Overfishing and Its Impact on Our Oceans

The overwhelming effects of dwindling fish biomass on the world as a whole and what can be done.

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Summary

The effects of commercial fishing on the world's fish populations has been largely ignored as an issue up to now. It not only impacts the biomass of the caught fish, but indirectly effects nearly every aspect of the saltwater ecosystem. Much of the problem lies in the difficult nature of policing the fishermen in international waters, but demand for the most effected fish is the obvious driving force of their actions. Countries like Japan, Portugal, and other historically seabound nations are huge fish consumers, and many nations, like Greenland and Iceland, are dependent on their seafood exports to sustain their economies. Fish is also an important part of the diet of those in developing nations. Reasons like these make it difficult to address the issue, yet also extremely important that we do so. To help raise awareness of the issue and to initiate action, I will be sending a letter to the Union of Concerned Scientists as my service project.

Video Link

Overfishing and COOL: http://www.youtube.com/watch?v=cazSa7NT3UA
The Issue: Overfishing

Modern western life has come under a great deal of scrutiny in the past few decades, and human impact on the environment has been largely at the forefront of debate. Whether it's the climate, food, energy, or otherwise, it has become abundantly clear that the western world is edging closer and closer to the point of no return regarding the sustainability of its consumption. This point is illustrated in dramatic fashion by the state of the world's oceans. There is almost no species of saltwater fish that has escaped the devastating effects of commercial fishing practices. Biomass is dwindling each year, but demand for fish remains. One would imagine this issue would be an important one, given the potential for disaster should action not be taken. However, overfishing has received very little attention from the world as a whole, especially when compared to issues like global climate change or the state of the world economy. It has been predicted that the world's oceans could be emptied of all fish by as early as 2048.¹ Despite this fact, fish population stabilization is still possible. It will require reformation at every level of commercial fishing, down to consumer habits.

Until the 11th century, there was little demand for saltwater fish; it was difficult to procure and had to be preserved in salt in order to be distributed. Most opted for freshwater or coastal fish which could be easily obtained with small nets, harpoons, or rods. However, with the European population growing rapidly and farming becoming efficient enough to support large settlements, it became possible for people to stop farming for their own subsistence and to specialize in trades. Fishing as a means to make money quickly proved very profitable, as eating unusual saltwater fish became a sure status symbol. The growth of the budding fishing industry can also be attributed to the dietary restrictions imposed by the Christian church of the time. Tradition called for abstention from meat on Fridays and during Lent, as well as other Christian holidays, resulting in up to 150 days of the year on which fish was the only meat allowed. This also helped the transition from freshwater to saltwater fishing due to the limited number of fish that could be obtained from freshwater sources, which might itself be attributed to over-exploitation caused by the increase in commercial fishing. All accounts portray the oceans as teeming with fish at the time, and new angling techniques and technology allowed for ever increasing yields with which the growing demand could be met.²

Flash forward nearly a millennium to 1956, the year the United Nations gathers for the first Convention on the Law of the Sea (UNCLOS I), an international gathering of the UN member nations to determine how to define and regulate the enigmatic 'international waters' that lie outside of the sovereignty of all nations. In addition to marking territorial waters and granting sea access to landlocked countries, UNCLOS I also instituted the Convention on Fishing and Conservation of the Living Resources of the High Seas. This established a protocol for participating members to follow regarding fishing international waters and disputing the fishing practices of other member nations.³ A total of thirty-eight nations agreed to the terms of the convention, with another twenty signing the deal but not ratifying it due to objections with individual articles. This, however, is only 58 of the United Nations 193 members. China, which currently leads the rest of the world as the top seafood exporter, is not on
the list of participating nations. Also, developing nations collectively account for around fifty percent of seafood exports, most of which are also not bound by the convention.\(^4\)

The problems of overfishing can be broken into several categories. These include unethical fishing techniques, impacts on undersea ecosystems, and impacts on humanity's food supply. The evolution of fishing techniques has progressed rapidly in scale in the last 200 years. Fishing was practiced in prehistoric and ancient times as evidenced by hooks made of bone discovered in riverbeds and harpoon-like spears depicted in cave paintings in the Cosquer cave in France. A technique known as gillnetting, which involves using weights and floats to suspend nets upright in water to surround schools of fish, has also been found to have been in practice in ancient history as well. These practices sufficed for man up until the fishing revolution in the 11\(^{th}\) century. After this monumental shift, however, new and more thorough techniques were soon employed.

The first known description of trawling, the act of dragging weighted trawls, or nets, across the ocean floor or riverbed or at a specific depth, came in 1376. Ironically, the document that describes the practice is actually a petition to the King of England at the time to institute some sort of regulations regarding its use. Describing the “wondyrechaun,” as it was known at the time, the complainant states:

“..The great and long irons of the wondyrechaun runs so heavily and hardly over the ground when fishing that it destroys the flowers of the land below the water.... By which instrument in many places, the fishermen take such quantity of small fish that they do no know what to do with them; that they feed and fat their pigs with them, to the great damage of the commons of the realm and the destruction of the fisheries, and they pray for a remedy.”

The modern trawler functions in much the same way, but on a much larger scale. The largest trawlers, also known as factory trawlers, are massive ships with 10,000+ horsepower engines with on-board facilities to process and freeze their catches as they take them, allowing them to stay at sea for extended periods of time. The largest vessel of this type, the Annelies Ilena ex Atlantic Dawn, is approximately 475 feet long with a 7000 ton carrying capacity; With the ability to catch around 350 tons of fish a day, that means it could catch continuously for 20 days. Amazingly, there are 38,400 factory trawlers in the world today, though most are a third of the size of the Annelies Ilena. Estimates indicate that the world's fishing fleet is 2-3 times larger than is necessary to procure the current tonnage of fish caught each year. Factory ships, along with the rest of the world's fishing fleets, brought in around 86 million tons of fish in 2000. Fish accounts for 16% of the world's protein intake on average and is even more important in developing nations where it is difficult and expensive to raise livestock or maintain diverse crops. For this reason, despite the dwindling fish populations and destruction to the seascape, it is difficult to make a transition to more sustainable measures.

The effects of bottom-trawling are manifold. The most evident issues raised are those
related to the destruction of the undersea landscape, including ancient coral reefs, which are home to approximately 25% of marine life. A UN survey determined that bottom-trawling is responsible for up to 95% of the damage to undersea ecosystems that has been recorded. The destruction of these habitats make it very difficult for fish stocks to recover, as most species of fish require very specific conditions to reproduce. The dragging of the trawls across the ocean floor also throws debris and dust into suspension which is then caught by ocean currents. The resulting cloudiness reduces sunlight penetration, which has devastating effects on underwater flora like kelp. The resuspended sediment can also be rich in phosphorous, which encourages an increase in phytoplankton levels and cause an oxygen-deficiency, resulting in what is known as “dead-zone” in which marine life struggles to survive.

Another issue arises from the imprecise nature of such a large-scale fishing style. It is rare that the target fish is the only fish to be caught by the trawler, and bycatch results in a great deal of waste. For instance, the U.S. National Marine Fisheries Service estimates that for every pound of shrimp caught, there is three pounds of bycatch that comes with it. Bycatch is considered any fish that was not the intended catch of the vessel (though some bycatch can be kept and sold as well), including immature individuals within the target population. If a fish is caught before it has fully matured, not only is the overall quantity of fish reduced due space constraints, but the population itself is damaged in many cases. For instance, an individual orange roughy, a very overexploited species, doesn't begin mating until it is between 25-30 years old and can sometimes live to over 100 years old. For this reason, orange roughy is considered one of the world's most stressed fisheries.

Bycatch isn't limited to other fish, and can also include turtles, seabirds, and other unmarketable organisms. Unlike with line fishing, during which you can immediately identify bycatch and throw it back before it suffers any fatal injury, trawling leaves a large window between catching and sorting of the fish, during which period most bycatch either dies or sustains grievous injury.

On a positive note, however, several nations, including the United States, have placed restrictions on the use of trawling within their exclusive economic zones (EEZs), which is a 200 nautical mile stretch of water beyond the nations territorial waters. In 2007, a coalition of South Pacific nations agreed to require deep sea monitoring systems on board any deep ocean trawler so that they could stay at least five miles away from any protected ecosystem, thereby protecting approximately 25% of the world's oceans.

Remedying overfishing will require a great deal of cooperation and sacrifice. There are few incentives for fishermen to fish less than they currently do, given that if one group of fishermen decides to catch a more responsible amount of a troubled fish population, another group may capitalize and profit on the back of their decision. This is due to the current unregulated and unsupervised state of high seas fishing. While UNCLOS requires participating members to ensure that their fisheries and the waters within their EEZs are not overexploited, all activity beyond these limits are no one country’s responsibility. Getting these areas under some sort of control is an important part of the
One proposed solution is to establish quotas, or limits on the tonnage of fish that may be caught given a certain time period. Fishing vessels returning from international waters would be required to weigh their catches and once the fisheries hit the quota for a certain fish population, that species would be protected until its numbers recovered. If the quotas are set appropriately, their can be sustained growth within the population while they are still being caught. Another proposal would be to suspend fishing for a certain period each year, like during a species' mating period. Not only would this reduce the annual catch numbers, but, if used in tandem with quotas during the allowed season, would also allow for a great deal of remediation during the entire year. Some deep sea fishing operations currently receive subsidies as well to temper the cost of the fuel they consume. Some conservationists are calling for the discontinuation of this assistance, which would result in less fishing due to the need to reduce fuel costs.

Fish farming, also known as aquaculture, is the process of birthing and raising fish in captivity to sell in place of wild-caught fish and is one of the more controversial options to combat overfishing. Current data shows that approximately 43% of all the fish consumed each year is farmed, totaling 45.5 million metric tons (tonnes). As demand for fish climbs, as it has done steadily for several years, the dependency on fish farming will continue to grow, as the quantity of fish that can be caught from the wild each year has plateaued at around 93 million tonnes. A transition from primarily wild-caught fish to farmed fish is not a stretch given these statistics.

However, there are still inherent risks that come with fish farming that can actually contribute to the destruction of fisheries, and public opinion of aquaculture is mixed. The main concerns that many have with fish farming are the potential health concerns that arise due to the large amounts of corn in fish feeds for non-carnivores, the increased demand for wild-caught fish to create feed for carnivorous farmed fish (like salmon), the destruction of coastal habitats by the fish farms that are not landlocked, the conditions in which the fish live during their time in the aquaculture facilities, and the potential escapes from aquaculture enclosures by farmed species.

Fish farms adversely effect coastlands due to the inherent pollution produced by large quantities of fish condensed in a small area. The feces and uneaten feed that inevitable leak out of the pens ruin the water quality, and the spread of the “sea lice,” parasitic copepods that feed on the skin and blood of their hosts, is accelerated and can plague native species. These parasites are also one of the talking points for those that argue that the living conditions for farmed fish are inhumane. Additionally, the amount of space allowed for each fish is obviously much lower than what they experience in the wild, generally being somewhere around the size of a bathtub for each individual. This results in a lot of crowding and bumping which causes a lot of stress and premature death.

Aquaculture escapes are dangerous due the evolutionary advantage farmed fish tend to have. The farmed fish are selected for their size and robustness, and when introduced
into the wild population, they compete quite successfully. As an example, tilapia is a fish native to northern Africa, but has been become the prototypical aquaculture candidate due to its fast maturity and large size. The species is considered an invasive one in the areas it is farmed, however, and has disrupted many ecosystems. Another issue escapes present is when non-native farmed fish mate with native populations (like Atlantic Salmon with Pacific Salmon). The offspring is generally less viable than the typical offspring and dies off quickly, but causes a net decrease in the native offspring.

While fish farming and responsible legislation are crucial for the future of our oceans, the single most important reformation that must occur in order to stave off and hopefully reverse the problem of overfishing is consumer education, awareness, and restraint regarding their purchases of seafood. The quantity of fish caught each year is obviously driven by the demand for said fish; if people buy fewer of the fish that come from the most stressed fisheries, then the fishermen will abandon them in favor of more sought after species.

There are many resources available to assist the sustainability-conscious consumer in making responsible choices. The Monterey Bay Aquarium in Monterey, CA, for instance, started what they call their “Seafood Watch” in 1997. The Seafood Watch is a resource designed specifically for consumers, containing a list of most of the world's fisheries and a ranking system that catalogs each as either Monterey Bay's “Best Choice,” “Good Alternative,” or species to “Avoid.” Along with a guide for buying decisions, the site does a good job providing explanations for their decisions based on the fishing or aquaculture techniques used to obtain the fish, how sustainable the fishery is, and fish that are similar in taste.

Greenpeace, the well-known activist group dedicated to conservation and pressing for environmental policy reform, has their own resources as well. Similar to Monterey Bay, Greenpeace has compiled a list of fish they consider to be overfished or caught using questionable methods known as their “Red List.” Composed of twenty stressed fisheries, the list contains the most severe cases of overfishing and unsustainability, with Greenpeace's website also housing a more complete list based just on the sustainability of the species. Based on these lists (specifically the Red List), Greenpeace also does and annual report on grocery chains based on the fish they carry. Referring to the endeavour as “Carting Away the Oceans,” or CATO, Greenpeace annually grades twenty well known grocery stores on a ten point scale and provides a detailed profile of each chain. The profile presents Greenpeace's rationale for each grade and reports how many and which “Red Listed” fish each chain carries.

The US government legislated a positive resource for consumers with the 2002 Farm Security and Rural Investment Act, also known as the Farm Bill. Among other things, the Farm Bill introduced mandatory Country of Origin Labels (COOLs). These COOLs were made to be required on a variety of products that are commonly imported, including but not limited to fruits, nuts, beef, and, of course, fish. Providing the country of origin of a fish gives consumers great insight into the history of the fish they are presented for sale, especially when used in tandem with resources like Monterey
Bay's Seafood Watch or Greenpeace's Red List. The Seafood Watch has many entries for any one fishery, and one country's catch may be a “Good Alternative” while another's may be one to avoid.

The Country of Origin Labels seem to have one large loophole, however. Also included in the Farm Bill was a list of COOL exemptions. The most glaring addition to this list is the exemption for any fish product that is in any way processed before sale. For instance, fresh salmon is required to be labeled, allowing the consumer to distinguish between the ecologically friendly Pacific salmon and the extremely overfished Atlantic salmon. However, if the salmon is smoked before sale, as it is when it is sold as sliced smoked salmon or lox, then labeling is no longer required. Similarly, tuna steaks must be labeled, but precooked albacore tuna in a can does not. Monterey Bay lists all canned tuna as a fish to “Avoid” unless it comes from Hawaii; Without required country of origin labels, the consumer can't make this decision responsibly.

The Service Project: Information and Education

One doesn't have to search long in order to find a frozen, processed fish products in their local grocery store. I visited my local A&P to take a look at the variety of processed fish products they carried and which companies made them. During my search, I found that at this particular grocery stores, the main brands included Gorton's, Margaritaville, and Mrs. Paul's, among others. Examining their labels revealed little, except in the case of the ever popular fishstick. According to nearly every fishstick, fish patty, or frozen breaded fish fillet label I took note of, the main fish product in each was “Alaska Pollock.” Doing a little research using the resources mentioned above, I found that Alaska Pollock is listed on Monterey Bay's website as a “Good Alternative” to all other forms of pollock except that from the Barents Sea above Norway, citing the use of midwater trawling as the main concern, as there is an indeterminate amount of Chinook Salmon bycatch and the midwater trawlers still contact the seabed 44% of the time. Greenpeace, however, listed the species as one of its twenty “Red Listed” species, citing a sudden collapse in the population in 2008, though there are indications it is recovering after emergency reform.

The most shocking information came when I called the aforementioned companies to inquire about where they got the rest of their fish. Gorton's, for instance, carries products specifically labeled as tilapia as well as shrimp. Neither their tilapia or shrimp carried voluntary labels on the packaging. On the Gorton's website, they have included on their “About” page a “Commitment to the Environment” with a subsection concentrating on their efforts toward sustainable purchasing. It says:

“We stand behind the promise that our customers can "Trust the Gorton's Fisherman." We take this promise seriously, and it applies not only to the quality of products we make, but to how we make them. Gorton's actively supports environmentally responsible management of our natural resources as a way to ensure that our consumers will always have access to healthy and quality seafood products well into the future. Keeping this idea alive and well is a job we must do every day."
Upon calling Gorton's, I was promptly put on hold due to “high call volumes.” My call was taken after a 10-15 minute wait, at which time I asked them where their tilapia and shrimp came from. I was told that their tilapia was farm-raised in China and that they took in shrimp from a variety of sources depending on the product with most of it coming from Ecuador, Indonesia, and Malaysia. A quick look on the Monterey Bay's website calls into question the sincerity of their earlier pledge. In both cases, regarding the tilapia and the shrimp, the source of their seafood was considered one to “Avoid,” each having other “Good Alternatives” and “Best Choices.”

In another case, I called the customer service line for the Margaritaville brand seafood company. The first secretary to answer wasn't sure where the company got its fish, so she transferred me to someone she thought could help. This higher-up promptly answered my question, telling me that they too imported their shrimp from South and Central America, though they processed it in the United States. The shrimp in both these cases are caught using trawlers that destroy the shrimp ecosystems and make it difficult for the populations to recover.

For both cases, while each company graciously gave me the information I sought, there is little more one could do to discover where exactly the fish they were about to purchase came from. This particular COOL exemption completely removes the teeth of the mandatory exemptions. The fish that go into processed fish are no more sustainable than the fish fillets one buys fresh or frozen to cook themselves. In a way, having the mandatory Country of Origin Labels while exempting processed fish from using them is a deceitful way to seem proactive in fixing the problem while keeping the best interests of a billion dollar industry as the top priority.

In order to address this issue, I've decided to write an organization known as the Union of Concerned Scientists, presenting the facts I've obtained during my research and emphasizing the need for the reformation of the COOL exemption on processed fish (see Appendix A.)

Given the state of our oceans and the world's seemingly insatiable need for fish, the road back from our current practices seems difficult and tough to coordinate. However, there is hope in aquaculture, legislation of more rigid fishing quotas, and a jolt of consumer awareness. These will not have an effect overnight, just as the problem stemmed from historical irresponsibility, but we can save our oceans.
To whom it may concern,

My name is Chris Riehl and I'm currently a student at Rutgers University in New Brunswick, NJ studying Biotechnology. I'm writing you this letter as a portion of a capstone project based on the theme “Ethics in Science and Society.” I would like to bring to your attention the flawed exemption in the mandatory Country of Origin labeling system put into place originally with the 2002 Farm Security and Rural Investment Act (also known as the Farm Bill.)

While the Farm Bill made country of origin labels a requirement on all fresh and frozen fish in grocery stores, it made exempt all fish that is processed before commercial sale. This includes such products as fish sticks or patties, precooked shrimp, canned tuna, or anything in that vein. As I'm sure you're aware, overfishing is a severe issue we face as a society today, with some estimates predicting an emptied ocean by as early as 2048 should current trends persist. One of the most essential reforms for the future of our oceans will be the education of consumers on what fisheries are safe and underfished and which are being harvested unsustainably. With this exemption in country of origin of labeling, one of the first baby-steps in that process is crippled.

To prove whether or not the country of origin was a piece of information worth knowing regarding processed fish, I decided to call several of the companies whose products are on sale at my local grocery store. I called Gorton’s, a company that presents a concerned front on their web page, and Margaritaville, a lesser known brand that focuses more on Caribbean flavors to adorn their seafood. Each company was quite happy to share the information I sought when I called, and I was pleased with that transparency. However, upon learning the truth about the fish they source, I came to quickly understand the commercial advantage to being exempt to COOL.

In Gorton's case, their tilapia was farmed in China and in the case of both companies, their shrimp came from Central and South America. Resources like the Monterey Bay Aquarium's “Seafood Watch” list makes it clear that both of these products are fish that should be avoided due to overfishing or destructive fishing techniques such as trawling. Without knowing it, people are buying fish that come from overexploited fisheries from companies that claim to have sustainability in mind, or at least claim to be working toward sustainability. Without the necessary accountability to the consumer, the problem of overfishing is given a stronghold within the multi-billion dollar fish processing industry.

While there are other exemptions to COOL, all of which may have grounds for reexamination, I truly believe that this particular exemption is one that can not stand. Given your resources as a respected coalition of some of the world's brightest minds, I believe your influence would go a long way in convincing policymakers and their constituents that this is a change that should occur.

Thank you for taking this time to read my proposal. I hope to hear from you, as the opinion of your organization is one I respect very much.

Sincerely,
Christopher Riehl
The state of the world's oceans seems to me to be a largely overlooked issue in Western society. With climate change, the economy, and political unrest taking the spotlight in the public eye, the facts on dwindling fish populations and the destruction of undersea ecosystems has been put on a back burner. This is a shame because, according to Boris Worm, PhD, of Dalhousie University in Halifax, Nova Scotia, the ocean could be emptied of saltwater fish as early as 2048 if the current rate of decline continues. This is an issue that relates to many of the hot topics of today, as Dr. Worm's studies indicate that climate change and pollution are major contributors to the faltering fish populations. While I know it's difficult to pick up another torch in the midst of all our current problems, this issue is one that must be taken seriously. Current international law only does so much to protect fish stocks, and countries like China (the world's leading seafood exporter) are not even subject to them. We need an awareness boost, and we need one now.
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