

### Fished Out

*A huge net is being dragged across the sea floor, destroying everything in its path. Ahead of it bloom undersea forests and their hundreds and thousands of living creatures, both plant and animal; behind it is a desert. The net is pulled to the surface and most of the dead and dying life forms in it are thrown out. A few marketable species are retained. This is like taking a front-end loader and scraping up your entire front garden and shredding it, keeping a few pebbles, and dumping the rest of it down the drain.*

*Couple this with overfishing – really easy to do with megaships equipped with sonar for fast fish finding – and the eventual result is no fish*

*– Margaret Atwood, Payback: Debt and the Shadow Side of Wealth*

*Fishery management is an endless argument about how many fish there are in the sea, until all doubt has been removed – but so have all the fish.*

*– John Gulland*

*There is a sufficiency in the world for man's need but not for man's greed.*

*– Mahatma Gandhi*

In the early sixteenth century with the discovery of the New World, later to be called the Americas, there were frequent stories of an endless abundance of Atlantic cod that were reported back to Europe. This seemingly never-ending supply of cod helped fuel the new American colonies for generations and even gave Massachusetts' famous cape its name. At the turn of the sixteenth century John Mason, an English fishing skipper working out of Newfoundland shore station, noted:

*Cods are so thick by the shore that we hardly have been able to row a boat through them... Three men going to Sea in a boat, with some on shore to dress them, in 30 days will commonly kill between 25 and thirty thousand...<sup>1</sup>*

At that time cod were reported to be up to six and seven feet in length (roughly 2 meters) and to weigh as much as 200 pounds (90 kilograms), with their numbers dense enough to slow down boats.<sup>2</sup> Hundreds of fishing vessels caught thousands of tons of cod off of the New England coast. Vessels took in a daily catch of 15,000 to 30,000 fish and it seemed the fish were an "inexhaustible manna." Even by the end of the seventeenth-century travelers such as Baron De Lahontan still commented on the endless quantities of cod off of Newfoundland, Canada.

*You can scarce imagine what quantities of Cod-Fish were catch'd there by our Seamen... yet the Hook was no sooner at the bottom, than the Fish was catch'd; so that had nothing to do but throw in, and take up without interruption.<sup>3</sup>*

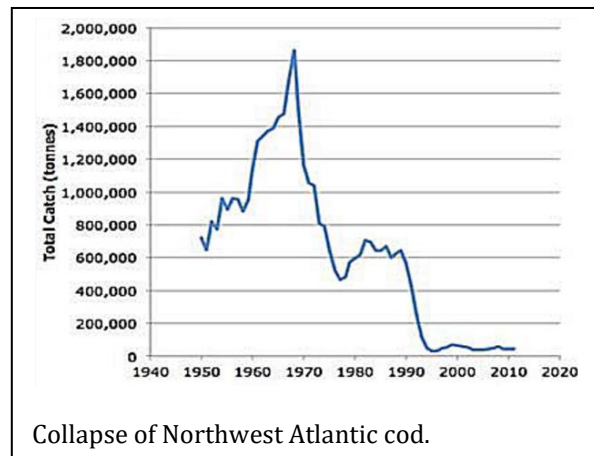
Cod fishing off the coast of New England was a huge business. In 1763 the English at the fisheries of Newfoundland caught and cured 386,274 quintals or about 42,500 tons of cod. In that year there were 106 fishing vessels with 265 ships transporting the salted cod to England and British Colonies. In 1783 the amount had increased to 591,276 quintals or over 65,000 tons of fish.<sup>4</sup> By 1827 the largest cod were already smaller at just over four feet long (1.3 meters), weighing in at 46 pounds (20 kilograms).

A quintal is an antiquated unit of weight equivalent to 100 kilograms or 220 pounds.

Upwards of 1,500 English, American and French fishing vessels extracted thousands of tons of cod off the coast of Newfoundland. A single fisherman was recorded to have caught about 12,000 cod annually, with the average fisherman catching about 7,000.<sup>5</sup>

Still the iconic cod proved not to be inexhaustible. After about 400 years of a strong fishing industry the populations of cod collapsed in 1992. Cod catches decreased from 500,000 tons in the Grand Banks in the 1960s to 50,000 tons.<sup>6</sup> This led to a fishing moratorium that caused 40,000 people in Newfoundland alone to be thrown out of work.<sup>7</sup> Inshore fishermen, like 76-year-old Wilson Hayward, believed the seeds of the collapse were sown after the Second World War. Hundreds of factory trawlers had arrived on the Grand Banks, which stretch out more than 320 kilometers (200 miles) off the Newfoundland's coast.

*I remember going out on to the cape in the night, and all you could see were dragger (trawler) lights as far as the eye could see, just like a city in the sea. We all knew it was wrong. They were taking the mother fish which had been out there spawning over the years. They cleaned it all up; they dragged the ocean floor like the paved road.<sup>8</sup>*



Trawling is a method of fishing that involves dragging a net through the water behind a boat. Bottom trawling is when a net is dragged across the seafloor is particularly destructive.

Fishing vessels advanced in size, power and technology. In 1954 the first new factory freezer trawlers appeared. These ships were capable of sweeping up as many cod in two 30-minute trawls as could be caught during the entire summer season in the sixteenth century.<sup>9</sup> Factory trawlers, mostly from Europe but some from as far as East Asia, began immense fishing operations with massive increases in catches by the 1960s and early 1970s. By the 1960s pair trawlers – two vessels that tow a single net – had tripled in size and engine power in only a decade.<sup>10</sup>

Atlantic cod, which is a relatively long-lived and slow growing species, could not keep up with the increasing rate of fishing. As the great majority of spawning adults were packed into ships' freezers, catches began to decline until they collapsed in the early 1990s.<sup>11</sup> In 1492 the amount of fish off the coast of Nova Scotia was estimated to be 4,000,000 tons. By the early 2000s that number had suffered a massive crash of nearly 99% with only 50,000 tons remaining.<sup>12</sup>

The cod stocks off the coast of the United States still remain significantly below sustainable levels.<sup>13</sup> Off the coast of Newfoundland, a study indicated the start of a recovery, which the authors attribute to improved environmental conditions, better fish management and the increased availability of the small fish they feed on, capelin, whose populations also fell drastically in the early 1990s. Even so, today's cod, at an average length of about 2.2 feet (0.68 meters) and at a weight of 8 pounds (3.6 kilograms),<sup>14</sup> is at a meager less than 5% of the size of legendary cod of the sixteenth century.

Other fish stocks experienced similar overfishing and collapse. In the mid-seventeenth century Nicolas Denys described his time along the Miramichi River, which flows through New Brunswick, Canada. He experienced sleepless nights because of the noise made by the massive amounts of salmon swimming in that river.

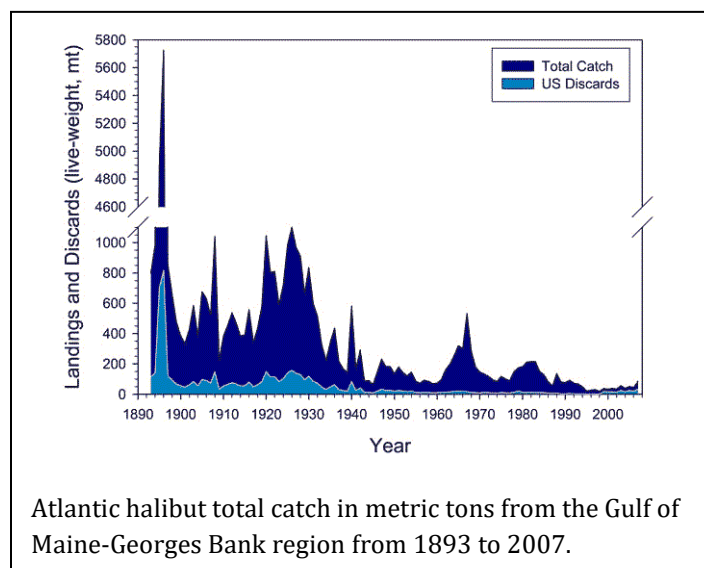
*So large a quantity of salmon enters the river at night one is unable to sleep, so great is the noise they make in falling upon the water after having thrown or darted themselves into the air passing over the river flats. I found a little river which I named Riviere au Saulmon... I made a cast of the seine net [a fishing net that hangs vertically in the water with floats at the top and weights at the bottom edge] at its entrance where it took so great a quantity of salmon that then men could not haul it to land and... had it not broken the salmon would have carried it off. We had a boat full of them, the smallest three feet long.<sup>15</sup>*

George Cartwright fished salmon for export in the late 1700s. He noted that the salmon were so thick that he could not have fired a shot into the river without hitting one. In 1799 he noted, "In the Eagle River [Labrador, Canada] we are killing 750 salmon a day and we would have killed more had we had more nets... the fish averaging from 15 to 32 pounds apiece."<sup>16</sup>

Overfishing combined with lumber mills, damming of rivers and pollution from tanneries and iron smelters caused the salmon populations to decline. John Rowan, an English visitor to Canada, noted as early as 1870 that the salmon fishing in Nova Scotia had already declined due to these factors and he predicted that eventually the rivers would be "rendered barren."<sup>17</sup> By 1900 salmon were effectively extinct in Connecticut and Massachusetts and in most of the rivers of New Hampshire and Maine.<sup>18, 19</sup> In the mid-1970s the total population of Atlantic salmon in North America was close to 1.8 million. By 2013 the population had fallen to one third of that level.<sup>20</sup> As of 2017 the population of Atlantic salmon has continued to decline.

As fishing greatly expanded off the coast of New England in the early years of the New World, cod was by far the fish of choice. Although halibut was also incredibly abundant it was largely discarded because the meat was a poor choice for salting, which was the method of preserving fish at the time. Later during the 1830s to 1840s many fishing vessels shifted to ice to store fish, which was found to be an ideal method for preserving halibut. This new technology, along with a cultural shift of preferring fresh to salted fish, led to the height of the halibut fishery during the 1840s to 1870s.

From that time on halibut stocks declined to just a tiny fraction of its once bountiful level.<sup>21</sup>



Overall the Northwest Atlantic has seen a major decline in fish catch, down from about 4.2 million metric tons (4.6 million tons) in the early 1970s to 1.9 million metric tons (2.1 million tons) in 2013, more than a 50% drop. Strict regulations have been in place to allow for fish stock recovery, but some historically plentiful fish such as cod, flounder and redfish are still showing limited or no recovery.<sup>22</sup> Atlantic cod catches remain extremely low since their collapse in the early 1990s.

The fisheries of the Bay of Bengal off the coast of India have been under overfishing stress for decades and are now severely depleted. Many once abundant species have all but vanished. Most unfavorably affected are the species at the top of the food chain. The bay was once feared by sailors for its man-eating sharks, but now they are rarely found in these waters. Other top predators like grouper, croaker and rays have also been decimated. Fishing catches now are mainly made up of species like sardines, which are near the bottom of the marine food web.

*Good intentions have played no small part in creating the current situation. In the 1960s, western aid agencies encouraged the growth of trawling in India, so that fishermen could profit from the demand for prawns in foreign markets. This led to a “pink gold rush”, in which prawns were trawled with fine mesh nets that were dragged along the sea floor. But along with hauls of “pink gold” these nets also scooped up whole seafloor ecosystems as well as vulnerable species like turtles, dolphins, sea snakes, rays and sharks. These were once called bycatch, and were largely discarded. Today the collateral damage of the trawling industry is processed and sold to the fast-growing poultry and culture industries of the region. In effect, the processes that sustain the Bay of Bengal’s fisheries are being destroyed in order to produce dirt-cheap chicken feed and fish feed.<sup>23</sup>*

As many as 44,000 fishing boats and 147 trawlers skim the Bay of Bengal every day with sea-floor-scraping nets that rake up everything. Many of the fishing boats operate illegally which makes the situation even worse. From 1985 to 2005 the amount of fish caught per net had dropped by about 80%, indicating the rapid decimation of fish stocks.<sup>24</sup> The result of this overexploitation may be disastrous for the region as millions of livelihoods are already endangered by the shrinking of the bay’s resources.

In the 1980s and 1990s, fisheries expanded into new areas and began to target different species, and for a while there was an increase in catches. But catch rates began to decline in the late 1990s and trawlers were forced to move increasingly further and further from their home waters.

*The Mergui archipelago on the Thai-Myanmar border is one of the more secluded parts of the Bay. In the late 19th century an English fisheries officer described this area as being “literally alive with fish”. Today the archipelago’s sparsely populated islands remain pristinely beautiful while some of its underwater landscapes present scenes of utter devastation. Fish stocks have been decimated by methods that include cyanide poisoning.<sup>25</sup>*

Historically, the oceans were considered limitless and thought to be able to supply enough fish to feed an ever increasing number of people. However, the demands of this ever growing world population now far outstrip the sustainable yield of the seas. Fish has historically been a vital source of food for humans. Providing approximately 16% of the animal protein consumed by the world’s

population, one billion people rely on fish as their primary source of protein.<sup>26</sup> As fisheries became depleted and fish were harder to catch, many fishermen and governments responded with investments in equipment and technology to fish longer, harder and farther away from their home ports.

*Consumer tastes in the First World have largely contributed to the problem. Increasing demand for top predators, such as swordfish or tuna, has put severe pressure on existing stocks... Long-line fishing for swordfish and other billfishes may significantly diminish the populations of many shark species, which are known to have slow reproductive rates and thereby slow recovery rates.*

Having exhausted the ocean of fish close to Chinese shores, huge numbers of Chinese trawlers sail out beyond their local waters to exploit the waters of other countries. These fishermen are subsidized by the Chinese government, which is not especially concerned with the health of the world's oceans and the local countries that depend on them. Increasingly, China's expanding fleet of fishing vessels is heading to the waters of West Africa and off the coast of poor countries such as Senegal. Local fisherman cannot hope to compete with Chinese ships that are so massive that they drag up as many fish in one week as Senegalese boats catch in a year.<sup>27</sup>

*In Senegal, an impoverished nation of 14 million, fishing stocks are plummeting. Local fishermen working out of hand-hewn canoes compete with megatrawlers whose mile-long nets sweep up virtually every living thing. Most of the fish they catch is sent abroad, with a lot ending up as fishmeal fodder for chickens and pigs in the United States and Europe.*

Overfishing and habitat degradation have profoundly altered populations of marine animals, especially sharks and rays. Sharks are primarily caught to meet the demand for shark fin soup, a traditional and usually expensive Asian delicacy.<sup>28</sup> After a shark is caught, its fins are cut off and kept, and then in a final cruel and heartless act, the maimed animal is often thrown back into the ocean where it sinks and dies. Millions of finless shark carcasses litter the ocean bottom every year.<sup>29</sup>

Queensland's shark control program that was established in 1962 to "minimize the threat of shark attack on humans" has to date caught and killed 50,000 sharks. As a result off of Australia's east coast shark populations have plummeted over the last 55 years. Hammerhead and great white sharks have plummeted by 92%, whaler sharks by 82% and tiger sharks by 74%.<sup>30</sup> An estimated 63 to 273 million sharks are killed each year, which is 6 to 8% of all sharks in the ocean.<sup>31</sup> This is equivalent to 120 to 520 sharks being slaughtered per minute. Because sharks are slow maturing and slow reproducing animals their populations are being decimated. Elizabeth Wilson, Pew Environment Group manager of global shark conservation, noted:

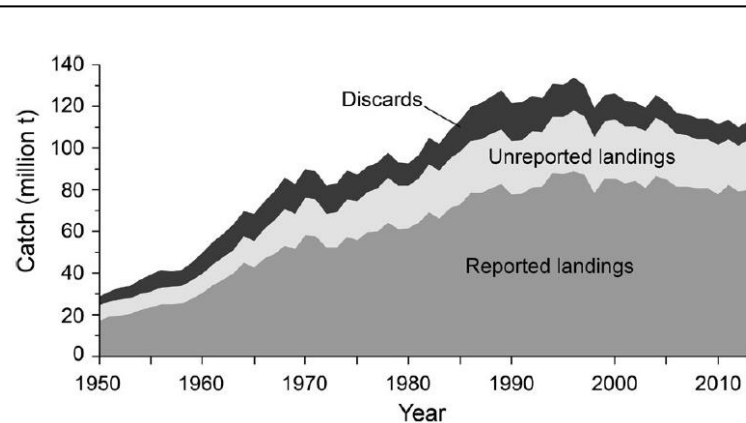
*"We are now the predators. Humans have mounted an unrelenting assault on sharks, and their numbers are crashing throughout the world's oceans."*

Worldwide, the extraction of fish from the oceans peaked in 1996 at just over 86 million metric tons (94 million tons) and has generally been declining since.<sup>32</sup> However, that number in 1996 may have actually been 130 million metric tons (143 million tons) if discarded and illegally caught fish are included. By including unaccounted for catches, the already serious decline in fish stocks since the

mid-1990s becomes three times larger than originally thought. Since 1996 fish catches have dropped on average a massive 1.2 million metric tons (1.3 million tons) every year.<sup>33</sup> By 2010 fishers had a reduced catch of 109 million metric tons (120 million tons) a 16% decline since the peak in 1996 just 14 years earlier.<sup>34</sup>

The fish killed but tossed back overboard, called bycatch or “trash fish,” as well as non-industrial levels of fishing accounts for one fourth of fish catches. In the 1990s between 20 and 27 million metric tons (22-30 million tons) of bycatch were discarded each year in the world's commercial fisheries.<sup>35,36</sup> For shrimpers, 80% of everything caught is bycatch and thrown back for dead.<sup>37</sup> Today, despite worldwide declining fish stocks, nearly 10 million metric tons are still being discarded or about 10% of annual catches.<sup>38</sup> Fishers sometimes reject a portion of their catch because some caught fish are damaged and are unmarketable, the fish are too small, the species is out of season, or the fish that were caught were not of interest. According to Dirk Zeller, a professor at the University of Western Australia,

*“Discards also happen because of a nasty practice known as high-grading where fishers continue fishing even after they've caught fish that they can sell. If they catch bigger fish, they throw away the smaller ones; they usually can't keep both loads because they run out of freezer space or go over their quota.”<sup>39</sup>*



Total global catches (millions of tons), separated into reported landings, unreported landings and estimated discards from 1950 to 2014. Note these data exclude marine mammals, reptiles and plant material, as well as all freshwater catches.

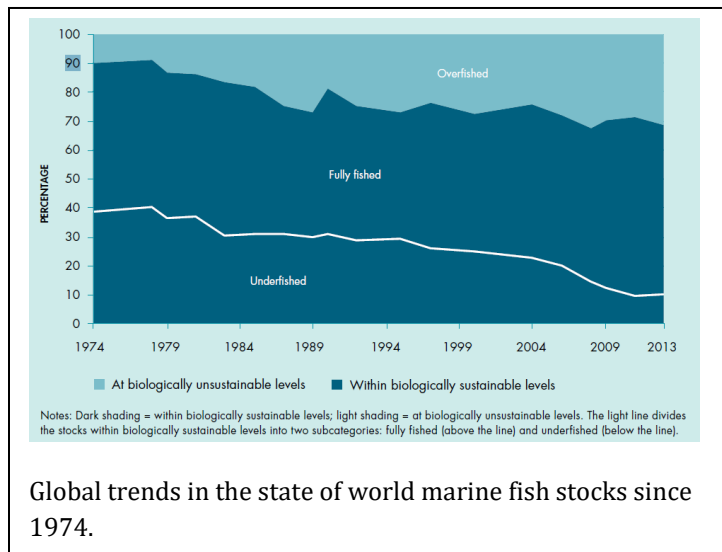
Still worse, a new phenomenon has emerged in parts of Asia and elsewhere where some trawlers are no longer targeting particular fish. Instead, they are scooping up any and all sea life that they find turning this indiscriminate catch into fishmeal, fish oil, chicken feed, or surimi, which is the white compressed paste that is used to make fish cakes. Amanda Vincent, professor at the University of British Columbia, has termed this extremely destructive practice as “annihilation trawling.”<sup>40</sup>

According to the UN Food and Agriculture Organization's (FAO) 2015 report, approximately 30% of the world's stocks are now overfished and unsustainable. An additional 60% of fish stocks are the maximum limit and have no room for further expansion. The over-exploitation of the planet's fish has more than tripled since the 1970s. The fishing of 41% of tuna stocks are at unsustainable levels.<sup>41</sup> Lasse Gustavsson, the director of Oceana, a marine conservation body, said,

*"We now have a fifth more of global fish stocks at worrying levels than we did in 2000. The global environmental impact of overfishing is incalculable and the knock-on impact for coastal economies is simply too great for this to be swept under the rug anymore."*<sup>42</sup>

The populations of all large predator fish in the oceans have declined by 90% in the 50 years since modern industrial fishing became widespread around the world.<sup>43</sup> Doctor Maria Salta, a biological oceanographer and lecturer in environmental microbiology in the School of Biological Sciences at the University of Portsmouth, echoed this dire outlook on the state of the oceans.<sup>44</sup>

*"It is clear that if we continue like this, in a few years time, there is not going to be much left. We are losing species every day without ever knowing about them. Sometimes humans can be like a plague to the environment. The oceanic white-tip shark populations declined by 99 percent from 1950 to 1999, making it now an endangered species."*



According to an NRDC (Natural Resources Defense Council) report, more than 650,000 marine mammals are killed or seriously injured every year in foreign fisheries after being hooked, entangled or trapped in fishing gear.<sup>45</sup> Seals, sea lions, whales, dolphins, porpoises and others are killed due to indiscriminate fishing practices, threatening the survival of numerous marine mammal populations.

Seabirds, such as terns and penguins, are starving because industrial fisheries are catching their food sources. Their seabirds' diminishing food supply has caused a 70% community-level population decline over the last 70 years. Since the 1970s and 80s, nearly 50% of terns and frigate birds and 25% of penguins are gone. Not only are seabirds starving to death trying to compete with massive fishing vessels, they are also getting tangled in fishing gear and dying from eating the plastic waste that has flooded into the oceans.<sup>46</sup> Longline fishing alone is estimated to kill 160,000 to 320,000 seabirds every year.<sup>47</sup> Longlines, which can be up to 80 miles long, unintentionally trap, drown and harm seabirds, as well as turtles, dolphins and other marine life. Industrial fishing vessels accidentally kill tens of thousands of albatrosses each year bringing them ever closer to extinction.<sup>48</sup>

Fishing operations have expanded to, quite literally, every corner of the ocean over the last 100 years. Technological advances have been made that have enabled humans to find and catch every single fish in the ocean, no matter where they are located on the planet. A huge problem associated directly with overfishing is the widespread use of trawling. Doctor Maria Salta comments,

*"It's the equivalent of forest clear-cutting, but in the ocean, because when they trawl the entire bottom, whatever is there, is removed from the environment and changes the entire ecosystem. Biomass of the deep sea is in sharp decline because of trawling."*<sup>49</sup>

The rapid depletion of fish stocks on continental shelves helped create pressure to find alternative fishing grounds. At the end of the twentieth century fleets of ships began fishing seamounts. These are mountains that rise from the ocean seafloor that do not quite reach the surface of the ocean. These more remote fishing areas are more easily prone to fish stock collapse as the fish that are targeted over seamounts are typically long-lived, slow-growing and slow-maturing. Many of these fisheries more closely resemble mining operations than sustainable fisheries, with targeted fish stocks showing signs of overexploitation within a short period from the start of fishing. This has been the case for the orange roughy fisheries off the waters of New Zealand, Australia, Namibia, and the North Atlantic.<sup>50</sup>

*...on seamounts and on continental slopes, where virgin communities are fished, similar dynamics of extremely high catch rates are observed, which decline rapidly over the first 3–5 years of exploitation.*<sup>51</sup>

The problem is worsened by the dangers of trawling, which damages seamount surface communities. The fact that many seamounts are located in international waters makes proper monitoring difficult.

*It is widely accepted that seamounts are fragile habitats. Trawl gear is today being deployed across steeply irregular, and often boulder-strewn, sea floor surfaces at depths typically lying between 500 and 1000/2000 m [1640 and 3280/6560 feet]. Netting caught during passage across the seabed can cause considerable damage to seabed environments (e.g. deep water coral reefs), and if not recovered may remain there, out of sight, and continue ghost fishing almost indefinitely. The potential magnitude of disturbance to seabed environments can be likened 'forest clear cutting'.*<sup>52</sup>

Since it takes an average of only 4 years for seamount fisheries to collapse and 5 to 15 years after collapse for recovery, these seamount fisheries are not sustainable in the long term.<sup>53</sup>

Expanding areas of fishing, using bigger vessels, better nets, and new technology for spotting fish are not bringing the world's fleets bigger returns. These technological advances put immense pressure on fish stocks and leave fewer regions out of reach so that fish can reproduce unmolested, thus worsening the effects of over-harvesting. "Pirate" fleets roam these areas with relative impunity and without great concern about the sustainability of these aquatic resources.

When there are too few fish to catch in an area some fishing vessels venture farther from shore into deeper waters, staying out at sea longer. Investigative reports reveal how the fishing industry, especially in Southeast Asia, coerces or forces men against their will into modern-day slavery in vast fishing fleets, sometimes for years on end.<sup>54</sup> Poor villagers are offered what seems to be a well-paying fishing job but then incur debt for food and lodging. According to Doctor Jessica Sparks who researches the connections between fishing stock declines worldwide and forced labor on the open seas,



*“That’s called debt bondage. There are stories of fisherman being out at sea for five to ten years, without ever setting foot on land, getting transferred from one vessel to another at sea. There’s a lot of physical violence, sexual violence, mental violence—people getting thrown overboard to fish for sharks.”*

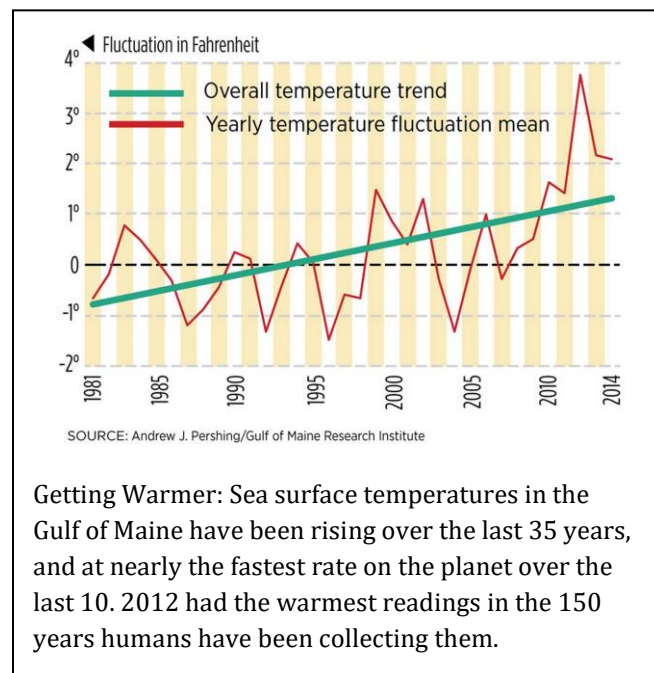
Fisheries experts trying to quantify illegal fishing along the African coast, say tens of thousands of tons of fish are stolen by foreign fishing vessels just along the coast of Senegal alone.<sup>55</sup> This ongoing practice of fishing fleets moving their operations from depleted areas to new areas is causing a long-term decline in global catches as overfishing spreads. Global fish catch fell by 13% between 1994 and 2003.<sup>56</sup>

The Gulf of Maine extends from Cape Cod in Massachusetts to Cape Sable at the southern tip of Nova Scotia. In this area years of strict fishing limits were instituted with the goal at rebuilding cod stocks. Historically, the establishment of fishing quotas has helped stocks of various fish recover. Yet despite these limits, this wasn’t happening with cod in the Gulf of Maine and in fact, they were continuing to decline. As researchers investigated, they found that cod spawning and survival has been hampered by rapid, extraordinary ocean warming in the Gulf of Maine, where sea surface temperatures rose faster than anywhere else on the planet between 2003 and 2014.<sup>57</sup> According to Dr. Simon Boxall, an associate professor of oceanography at the University of Southampton:

*“Cod were overfished, but we also see climate change kicking in and warming the waters, and cod, which like a cooler climate, are being pushed further north. Our cod are migrating to Iceland.”<sup>58</sup>*

Andy Pershing, chief scientific officer at the Gulf of Maine Research Institute in Portland says “We’re really in the crosshairs of climate change right now.”<sup>59</sup> The dramatic warming in the Gulf of Maine during the summer and early fall has extended “summer conditions” by 66 days over the last 33 years. Warming over the last 10 years has occurred faster than 99% of the global ocean,<sup>60</sup> and in 2012 average water temperatures reached the highest level in the 150 years that humans have been recording them.<sup>61</sup> Andrew Thomas, a professor at University of Maine School of Marine Sciences, noted,

*“There are going to be winners, and there are going to be losers. If you’re a tourist and you want to swim on the beaches, a longer, warmer summer sounds fine. But there are definitely marine species that are going to have trouble adapting to that kind of change, because it’s happening very rapidly.”*



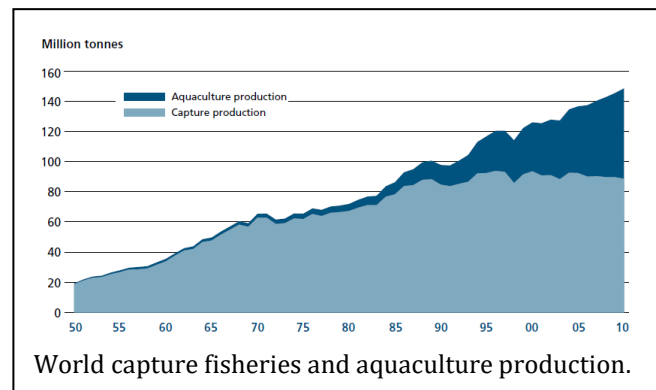
It's not only cod that is being affected by increasing water temperatures. According to National Oceanic and Atmospheric Administration (NOAA) researchers about half of 36 fish stocks in the Northwest Atlantic Ocean, many of them commercially valuable species, have been shifting northward over the last four decades, with some stocks nearly disappearing from United States waters as they move farther offshore. Janet Nye, a postdoctoral researcher at NOAA's Northeast Fisheries Science Center (NEFSC) laboratory in Woods Hole, Massachusetts commented:

*"During the last 40 years, many familiar species have been shifting to the north where ocean waters are cooler, or staying in the same general area but moving into deeper waters than where they traditionally have been found. They all seem to be adapting to changing temperatures and finding places where their chances of survival as a population are greater."*<sup>62</sup>

A 2013 paper in *Nature* showed that ocean warming has already affected global fisheries in the past four decades. Changes in the majority of the world's coastal and shelf areas have significantly and positively been related to regional changes in sea surface temperature.<sup>63</sup> The study's lead author William Cheung, an assistant professor at University of British Columbia's Fisheries Centre, noted,

*"One way for marine animals to respond to ocean warming is by moving to cooler regions. As a result, places like New England on the northeast coast of the U.S. saw new species typically found in warmer waters, closer to the tropics. Meanwhile in the tropics, climate change meant fewer marine species and reduced catches, with serious implications for food security. We've been talking about climate change as if it's something that's going to happen in the distant future -- our study shows that it has been affecting our fisheries and oceans for decades."*<sup>64</sup>

Fish have until recently been the only remaining important food source that is still mainly gathered from the wild rather than farmed, but as global wild fish catch continues to decline, aquaculture, also known as fish or shellfish farming, has increasingly filled the gap. Because of this seafood alternative, fish consumption has continued without much public notice of the devastation that has befallen wild fish stocks. Aquaculture, however, has grown more than 20-fold since the 1980s<sup>65</sup> and is now forecasted to overtake wild-caught fish as the main source of fish consumption by 2021.<sup>66</sup> However, there are also significant negative effects of aquaculture on the environment and wild fish worth considering.



At the core of industrial food production is monoculture, the practice of growing single crops intensively on a very large scale. Corn, wheat, soybeans, cotton, and rice are all commonly grown this way in the United States. Monoculture farming relies heavily on chemical inputs such as synthetic fertilizers and pesticides. The fertilizers are needed because growing the same plant in the same place year after year quickly depletes the nutrients that the plant relies on. These crops are also susceptible to disease and pests because a lack of variety in genetics makes them ecologically vulnerable.

Farmers attempt to control these problems with chemicals, pesticides and genetically modified crops. Aquaculture is experiencing similar problems as fish growers are fighting for control of their typically monoculture stocks by using similar methods.

The salmon farming industry uses open net-cages placed directly in the ocean, where farm waste, chemicals, disease, and parasites are released directly into the surrounding waters, harming other marine life. Since the start of large-scale salmon farming in the 1970s, control of sea lice has largely been done using chemotherapy. This has been effective and simple to use, but also creates unwanted environmental effects, occupational hazards and drug resistance problems.<sup>67</sup>

*Fish excreta [waste] and uneaten feeds from fed aquaculture diminish water quality. Increased production has combined with greater use of antibiotics, fungicides and anti-fouling agents, which in turn may contribute to pollute downstream eco-systems.*<sup>68</sup>

When over half a million or more farmed salmon are crowded in a small area, fish feces and waste feed that is produced is enormous. For example, in Scotland the discharge of untreated organic waste from salmon production is equal to 75% of the pollution discharged by the human population.<sup>69</sup> This can have a significant impact on the ocean bottom and surrounding ecosystems and makes the farmed salmon more vulnerable to sea lice. Sea lice proliferate on salmon farms and spread to surrounding waters attacking younger vulnerable wild salmon as they swim in their natural environment, causing disease in the wild salmon populations.

*The evidence that salmon farms are the most significant source of... sea lice on juvenile wild salmonids [a fish of the salmon family] in Europe and North America is now convincing. Farms may contain millions of fishes almost year round in coastal waters and, unless lice control is effective, may provide a continuous source of sea lice, although the amount of infestation pressure will vary over time owing to seasonal and farm management practices.*<sup>70</sup>

Another inescapable consequence of open-pen salmon farming is that predators are naturally attracted to the large quantities of fish that are kept confined in artificial environments. Just as ranchers shoot predators, such as wolves and coyotes, salmon farmers will shoot predators such as seals and sea lions that endanger their salmon stocks.

*Department of Fisheries and Oceans (DFO) statistics show that since 1990, the B.C. [British Columbia] industry has shot and killed more than 7,000 of our marine mammals: almost 6,000 harbour seals, 1,200 California sea lions and 363 endangered Steller sea lions.*<sup>71</sup>

The United States imports about 86% of its seafood, about half of which is grown in aquaculture. Almost 90% of farmed fish and shellfish comes from Asia.<sup>72</sup> China produces about 70% of the farmed fish in the world, employing 4.5 million fish farmers. Fish farms can be found in lakes, ponds, rivers and reservoirs, or in huge rectangular fish ponds dug into the earth.

Fish and shellfish in Asian countries are often raised in filthy, overcrowded conditions. In China, water supplies are contaminated by sewage, industrial waste and agricultural runoff that includes pesticides. Half of the rivers in China are too polluted to even serve as a source of drinking water. Nearby coastal waters, which are also heavily fish farmed, are polluted with oil, lead, mercury, and

copper.<sup>73</sup> Farmers have been known to feed tilapia fish with the feces of pigs and geese to lower the cost of production.<sup>74</sup> The heavily polluted Yangtze River, contaminated with heavy metals, fertilizers, pesticides, and weed killers, is bordered by 20,000 chemical plants<sup>75</sup> and is also lined with fish farms. One fish farm along that river sends about 2.7 million catfish fillets each year to the United States through an importer in Virginia.<sup>76</sup>

To keep the animals alive in these poor quality water conditions and overflowing farms, they are liberally dosed with powerful, and often illegal, antibiotics and pesticides. This keeps the animals alive, yet leaves poisonous and carcinogenic residues in seafood.<sup>77</sup> The toxic output from all of these farms also has a tremendous impact on the surrounding environment. Reservoirs that are used by fish farmers essentially become toxic waste dumps because of the liberal use of animal manure, fertilizers and antibiotics.<sup>78</sup>

*Industrial fish farming has destroyed mangrove forests in Thailand, Vietnam and China, heavily polluted waterways and radically altered the ecological balance of coastal areas, mostly through the discharge of wastewater. Aquaculture waste contains fish feces, rotting fish feed and residues of pesticides and veterinary drugs as well as other pollutants that were already mixed into the poor quality water supplied to farmers.*<sup>79</sup>

In the United States, most shrimp is imported that is grown in industrial-sized, man-made ponds along the coasts of Southeast Asia and South and Central America. Thailand is the leading shrimp exporter to the United States, followed by Ecuador, Indonesia, China, Mexico, and Vietnam.<sup>80</sup> Coastal mangroves, which provide a thriving habitat for many species, are frequently cut down to make way for shrimp ponds. Almost 10% of the world's mangrove forests have been destroyed<sup>81</sup> with the building of shrimp ponds, considered the world's largest cause of coastal mangrove destruction.<sup>82</sup> These shrimp farms produce a huge amount of waste that pollutes the surrounding land and water, depleting the freshwater supply. In Bangladesh shrimp aquaculture generates 600 metric tons (660 tons) of waste per day.<sup>83</sup> After an average of seven years, the ponds, crammed with millions of shrimp, become so polluted with shrimp waste and chemicals that shrimp farmers move on to build new ponds, leaving behind abandoned wastelands.

The explosive growth of shrimp farms in Ecuador, Honduras and Mexico has resulted in a negative environmental impact on water quality and destroyed large areas of mangroves. Nearly three quarters of the fish caught at sea hatch or reproduce in mangroves, or rely on the intact mangrove system. The destruction of these mangroves has caused a decline in wild fish catch, with studies indicating that for every hectare of mangrove forest destroyed, an estimated 757 kilograms (1,669 pounds) of commercial fish are lost.<sup>84</sup>

In addition to their own environmental and health hazards, farmed fish is often fed large quantities of wild-caught fish. Many intensive aquaculture farms use between two to five times more fish feed to fatten their farmed fish than is actually produced. For example, it can take 2.8 pounds of wild fish to produce a pound of shrimp, 3.2 pounds to produce a pound of salmon and 4.7 pounds to produce a pound of eel.<sup>85</sup>

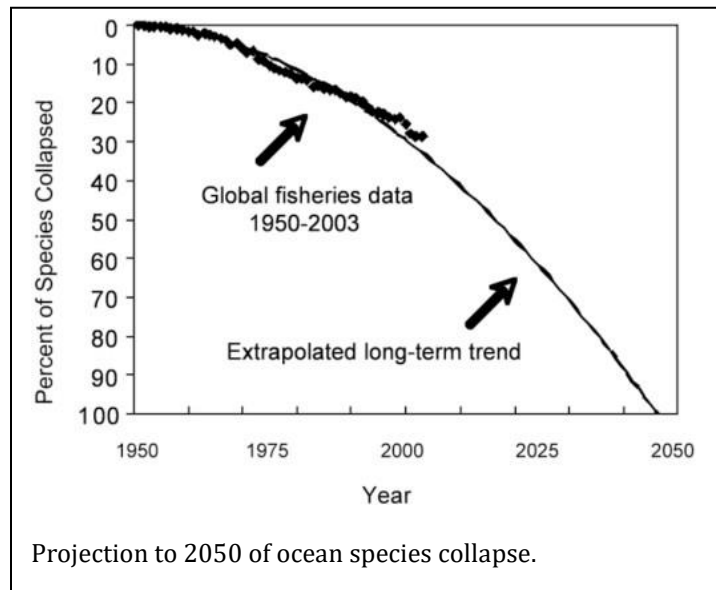
The world's oceans are under increasing stress with nearly 6 billion metric tons (6.6 billion tons) of fish and invertebrates that have already been taken from the oceans since 1950.<sup>86</sup> Dr. Boris Worm, a Marine Research Ecologist and Associate Professor at Dalhousie University, Canada, led an international team of researchers who found that fishery decline is closely tied to a broader loss of marine biodiversity. These fisheries experts and ecologists are predicting that if fishing around the world continues at its present pace, species will vanish, marine ecosystems will unravel and there will be global collapse of all species currently fished, possibly as soon as mid-century.

*Our data highlight the societal consequences of an ongoing erosion of diversity that appears to be accelerating on a global scale. This trend is of serious concern because it projects the global collapse of all taxa [group of organisms] currently fished by the mid-21st century (based on the extrapolation of regression to 100% in the year 2048).<sup>87</sup>*

The decrease of biodiversity, or variety of life, in the oceans tends to bring reductions in the size and robustness of local fish stocks. It is this loss of biodiversity that is driving the declines in fish populations that are seen in large-scale studies.

*"The image I use to explain why biodiversity is so important is that marine life is a bit like a house of cards," said Dr. Worm. "All parts of it are integral to the structure; if you remove parts, particularly at the bottom, it's detrimental to everything on top and threatens the whole structure."<sup>88</sup>*

In 1883 Professor Huxley came to the following conclusion, based on what he saw as the insignificant human impact on the inconceivably great numbers of fish in the ocean:



*"I believe, then, that the cod fishery, the herring fishery, the pilchard fishery, the mackerel fishery, and probably all the great sea-fisheries, are inexhaustible; that is to say that nothing we do seriously affects the number of the fish."<sup>89</sup>*

Ultimately time would prove Professor Huxley wrong. The unrelenting expansion of fishing operations due to the market driven competition for resources means that the risks of overfishing and unsustainable natural resource use are tending to increase, in spite of efforts to promote sustainable fishing and fish farming worldwide. Market demand for tuna is still high and the significant overcapacity of tuna fishing fleets remains. Growing seafood demand, combined with fewer fish, poor traceability systems and a vast ocean virtually impossible to patrol, provides big incentives for those willing to catch fish illegally and funnel them into the legitimate supply chain.

Pollution, environmental degradation, climate change, diseases, and natural and human-induced disasters add to the threats to livelihoods for those that rely on fishing. Shrinking catches and declining fish stocks, combined with pressure from growing coastal populations, are particularly affecting smaller fishing communities in many developing countries, where social protection and other employment opportunities are often lacking.

Ever-expanding global aquaculture is fraught with its own environmental impacts that are also negatively impacting wild fish populations. With a blind emphasis on economic growth, fish farms have destroyed mangroves, polluted waterways and created seafood that can be contaminated with antibiotics, pesticides, heavy metals, and potentially dangerous.

As human populations continue to expand, so does the insatiable appetite for seafood. The fish supply has been slowly collapsing for decades as bigger and better technologies are utilized to harvest every bit of the ocean. The once “inexhaustible manna” has proven to be finite and buckling under the pressure of human activities. Without serious and worldwide transformations as to how we manage our marine resources, this strain may reach a point in the near future where we may find a largely dead ocean devoid of fish.

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***This is one chapter from an upcoming book – Moving Back from Midnight – A World in Peril.***

***If you have feedback or you would like to help with working on this book in any way please contact us at [movingbackfrommidnight@gmail.com](mailto:movingbackfrommidnight@gmail.com). Our planet is under major threats and it will take all of us taking action to reverse course and make it a sustainable world.***

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