

# Fishy Biomass\*

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The Grand Banks off the island of Newfoundland on Canada's east coast once teemed with such an abundance of codfish that they reportedly choked the passage of vessels. About 500 years later, in 1992, fishing trawlers could find no cod, and officials declared a moratorium on the fishery. Little has changed since that disappearance of wild cod from the seas off Newfoundland and Labrador: both the fish and those who relied on hunting them are hard to find.

From the mid-19th century on, the cod fisheries on the Grand Banks have been objects of techno-scientific management. Processed through such algebraic machines as merchant capital, jiggers, and scientific models, codfish have been transmuted into biomass, fishermen transmogrified into labor, and coastal waters transformed into liquid farmlands. Merchant capital demanded that fish be harvested in the predictable patterns and quantity necessary to meet the loan repayment schedule. The resulting outsized technologies increased catch levels enough to occasionally not only pay off financiers but also to fatten profits. International agreements established national boundaries to police fishermen and capitalists, both foreign and domestic. And scientific theories of fish and men precisely calculated the maximum quantities of fish that could be harvested from the oceans in perpetuity.

Yet, within three generations of scientific manage-

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ment, the Grand Banks were emptied of commercially viable codfish stocks and have remained empty for almost two decades. In the absence of codfish, the labor force once employed on trawlers and fish factories has been redistributed as coal workers to the tar sands of Alberta, professional harvesters to the aquaculture industry, and tourist guides to the oceans. And those still wanting to fish cod for food are criminalized.<sup>1</sup> These fishermen have little to hope for without grasping the crucible in which codfish are transmogrified into saleable biomass.

## A World Without Fish

Worldwide the oceans are emptying of fish. Since the 1990s, the catch of wild fish has steadily declined. Nowadays, even UN bureaucrats and fisheries scientists repeat in statistics what fishermen have been warning about in prose for years: that the earth's waters are being emptied of its creatures. Some 77% of global fish stocks are fully exploited or have collapsed.<sup>2</sup> The authoritative opinion suggests that all commercially valuable species will collapse if current trends continue.<sup>3</sup> Some four million commercial fishing vessels trawl the oceans capturing some 350 billion pounds of fish, twenty-five percent of which is discarded as waste, quaintly called

1 The Telegram (2010). Recreational cod fishermen fined for illegal fishing. Accessed on January 15, 2011 at <http://www.thetelegram.com/Business/Natural-resources/2010-04-09/article-1453916/Recreational-cod-fishermen-fined-for-illegal-fishing/1>

2 FAO 2009. "The State of World Fisheries and Aquaculture 2008" FAO Fisheries and Aquaculture Department. *Food and Agricultural Organization of the United Nations*. Rome; World Bank and FAO. 2009. *The Sunken Billions: The Economic Justification for Fisheries Reform*. Agriculture and Rural Development Series. Available from: <http://siteresources.worldbank.org/EXTARD/Resources/336681-1224775570533/SunkenBillionsFinal.pdf>.

3 Pauly D, Watson R, Alder J. (2005). Global trends in world fisheries: impacts on marine ecosystems and food security. *Philos Trans R Soc Lond B Biol Sci*.360:5-12

'bycatch'.<sup>4</sup> Predatory fish such as salmon, cod, and shark are being killed at rates threatening their existence.<sup>5</sup> Those that remain are emaciated by hunger because the prey they feed on is being harvested as fishmeal to fatten chicken, cows, and other fish.<sup>6</sup> The growing consumption of Omega 3 fats in the North is devastating the primary protein source of millions of fishing communities in the South.<sup>7</sup> Half of the fishy biomass served on tables in the North is now manufactured on watery farms.<sup>8</sup>

The collapse of the Newfoundland and Labrador cod fishery (once the world's largest ground fishery) has become legendary and reflects these global trends. The 1992 moratorium on cod fishing in these waters continues to this day. For three decades, the cod have not returned to the Grand Banks and have been recommended as a candidate for Canada's endangered species list.<sup>9</sup> The disappearance of codfish from these waters was neither a natural disaster nor an accident. Hunting for sport decimated the bison that roamed the North American plains in the millions and the passenger

4 Whitty, Julia. (2006) Fate of the Oceans, *Mother Jones* March/April 1-12. Accessed on August 7, 2007 at <http://motherjones.com/politics/2006/03/fate-ocean>

5 Pauly Daniel., & Reg Watson. (2003). Counting down the last fish. *Scientific American* July, 42-47

6 Oceana. (2009). *Hungry Oceans: what happens when all the prey are gone?* Accessed on July 5, 2009 at <http://na.oceana.org/en/blog/2009/03/hungry-oceans>

7 Belton, B. (2004). High Seas Drifters: The reckless deep-sea gold rush that could turn the North American continental shelf into one giant factory-style fish farm. *The Ecologist*. August:32-38.

8 Myers R, & Worm, B. (2003). Rapid worldwide depletion of predatory fish communities. *Nature* 423:280-283.

9 Macintosh, Zoe. (2010). Some cod populations at historic lows. In *Live Science* accessed on May 15, 2010 at <http://www.livescience.com/environment/cod-fish-endangered-100513.html>. For the official pronouncement, see Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2003). COSEWIC Status Assessments, May 2003. Accessed on May 4, 2003 at: [http://www.cosewic.gc.ca/htmlDocuments/Detailed\\_Species\\_Assessment\\_e.htm](http://www.cosewic.gc.ca/htmlDocuments/Detailed_Species_Assessment_e.htm).

pigeons that once blotted out the noonday sun during their migratory journeys. But wanton destruction does not account for the disappearance of the codfish. That was the result of the scientific management of a natural resource.

Yet, the scientific management of codfish continues to be peddled as the cure for its destruction. The failure of scientific resource management has been reinterpreted as a failure *in it*, prompting the search for new and improved versions of resource management. Accordingly, by overwhelming scientific consensus, 'overfishing' is now blamed for the disappearance of the cod. Rapacious industrialists, greedy consumers, ignorant fishermen, and pliant government bureaucrats have been fingered as the usual suspects in that familiar narrative, which takes as given objective science and neutral technology.<sup>10</sup> By constructing the problem as one of 'overfishing,' even more advanced scientific management of cod fishing is made plausible as a solution. Conveniently forgotten in this familiar story of the misuse of science and technology by capital is that until 1992, the cod-fisheries off the coast of Newfoundland and Labrador were generally regarded as the outstanding exemplar of a scientifically managed natural resource.

Thus, the contemporary social imaginary runs on a narrow gauge where techno-science constitutes both rails of problem and solution.<sup>11</sup> For instance, the alternative to the permanent decline in wild cod stocks is to produce cod in egg-to-plate production systems that begin on fish farms.

10 Simpson, Jeffrey. (2010). Cod in Newfoundland: already seen that drama. *Toronto Globe and Mail*. May 13.

11 "To remain internationally competitive, Canadian producers must sustain the relentless pursuit of technological and management improvements that allow Canada to gain stature in world aquaculture. The capability to produce and market desired products at internationally competitive prices is paramount to sustained development." This recommendation is the Canadian government's recommendation for its *Aquaculture Development Strategy*. Department of Fisheries and Oceans, Canada. Accessed online on May 10, 2010 at <http://www.dfo-mpo.gc.ca/aquaculture/ref/FADS-SFDA-eng.htm#tphp>.

Such farmed cod are less like lions in a zoo used to titillate city folk and more like those domesticated game reared and shot in pens by trophy hunters. This aquaculture of cod is only the most recent phase in a more extended history of the scientific management of cod as a natural resource.

## **Killing Cod, Scientifically**

For most of human history, fisheries have neither been managed nor been objects of techno-science. To this day, fishing is primarily a small-scale subsistence activity, subjected to the rhythms of season and tide, subservient to the nature of fish, and limited by fishermen's ability. By the latest count, such fishermen outnumber laborers on the world's industrialized fishing fleets by sixty. They receive only one-fifth of the public money from the industrial fleets, yet they catch just as many fish. They produce none of the pollutions routinely generated by industrial fishing, avoid harm to spawning fish and habitat, and waste none of their catch. Oriented primarily toward fishing for food instead of for profit, the vast array of artisanal fisheries that include the stilt fishermen of Sri Lanka, the horseback shrimpers of Belgium, the poisoned spear fishing of the now extinct Marsh Arabs of Iraq, and cormorant fishing in China, do not mistake fish for a commodity, fishermen for workers, or fishing as employment.<sup>12</sup>

Similarly, from the late eighteenth century until World War II, cod fishing off Newfoundland and Labrador was predominantly practiced by subsistence-oriented fishing families who produced salt-dried cod for trade with merchants.<sup>13</sup>

12 For an overview of the contrast between subsistence and industrialized fishing start at FAO. © 2008-2010. Small-scale fisheries - Web site. Small-scale fisheries around the world. In: FAO Fisheries and Aquaculture Department [online]. Rome. Accessed on 23 ay 2010] <http://www.fao.org/fishery/ssf/world/en>. Then follow up with FAO (2009). *Fisheries and Aquaculture report #911*. Rome, which offers a conspectus on the state of small-scale fisheries around the world.

13 The family-based inshore cod-fishery that prevailed roughly between the 1790s

These fishing grounds were once the wealthiest and most productive in the world, intersected by the north-flowing warm Gulf Stream and the south-flowing cooler Labrador Current. Rich in microorganisms and minerals, these waters once supported such an abundance of marine life that only “in Newfoundland as nowhere else can one be made to feel the contrast between a land that is infinitely silent, motionless, poor in vegetation, above all poor in its variety of living creatures, and a sea which harbors every form of life.”<sup>14</sup>

Unlike herring and salmon, the cod has a high protein content without being fatty, so it was once called ‘the beef of the sea.’ As a lean fish, it is also relatively easier to salt cure and dry in the sun, which accounts for the centrality of cod to the Atlantic fish trade in the early modern period, between North America, Spain, and Portugal, among other countries. No wonder then that for half a millennium, salted and dried cod, variously called *bacalao* (Spanish), *bacalhau* (Portuguese), *klippfisk* (Norwegian), and *þorski* (Icelandic), has constituted the staple food in many a cuisine.

Codfish are carnivores. As fry, they feed on plankton near the water’s surface, graduating as they grow to eat small crustaceans, including mollusks, and then to bigger fish such as herring, capelin, and squid. Codfish favor salt waters and thrive in temperatures around fifty degrees Celsius, though warmer waters are noted to speed up their hatching and re-

and 1930s was partly a reflex of merchant capitalism as argued persuasively in Gerald Sider. (2003). *Between history and tomorrow: making and breaking everyday life in Newfoundland*. 2nd edition (Ontario: Broadview Press). In the centuries before the nineteenth, there were few ‘planters’ or settlers on the maritime coast. Most fishermen, hired as servants for wages, were brought over from Spain, Portugal, France, and England to work on the North Atlantic fisheries between the melting ice of Spring and encroaching fog and sea storms of Fall made perilous the transatlantic passage.

14 Robert Perret, *La Geographie de Terre-Nueve*, (Paris, 1913, p.172) quoted in Innis, Harold.(1954). *The Cod Fisheries: the history of an international economy*. (Toronto: University of Toronto Press), p.2-3. A fuller account of the modes and manner of cod fishing off the Grand Banks can be read in Kurlansky, Mark. (1999). *Cod: a biography of a fish that changed the world*. (London, Vintage).

productive cycles. Location, climatic conditions, and the salinity and warmth of the seas largely determine codfish's spawning, growing, and reproductive cycles. Cod at the Gulf of Maine spawn in winter, while those at the Gulf of St. Lawrence spawn in summer; shore cod of Newfoundland reach adulthood in about two years, whereas bank cod take about four years to mature. Though codfish average about two feet and some six pounds in the Grand Banks, they vary in length and weight, with one of the largest caught off the Labrador coast recorded at over five feet long and over one hundred pounds.<sup>15</sup>

Governed by their breeding and feeding cycles, hunting for cod was circumscribed by the times and seasons during which codfish were available. Typically, the inshore fishing season was limited to roughly six to eight weeks when “the codfish bounding above the waves and reflecting the light of the moon from their silvery surface” chased in from the banks, their primary food source. This capelin was “hurrying away in immense shoals to seek refuge on the shore”.<sup>16</sup> Fishing relied on a baited hook on a single line dropped over the side of a small rowboat called a dory. Though larger boats were used seasonally to reach the offshore fishing banks, hunting cod with baited hooks implied the cod were hungry to go for the bait. Once cod gorged on capelin, they would stop biting at the baited hooks, and the cod fishery would end. Well into the twentieth century, when the fish were out at sea, fishermen would repair boats and houses and find other ways to exist, including garden farms of potatoes and turnips, livestock such as pigs, goats, and chicken, and the occasional caribou hunt during winter.<sup>17</sup>

15 See Innis, *Ibid.*

16 Anspach, Lewis.(1989). *A history of Newfoundland.* (London), quoted in Sider, *Ibid.* p.72.

17 Cadigan, Sean.(1999) *The Moral Economy of the Commons: Ecology and Equity*

*Algebraic Machines, I: finance capital*

By the middle of the eighteenth century, the cod fisheries off the Grand Banks were well woven into trade routes connecting Europe, Africa, North America, and the Caribbean.<sup>18</sup> Fish, rum, enslaved people, and manufactured goods were exchanged according to variable equations, and merchant capitalists from England and other European countries financed many Newfoundland cod fisheries. For most of the nineteenth and twentieth century, the political economy of the cod fisheries is best characterized as merchant capitalism. Through the store, the merchant sold fishermen such necessities as fishing supplies, building materials, and foodstuffs, including tea, flour, salt, pork, and lamp oil. However, they did so mostly on credit instead of for cash. The sale of goods from merchants to fishermen from roughly the beginning of spring through the fishing season raised a legally enforceable claim against the total catch of the fisherman in the fall. Called the “truck” system, this circulation of goods for codfish, mainly in the absence of cash, meant merchants imputed prices for both sides of the trade.<sup>19</sup> The custom of borrowing money in the form of goods and repaying such credit in codfish meant the logic of capital and interest was inserted into the fiber of the relation between fisherman and merchant. Though fishing families controlled the modes of producing salt cod, the value of goods received and cod given was recorded and calibrated in the merchants’ books of accounts. Should the value of cod exceed that of the goods delivered on credit, the merchant

in the Newfoundland Cod Fishery, 1815-1855. *Labour/Le Travail*. 43(Spring):9-42; documents the activities of fishermen and their families unrelated to fishing by which they deepened their competency to be independent of fish merchants.

18 Morgan, Kenneth.(1993). *Bristol and the Atlantic Trade in the 18th century*. (Cambridge: Cambridge University Press).

19 Sider (2003), *Ibid*, pp.25-29, and 79-83.



would balance the books by giving a winter supply of goods. Should the fisherman have received more goods than he paid in cod, he was carried on the books to the following year.<sup>20</sup>

Crucially, the length of the fishing season and the quantity of codfish caught in a given season would naturally fluctuate from year to year. This implied inevitable mismatches between the predictability of loan repayment schedules and the variability in the comings and goings of the codfish. For many reasons, not least of which was the increasing scale of the merchant's operations, the mismatch became increasingly unprofitable for the merchant capitalist, who demanded a more reliable and increased flow of codfish to match the growing credit outstanding. The customary practice of carrying forward loans or forgiving debts on account of unexpected changes in catch volumes reflected the subordination of finance capital to the exigencies of subsistence and the vagaries of nature. The dream of disciplining the natural ebbs and flows of codfish to the time value of credit money presupposed a reversal in this hierarchy of values. By making loan repayments a normal and normative demand, finance capital began to reshape the forms-of-life lived in concert with codfish.

*Algebraic Machines, II: jiggers and more*

In the mid-nineteenth century, fishermen could do little to change the rhythms of feeding, spawning, and migrating of codfish, as these were attuned to seasons, temperature, and other imponderables. However, they were tempted by and encouraged to the solution of increasing the catch. Specifically, in response to the demand for increasing the annual yield,

20 Sider, *ibid.*, insists that the truck system always worked to the disadvantage of the fisherman, whereas Cadigan (1999) show evidence of merchants being paternalistic in carrying fishermen for many years, knowing full well that absent a winter supply many would face destitution if not starvation.

fishermen began to experiment with and adopt more intensive technologies for fishing. Hence, after nearly 350 years of using the baited hook and line method, a slew of new instruments introduced in the latter half of the nineteenth century changed Newfoundland codfishing practice. All these technologies shared one crucial feature: they were designed to ignore the nature of codfish.

The efforts to increase the catch through technical means relied on extending the fishing season in time and across space and increasing the quantity of the catch per unit effort. The cod jigger (two hooks attached to a lead weight emblazoned with the *image* of a capelin) and the cod seine were the first in this class of instruments. By design, the jigger was dropped into a school of satiated cod and rapidly moved up and down until one of the hooks pierced the flesh of codfish so it could be hauled aboard. With the jigger, cod could be captured after gluttoned full of capelin, lying logy on the bottom of the fishing grounds, refusing to bite at baited hooks. The cod seine, a roughly six-hundred-foot net composed of four to five-inch meshes towed by a crew of about six people, vastly increased labor productivity. Entire schools of codfish could be hauled aboard with the seine, catching young and old, spawning and mature cod alike.

The jigger and the seine encode the diagram of all industrialized fishing technologies aimed at increasing the catch size: the disregard for the nature of codfish and the disdain for the agonistic craft of hunting fish. Designed to catch fish whether they were hungry or not, the jigger and seine staged codfish as biomass. Reciprocally, such technologies of fishing also entailed transforming the activity of fishing from hunting to harvesting and recasting fishermen into the form of abstract labor. A related fishing tool was the longline or bultow, which comprised a long central line attached to dozens of fishing lines and hooks dropped to various depths and kept

afloat with glass buoys on either end. Whether the jigger, the longline or traps, seines, and gillnets, the new technologies introduced during the second half of the nineteenth century transformed the activity of hunting codfish into the passive harvesting of a natural resource measured as fishy biomass.

Yet it was only with the deployment of the first bottom dragger in 1954 that natural thresholds associated with the cod fishery were wholly transcended. Though long lines today run hundreds of miles and have thousands of hooks at depths exceeding two thousand feet, it is the factory freezer dragger, trawling the ocean beds without regard for weather conditions, the hunger of cod, or other natural phenomena, which allows cod fishing to be temporally and spatially unbounded. The British built the first trawler or dragger in 1954 –the *Fairtry*- and that design was soon copied and elaborated by the Russians, the French, the Japanese, and the Spanish. The *Fairtry* was over 280 feet in length, lay at 2600 pounds of gross tonnage, and had onboard a freezer, filleting, and fishmeal machines. From harvesting to making the codfish market-ready, all the processes could be conducted on board, and *Fairtry* was able to fill her hold with 600 tons of fish in 40 days.<sup>21</sup> The steady intensification in the industrialization of fishing technologies has had the desired consequence of increasing the catch. Of the 100 million tons of cod estimated to have been captured from 1500-1992, it took 400 years to hunt down half of that number and less than a century to harvest the remaining 50 million tons.

Since the cod collapse in 1992, the idea of aquaculture cod has taken over the imagination of fisheries scientists, investors, and government agencies. Aquaculture not only

21 Blake, Raymond.(1997). The international fishery off Canada's East Coast in the 20th century. In *How deep is the ocean: historical essays on Canada's Atlantic Fishery*, (eds). James Candow and Carol Corbin. (Sydney, Nova Scotia: Cape Breton University Press), pp.208.

entails programming the production of biomass but also the individual or corporate ownership of it.<sup>22</sup> In contrast to the older forms of ‘capture fishery,’ this new ‘culture fishery’ on fish farms aims to control the complete lifecycle of codfish from “egg to plate.” Having failed to predict and control the behavior of codfish in the wild, the fish farm now expresses the controlled conditions of a scientific laboratory onto the waters. Fish farms are thought to solve the problem of wild cod by reengineering them as domesticated species.

*Algebraic Machines, III: modeling living fish*

Fisheries science runs in tandem and is intertwined with the intensification of fishing technologies. For most of the history of the cod fishery, knowledge of the fish was limited to what fishermen knew. Therefore, inter-annual fluctuations in landings were accepted as the inevitable consequence of variable migration patterns, considered typical of all marine fish. Yet, by the 1850s, pressured by fish merchants to increase the catch size and by investors to smooth out fluctuations in the catch, governments began to recruit scientists to discover what caused inter-annual fluctuations in landings and to uncover the supposed ‘natural laws’ that determined years of lean and plenty.

In the 1880s, the German biologist Frederich Heincke combined the statistical methods he borrowed from studying human populations with observations of morphological features of herring that had been caught in different fishing locales. The first to self-consciously apply scientific methods

22 “Aquaculture is the culture of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants. Culture implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Culture also implies individual or corporate ownership of the stock being cultivated,” in *Federal Aquaculture Development Strategy*, Department of Fisheries and Oceans, Canada. Accessed online on May 10, 2010 at <http://www.dfo-mpo.gc.ca/aquaculture/ref/FADS-SFDA-eng.htm#tphp>.

to learning fish, Heincke insisted that population thinking could be fruitfully adapted to the fisheries.<sup>23</sup> Codfish could be considered a single species population whose measured birth and death rates would produce statistical estimates of harvestable cod. The notion of ‘population’ had so seeded the field of fisheries science that by the 1950s, population models predicted the amount of surplus biomass (or live weight of fish) produced each year by a specific fish population, labeled Maximum Sustainable Yield (MSY), which if extracted would maintain stable annual landings.<sup>24</sup>

The scientific conceit behind this prediction was that annual landings would remain perpetually stable if no more than the predicted surplus biomass were captured. While the surplus-production model allowed fisheries scientists to determine the maximum sustainable yield of fish populations, it did not account for technological innovations like the factory freezer trawler. Reality overtook that scientific model when for instance, at the peak of the Newfoundland cod fishery, trawlers from over 20 nations jostled for position on the off-shore banks creating a “city of lights” on the fishing grounds. By 1968, this “cod rush” off Newfoundland resulted in a “kill-

23 "Pronounced aversion toward measurements and numbers...is admissible when it is a manner of gaining a quick overview about the manifold varieties of organic forms, and is pardonable when the pleasure of the composing artist in the beauty and variety of forms and in his (God's) fanciful conceptions is greater than the sense for exploration of the analytical scholar; but this aversion toward measurement and numbers, which at times is heightened into contempt, is incomprehensible, inadmissible, and unpardonable when the scholar demands that his labours be regarded as a contribution to the knowledge of the true laws of nature. - F. Heincke, 1898 in Sinclair, M., and P. Soleman. "The Development of 'Population Thinking' in Fisheries Biology between 1878-1930." *Aquatic Living Resources* 1 (1988): 189-213. p.195.

24 The history of the MSY construct and its political versus scientific virtues in particular for the cold war era United States are detailed in Carmel Finley, "A Political History of Maximum Sustained Yield, 1945-1955," in *Oceans Past: Management insights from the history of marine animal populations*, ed. David Starkey, Paol Holm, and Michaela Barnard (London: Earthscan, 2008), 189-214; and Smith, T. 1994. *Scaling Fisheries: The science of measuring the effects of fishing, 1855-1955*. (Cambridge: Cambridge University Press).

er spike” — the largest annual landings of cod ever recorded—and a steep decline in landings after that.<sup>25</sup>

By reframing this decline as a “tragedy of the commons,” economists joined biologists to widen the scope of fisheries science. While the surplus-production model allowed fisheries scientists to determine the maximum sustainable yield from fish populations, there was no way to guarantee that fishermen would behave in accord. Economists claiming to understand and model human behavior then proposed bio-economic models as the appropriate scientific response to the failure of the prior population model<sup>26</sup>. By including the demand side of the equation, economists claimed to offer a more robust prediction of the equilibrium quantity of landings. They further proposed limiting the access to fish populations by enclosing the oceans within defined national boundaries. Creating public property of about two hundred miles of ocean excluded foreign fleets and gave legal teeth to quota restrictions imposed on domestic fishermen.<sup>27</sup> Within these constraints, rational fishermen could now maximize their profits while minimizing the dangers of overfishing. Total Allowable Catch (TAC) and Maximum Economic Yield (MEY) were the resulting new and improved scientific numbers that now fell out of the system of equations developed to optimize the joint behavior of codfish and the fishing industry.

From its inception in the population model, fisheries science was built on the assumption that living beings can be described in the logic of mathematics and experiments. MSY

25 Finlayson, A. (1994) *Fishing for Truth: A Sociological Analysis of Northern Cod Stock Assessments from 1977-1990*. (St. Johns: ISER Books).

26 Gordon, H.S. (1953). An Economic Approach to the Optimum Utilization of Fishery Resources. *Journal of the Fisheries Research Board of Canada*. 10:442-57 is an exemplary instance of bio-economic models of fish and fisherman.

27 Sinclair, P. (1988). The State Encloses the Commons: Fisheries Management from the 200-Mile Limit to Factory Freezer Trawlers. In. *A Question of Survival: The Fisheries and Newfoundland Society*. Eds. P. Sinclair. (St. Johns: ISER Press)

and TAC were the glue precipitated from scientific models of fish and fishermen that bound together industrialists, regulators, fishermen, fishing technologies, and fish. By harnessing outsized technologies and profit-seeking capitalists to such numbers and giving the supervisory reins to government regulators and scientists, it was believed that no more than the surplus biomass of cod would be harvested. Thus, on the eve of its collapse, the cod fisheries off the Grand Banks were widely acknowledged as the world's most scientifically advanced, best-funded fisheries management regime.

And yet, in 1992, the cod fisheries off the Grand Banks collapsed, apparently forever. It triggered the largest single-day layoff in Canadian history, ending the many forms-of-life shaped by cod for nearly half a millennium. Induced by unemployment and relocation programs, the fishing families of Newfoundland were broken up and dispersed across Canada as far as the tar sands of Alberta in search of food and shelter. Others were encouraged to seek remarkably ineffective retraining programs. For instance, of some 40,000 persons receiving such assistance between 1994 and 1996, only “732 people were placed in jobs outside the fishery, 1,492 retired from the fishery, and 3,900 got jobs in non-groundfish fish plants.”<sup>28</sup>

In the wake of the collapse, the assumptions of bio-economic population models have come under attack. Increasingly, fisheries science has become informed by the pre-suppositions of complex systems theory, which theoretically falsify many of the equilibrium and averaging assumptions of

28 Sider (2003), *ibid*, p.33. See also pp.29-35 for the socio-political consequences of the collapse of the cod fisheries off the Grand Banks. For a moving historical account of the transformation of the cod fisheries from abundance to scarcity see, Chapter 3 of Nicholls, Steve.(2009). *Paradise Found: Nature in America at the time of Discovery*. (Chicago: University of Chicago Press). Also consult, Bavington, Dean.(2010). *Managed Annihilation: An Unnatural History of the Newfoundland Cod Collapse*. (Vancouver: UBC Press), p.1-2

bio-economic models. Complex systems such as road traffic and stock markets operate in nonlinear ways, and wild cod are assumed to behave similarly. However, since ecosystem models with accurate predictive ability have not yet become available (and some scientists argue they are theoretically impossible given the uncertainty and complexity of perturbed marine systems), bio-economic models remain the dominant scientific way of understanding wild cod, though they are used with increased caution and ironic recognition of their unreliability.<sup>29</sup>

## **Reviving Fishy Biomass**

Since 1992, all attempts to respond to the collapse of the cod fisheries have relied on applying further doses of techno-science to maintain the profits from the production and sale of codfish. The 'money value' of time, the 'biomass' of fish, and the 'population' of cod are abstractions that continue to be produced in the crucible of algebraic machines. Once, finance capital provoked technical innovations in the cod fisheries by making plausible a correspondence between the calculated flows in the value of time and the volume and constancy of fish landings. So provoked, fishing technologists continually sought to increase the catch by expanding the scale of operations. Exemplified by the jigger and culminating in the factory freezer trawlers, technical advancements in fishing entailed staging codfish as biomass, fishermen as

29 For the intrinsic vagueness of system-theory constructs in the fisheries and the likely lack of its operationalizations, see Garcia, S.M.; Zerbi, A.; Aliaume, C.; Do Chi, T. and Lasserre, G. 2003. The Ecosystem Approach to Fisheries: Issues, terminology, principles, institutional foundations, implementation and outlook. *FAO Fisheries Technical Paper*. No. 443. FAO: Rome. To locate the position of eco-systems models on the vector of scientific models of the cod fisheries, consult, Caddy, J. (1999). Fisheries Management in the Twenty-First Century: Will new paradigms apply? *Reviews in Fish Biology and Fisheries*. 9:1-43; and Caddy, J. and Cochrane, K. (2001). A Review of Fisheries Management Past, Present and Some Future Perspectives for the Third Millennium. *Oceans and Coastal Management*. 44:653-682.



instances of abstract labor power, and fishing as work. The potential for large-scale technologies to destroy what they set out to harvest also sparked the birth of fisheries science in the late nineteenth century. Increasingly refined scientific models of codfish and fishermen's behavior took for granted what technique had made possible and offered precise calculations of the harvestable biomass. Despite their evident failure, that once ruinous alliance between economics, technology, and science continues.

For instance, the disappearance of wild codfish has been interpreted as an occasion to profit from raising codfish on fish farms. In this effort to create a cod aquaculture industry, scientists and entrepreneurs—leveraging university-based research and enabled by policies from provincial and federal Canadian governments—are beginning to domesticate cod populations over their entire lifecycle. Cod are grown in hatcheries and brood stocks developed through a cod genome project that has identified genetic traits consistent with rapid growth and large sizes suitable to maximize profits. Investments in techno-scientific inputs increase the resistance of such fishy biomass to diseases and stresses produced by being confined in sea cages, including cannibalism. Feeding cycles, water temperatures, and worker training programs aim to control the conditions for producing optimally profitable biomass. Thus, fish farms represent the effort to replicate the controlled conditions of a scientific laboratory on moving waters.<sup>30</sup>

Yet, the dream of total control is unattainable, though

30 The domestication of wild nature for global markets is aptly illustrated in Lockett, J. (2001), "You cannot develop new markets without a consistent supply of product, and steady, predictable year-round production is the goal for every new species that is being brought into aquaculture. *It is a question of getting animals to spawn when you want them to rather than when nature dictates.* Scientists and industry are finding ways to alter the timing of these natural events to their advantage" in *Aquaculture: what's on the menu?* *Atlantic Business Magazine*, June/July:52-62; 56. (emphasis added)

not for want of trying. For instance, the interaction effects between the domesticated biomass produced through the artificial selection of traits geared to market values and wild cod remain unclear, mainly since the coastal grow-out sites licensed to have farmed cod occur precisely where the remaining wild cod fish are to be found.<sup>31</sup> Fed on wild fish ground up as fish-meal, a pound of farmed cod indirectly absorbs between three and five pounds of wild fish. Thus, instead of preserving wild fish stocks, the aquaculture of cod depletes them.<sup>32</sup> Moreover, the industrial fish farms of the North beggars subsistence fishermen of the South since the fish meal is made of small pelagic fish such as sardines, anchovies, and herring that constitute the staple food of many fishing communities in the South. Thus, instead of feeding the world's population, aquaculture, the "beef of the sea," contributes to famishing it.<sup>33</sup> In a final irony, farmed codfish is packaged within the ideological system of ecological management. Yet, as realizations of controlled laboratories, fish farms potentially damage the environment. For instance, the waste from fish farms poisons the waters for miles, much like that from hog farms on the land. Similarly, the cod that escape from their confinement in sea cages can change the genetic composition of wild cod, making the latter less fit to survive in their natural environment.

Moreover, egg-to-plate farming is highly capitalized

31 Ruzzante, D.; Wroblewski, J.; Taggart, C.; Smedbol, R.; Cook, D. and Goddard, S. (2000). Bay-Scale Population Structure in Coastal Atlantic Cod in Labrador and Newfoundland. *Canadian Journal of Fisheries Biology*. 56:431-47. Royal Society of Canada. (2001). *Elements of Precaution: Recommendations for the Regulation of Food Biotechnology in Canada*. An Expert Panel Report on the Future of Food Biotechnology. (Ottawa: The Royal Society of Canada)

32 Naylor, R.; Goldberg, R.; Primavera, J.; Kautsky, N.; Beveridge, M.; Clay, J.; Folke, K.; Lubchenco, J.; Mooney, H. and Troell, M. (2000). Effects of Aquaculture on World Fish Supplies. *Nature*. 405/6790:1017-24; and Pauty, D.; Tyedmers, P.; Froese, R. and Liu, L. Y. (2001). Fishing down and farming up the food web. *Conservation Biology in Practice*. 2(4):25.

33 Belton, B. (2004). *Ibid.*

and industrialized, producing the well-known consequences of corporate concentration. For example, to compete with low-cost producers such as China, and other white fish products such as Tilapia, cod farmed off the Grand Banks is now branded as a high-end product following the success of marketing salmon. But the corporate organization of the Canadian salmon farming industry is instructive in this regard: the roughly 140 start-up operations that began to farm salmon in the 1980s are now reduced to a group of some 11 giant corporations characterized by global ownership, vertical integration of operations, and contract farming.<sup>34</sup> Unsurprisingly, the individual fish farmer will be left holding an increasingly small share of the overall sale value of cod, most of which is captured by corporate intermediaries.<sup>35</sup>

### The Fisherman Knows Best

So why, despite their manifest failures, do the algebraic machines of capital and techno-science continue to be marshaled in the cod fisheries? In the light of the history of the cod fisheries, ‘feeding the hungry,’ ‘technological efficiency,’ ‘conservation,’ and ‘scientific knowledge’ are no more than the shibboleths of managers, regulators, scientists, and capitalists. A recent newspaper article is exemplary in this regard.<sup>36</sup> Jeffrey Simpson, a well-known columnist for the *Toronto Globe and Mail*, inveighs against “irate fishermen,” “the Fish Food and Allied Workers Union” and the “Provin-

34 Conley, D. (1998). Environmental Concerns: The Anti-Salmon Farming Lobby in BC. *Aquaculture Magazine*. July/August:36-51., and Marshall, D. (2003). *Fishy Business: The Economics of Salmon Farming in B.C.* Canadian Centre for Policy Alternatives, BC Office: Vancouver, B.C. Accessed online on February 2, 2004 at: <http://www.livingoceans.org/documents/fishy%20business.pdf>.

35 Lockwood, G. (1999). Who is Capturing Aquaculture’s Values? *Aquaculture Magazine*. January/February:30-33

36 Simpson, Jeffrey. (2010). Cod in Newfoundland: already seen that drama. *Toronto Globe and Mail*. May 13.

cial Fisheries Minister” for relying on “only anecdotal reports from fishermen” instead of on the scientific data produced by the Department of Fisheries and Oceans and endorsed by the Committee on the Status of Endangered Wildlife in Canada. In scolding these “local deniers and denigrators of (fisheries) science” for “discrediting the recommendations of the scientists,” he complains: “So year after year, indeed decade after decade, we stare in the face of scientific data that say stocks are declining fast or improving only very, very slowly from decimated levels, yet the same voices remain in angry denial that more serious conservation action is required.”

To forget it was precisely the most advanced fisheries science that purported to prove the abundance of codfish stock in the same year it became commercially extinct in the Grand Banks, the author reworks the familiar Enlightenment trope of the superiority of scientific knowledge against practical know-how. To argue against fishermen who say there are enough fish stocks for them to resume inshore fishing, he characteristically conflates coastal fishermen with labor on a factory freezer trawler, confuses fishing for cod with harvesting biomass, and confounds the quantity of cod needed for local trade and sustenance with the tons required to process in China and sell at Walmart.

Indeed, fishing communities have been the sites of dissension, debate, and protest since the introduction of the jigger, the seine, and the longline in the 1840s.<sup>37</sup> Without elab-

37 For a glimpse into the many attempts by fishing people to protest the introduction of threshold breaching fishing gears, see particular chapter 10 in Roberts, Callum. (2007). *The Unnatural History of the Sea* (London: The Island Press). For examples of such dissent and protest specific to the cod fisheries of Newfoundland and Labrador, consult the magisterial work of Innis, *ibid.* Cadigan, S. (1995). *Hope and Deception in Conception Bay: Merchant-settler relations in Newfoundland, 1785-1855*. (Toronto: University Of Toronto Press) details the vexed relationships between merchants and fishermen in these parts. Cadigan, Sean.(1999) *The Moral Economy of the Commons: Ecology and Equity in the Newfoundland Cod Fishery, 1815-1855. Labour/Le Travail.* 43(Spring):9-42; also describes the wrenching impact on native peoples of Europeans who settled the coast lines and highlights the arguments by fishermen against capital

orating on the details, one can uncover the red thread that runs through the fabric of these objections. Starting with the jigger and for over a hundred years, fishermen protested using intensive fishing technologies because they disregarded both the codfish and the activity of fishing as such.

Jiggers and seines increase output by indiscriminately killing and/or wounding codfish. Rooting their objections in the hunger of codfish going for bait, this argument against killing spawning or satiated cod applies *a fortiori* to later more intensive fishing technologies. Longlines and trawlers only build on the disregard for hungry codfish that jiggers and seines encode by design. These now scoop up hundreds of tons of biomass from the oceans yearly, regardless of species, age, and breeding cycle. What is not commercially valuable is thrown back, dead, as bycatch. Unmanned 'ghost nets' that have broken free from trawlers now roam the seas unceasingly netting fishy biomass that is destined to rot.

Their objection to the capitalization of the fishery is not only that expensive technologies necessarily introduce vast differences in income and wealth within their communities. But as important to their concerns is the transformation entailed by the technologization of fishing: when required to operate capital-intensive technologies instead of being able to use human-scaled tools, fishermen would be transmogrified into instances of abstract labor. According to state officials and capitalists, today's fisherman can be a coal digger tomorrow and an environmental engineer the next day. Fishing technologies that unmoor the fisherman from his tool thus transmute

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intensive and productivity enhancing technologies. For the repeated failures of techno-science in making up the cod fisheries, also consult by the same author, "Failed Proposals for Fisheries Management and Conservation in Newfoundland, 1855-1880." In *Fishing Places, Fishing People*. Eds. D. Newell and R. Ommer. (University of Toronto Press: Toronto); and 2003, The Moral Economy of Retrenchment and Regeneration in the History of Rural Newfoundland. In *Retrenchment and Regeneration in Rural Newfoundland*. Ed. R. Byron. (University of Toronto Press: Toronto).

him into a variable instance of abstract labor power.

Similarly, their objections to knowledges of a mathematical kind are rooted in the heterogeneity between such scientifically constructed objects as 'population,' 'biomass,' or 'maximum sustainable yield' and concepts borne of common-sense and practical reason. Scientific constructs erase commonly perceived distinctions and create imaginary worlds, for instance, one in which "ecosystem services provided by the coastline" becomes thinkable. This kind of scientific know-how remains a species of nonsense to the fisherman, whose knowledge remains tethered to his embodied craft.

At the heart of their protests is fishermen's recognition that fishing as a form-of-life can only be lived well within the natural thresholds defined by codfish's feeding and breeding habits and their own embodied capacities.<sup>38</sup> In this view, any kind of economic and techno-scientific rationalism that violate natural thresholds also subverts the nature of codfish and the culture of fishing. For them, the fisherman enters an agonistic relationship with his prey, and the fishing activity is bounded by the limits of his ability and its feeding and breeding habits. These dual natural thresholds demarcate the boundaries within which fishing occurs as a form-of-life. Beyond this place lies an undifferentiated space, which transmogrifies fisherman and codfish. The fish farm is now built in that nether world where generic biomass is farmed and harvested as cod, abstract labor seeking utility masquerade as fishermen, and fishing can mean operating a 6000-ton factory freezer trawler.<sup>39</sup>

38 Consult Agamben, Giorgio. (2000). "Form-of-Life" in *Means without Ends: Notes on Politics*. (Minneapolis: University of Minnesota Press) for the distinction between form-of-life and form of life. Summarily, form-of-life refers to "a life that cannot be separated from its form is a life for which what is at stake in its way of living is living itself" (p.4).

39 The pivotal argument of this essay concerning natural thresholds is derived from Illich, Ivan.(1973). *Tools for Conviviality*. (Berkeley: Heyday Books). We also rely on this work for the implicit distinction herein between tools that can be 'used' and those

Today, the fisherman who hunts cod is a criminal under the law.<sup>40</sup> Hunting for codfish is criminalized because the hunter kills cod for largely non-commercial purposes. As such, he is a witness to a fading form-of-life that is either unthinkable or sentimentalized within the ambit of technoscientific and economic rationalism. In that sphere, fishing with a baited hook and line appears as naïvely romantic, cussedly Luddite, or as the willful stubbornness of ‘deniers and denigrators’ of science.

## Holding Hands

The fisherman whose complaints gave voice to the codfish, whose practice embodies a lived relationship with it, is left mute and somewhat defenseless by the operations of such algebraic machines as finance capital and techno-science. The question of what is to be done still looms large, unanswered. Some in the spirit of ecosystem-based management have sought to extract fishermen's local knowledge to construct a more robust science.<sup>41</sup> Others have tried translating scientific precepts into common sense precepts through education and professionalization of the fisherman.<sup>42</sup> When

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that must be ‘operated.’ Also consult Illich, Ivan.(1985) *Shadow Work* (London: Marion Boyars) for elaborations of this concept articulated to ‘science,’ and ‘economy.’ For the distinction between common sense and scientific rationality consult, Arendt, Hannah. (1993). “Conquest of nature and the stature of man,” in *Between Past and Future*. (New York: Penguin Books) 265-280.

40 To grasp the extent of the political repercussions resulting from the *de facto* criminalization of fishermen see CTV.(2003). *Grimes says ban on cod fishing dead wrong.* Accessed on Nov 13, 2004 at: [http://montreal.ctv.ca/servlet/an/local/CTVNews/20030507/grimes\\_cod\\_nfld\\_030507?hub=OttawaHome](http://montreal.ctv.ca/servlet/an/local/CTVNews/20030507/grimes_cod_nfld_030507?hub=OttawaHome)

41 Nicole, Power.(2000). “Women Processing Workers as Knowledgeable Resource Users: Connecting Gender, Local Knowledge, and Development in the Newfoundland Fishery,” pp. 189-204 in *Finding Our Sea Legs: Linking Fishery People and Their Knowledge with Science and Management*, Eds. Barbara Neis and Lawrence F. Felt. (St. John's: ISER Books).

42 For instance, “By allowing professional fish harvesters to] make their own business decisions and be accountable for the consequences ... [DFO hopes] to spawn

fishermen are not exploited as a source of knowledge for science or fashioned as professional managers, they are criminalized.

In this essay, we tried to raise a barrier against those algebraic machines that have and continue to reduce the forms-of-life of fishermen into a form of life. Our argument that finance capital and techno-science necessarily transmogrify cod into biomass, fishermen into abstract labor, and fishing into work aim to fortify a line of defense against the nexus of power/knowledge that devastates forms-of-life lived in concert with fish. Let us recall that the vast majority of fishermen and fishing communities of the world are oriented by subsistence and local trade. In the spirit of holding hands with those with whom we have little in common but to whom we are nevertheless committed, this essay tells fishermen nothing they don't already know.

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a new and positive fisheries management culture and usher in a new era of public-private sector co-operation in Canada's fisheries." Department of Fisheries and Oceans. (2001). *Atlantic Policy Review*. 26,49. For the state sponsored transformation of fish hunters into professional managers of biomass, also see, Professional Fish Harvesters Certification Board Newfoundland and Labrador (PFHCBNL). 2004. *Frequently Asked Questions*. Accessed on October 12, 2004 at: <http://www.pfhcb.com/>.