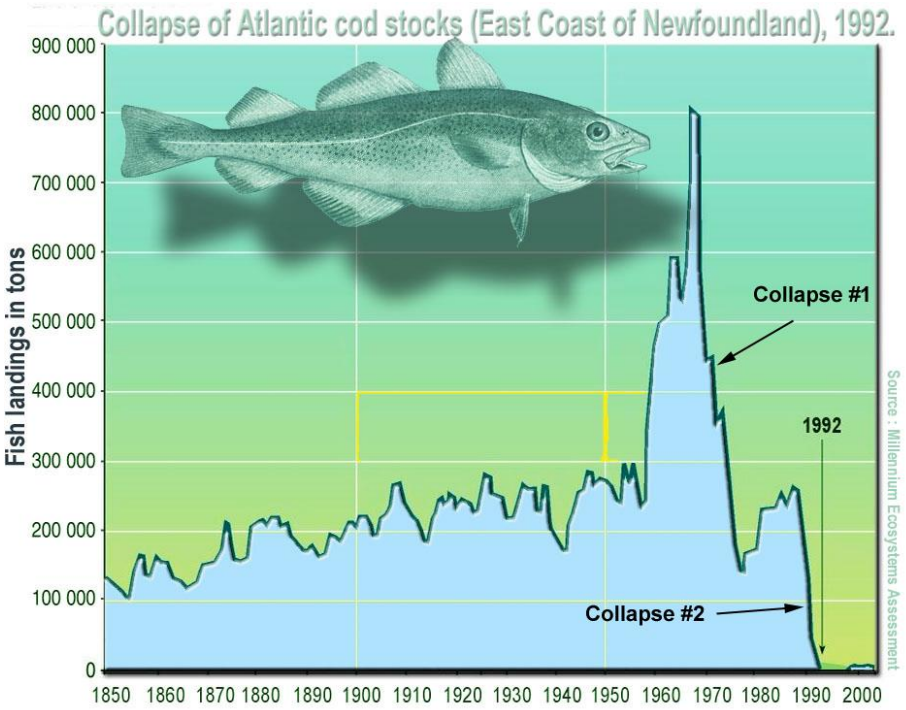


There is no doubt that overfishing caused the spike in cod landings during the 1960's and the first collapse in the 1970's is the consequence of overfishing. However, the second and more lasting collapse occurred in the 1989-1991 period. The driving force of this decline has been man-made storage behind the reservoir dams.

From 1850 through the late 1980's there was a sustainable median catch of 200,000 tons per year followed by what appears to be an irreversible collapse, which has continued through 2018.

I believe the elimination of this 140 year sustainable cod catch of 200,000 tons is what Dr. Neu had in mind when he said the storage of these waters "*MUST HAVE FAR REACHING CONSEQUENCES ON THE LIFE AND REPRODUCTION CYCLE IN THE MARINE ENVIRONMENT OF THE REGION AFFECTED.*"

The passage of time has documented that his predictions, based on earlier research, were correct.

THIS NEGATIVELY IMPACTED MARINE ENVIRONMENT ALSO INCLUDES THE GULF OF MAINE

I have written a more comprehensive analysis on other environmental impacts in my January 15, 2019 report, "Hydro-Quebec's Dams Have a Chokehold on the Gulf of Maine's Ecosystem," in which, I describe how these dams have starved the fisheries in downstream waters of nutrients and changed the thermohaline circulation, not only in the Gulf of St. Lawrence, but also in the Labrador Current. Subsequently, this has changed the thermohaline current in the Gulf of Maine as the St. Lawrence waters and Labrador Current mix together over the Scotia Shelf, which is offshore of Nova Scotia, and then flow into the Gulf of Maine.

The strength of the thermohaline current and thus the transport of deep nutrient enriched ocean water into the St. Lawrence Estuary, Grand Banks and Gulf of Maine depends on the amount of fresh water flowing into these water bodies. Reduced spring and summer outflows from these reservoir hydroelectric dams have created a chokehold on the delivery of the annual budget of dissolved silica and other nutrients via both the rivers and upwelling ocean waters. The cumulative impact of these stored waters have starved the fisheries to depletion.

Dr. Neu was quoted as follows in *The Sherbrooke Record*:

> "*In their natural state, rivers carry smaller flows during the winter when precipitation is frozen as snow, and sharply increased flows after the spring thaw. This coincides with the life cycle of marine organisms, increasing food supplies as they come out of their winter hibernation and decreasing supplies when winter returns.*
>
> *But hydro-electric dams tend to level out the cycles, storing much of the spring and summer runoff in the reservoirs until winter, when consumer demand for power is greater. This means that fresh-water nutrients reach the ocean in the winter, when the fish don't need them, and are lost into the barren depths beyond the continental shelf. In the spring and summer the nutrient supply fails to increase as rapidly as is needed."*

THERE WAS A SUSTAINABLE MEDIAN (COD) CATCH FOR 100 YEARS OF 8,000 METRIC TONS IN THE GULF OF MAINE AND THE PRECIPITOUS DECLINE, WHICH BEGAN IN 1991, IS CONSISTENT WITH THE TIMING OF COLLAPSES IN GULF OF ST. LAWRENCE AND WESTERN ATLANTIC.

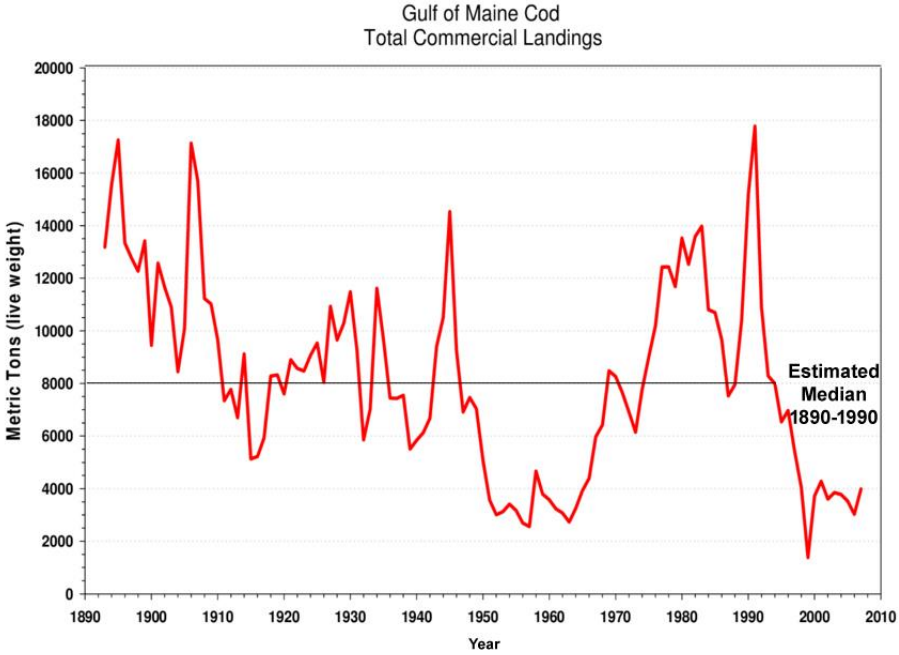
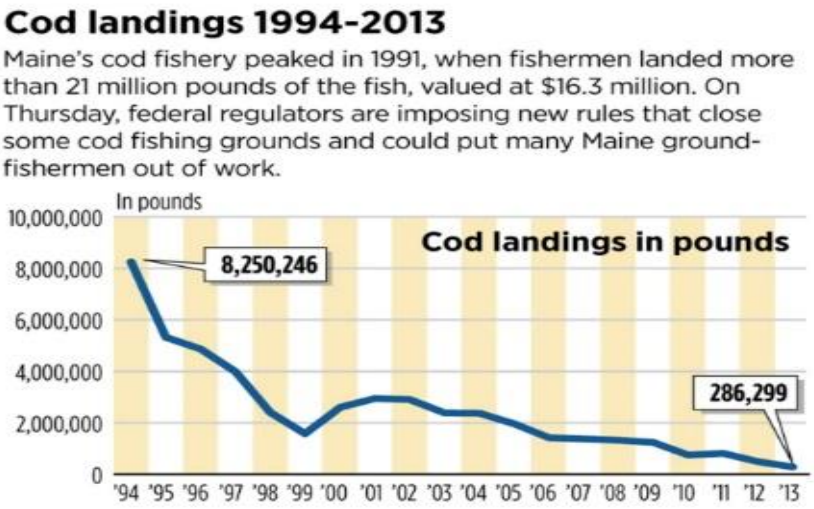


Figure 1.2 Total commercial landings (mt) of Atlantic cod from the Gulf of Maine stock, 1893-2007.

The public perception is that the depletion of the cod fishery has been caused by overfishing and/or global warming. The graph shown below by Michael Fisher of the Portland Press Herald does a great job of supporting this narrative,

but fails to disclose there was a sustainable catch for the preceding 104 years, as shown in the graph on the preceding page.



THE DRIVING FORCE BEHIND THE DEPLETION OF THE COD FISHERY WAS CAUSED BY THE PROLIFERATION OF RESERVOIR HYDROELECTRIC DAMS BY HYDRO-QUEBEC

These dams created huge storage lakes built for power development and capable of holding the spring run-off of large drainage areas and storing it over entire seasons, years and even longer.

The water volume in Moosehead Lake in Maine is 5.19 cubic kilometers (km^3) and Hydro Quebec built the equivalent of 80 Moosehead Lakes in the three watersheds listed below.

Gulf of St. Lawrence Watershed		James Bay/Hudson Bay Watershed		Labrador Sea Watershed	
1956 Bersimis -1	13.9 km^3	1979-81 Robert-Bourassa Generating Station	61.7km^3	1971-74 Churchill Falls	32.64 km^3
1969 Outardes-4	24.3 km^3	1982-84 LaGrande -3 Generating Station	60.0km^3		
1970 Daniel Johnson Dam	142.0 km^3	1984-85 LaGrande-4	24.5 km^3		
	180.2 km^3	1993 Brisay	53.8 km^3		32.64km^3
			200.0 km^3		

To put this in perspective, since the 1970's the review standards in Maine's Natural Resource Protection Act, which mandate submission of proof to minimize environmental impacts, would have prevented the building of even a small or large reservoir on any brook, stream, or river flowing into the Gulf of Maine.

RESERVOIR HYDROELECTRICITY GENERATED BY HYDRO-QUEBEC IS NOT GREEN ENERGY. IF MAINE'S PUC & DEP SAY "YES" TO CMP'S PROPOSED NEW ENGLAND CLEAN ENERGY CONNECT (NECEC), IT WOULD BE THE HEIGHT OF HYPOCRISY.