Audrey Nailor
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# "The Silence of the Whales: Marine Depletion in Memory and the Future"

I grew up in Portsmouth, New Hampshire, in an ancient house so familiar with the Piscataqua River that it had a distressing tendency to show up in the cellar and garden, leaving mussel shells in the driveway and seaglass on the pebbled beach. The river reeked in those days, but there were wonders on it – quiet mallard ducks so docile they would sit in my lap and share sandwiches, assorted boats that went back and forth, and exciting ribbons of red and green kelp that washed up occasionally with tiny mussels attached.

My parents would take me to New Castle Beach and, essentially, set me loose on the sharp black rocks and fine white sand while they sat back and diddled with checkbooks. I spent hours barefoot in meager tide pools long picked over, hoping to find a living and reasonably playful periwinkle. Crabs, for a child, are a splendid thing to find in a tidepool – lively and comical, sometimes *as big as your hand* –proof of the fantastic, scrabbling desperately in your palms. There were blue sea lice in inexplicable clusters; mussels firmly closed against exploration; and, if one was lucky, tiny wide-eyed fish.

After the house was restored, my parents decided that they needed to do another one, and so we spent many years wandering about the state, renovating houses in increasingly efficient succession. We moved farther into rural zones, far from twee port towns and depleted tidepools, into cow and mountain country. The ocean became a distant treat, visited on birthdays, and I did not think about it often.

I had always assumed I would grow up to be involved in environmental conservation, but as my college credits mounted and graduation loomed – too early - I realized I was

getting farther and farther away from that six-year-old's dream. I was taking courses that would allow me to get into medical school, but I was filling my requirements with the oddest, most disparate things – Bacteriology of Food, for example – and filling my electives with things like Intermediate Drawing and Tutor Development instead of choosing high-level science courses. I had invested so much in every course, but saw no way to synthesize them; I loved genetics and evolution and bacteria and ecology and dinosaurs and computers and drawing, and didn't have a particularly marketable or combinable interest in the lot. If I picked one at random and stuck with it, I would be unhappy. If I didn't pick, I would be screwed. I decided that what I really wanted was some kind of research experience or field work that would get me excited about biology.

It was my classmate Kate who reminded me about stories. She formed a small gathering called the Storyteller's Club and invited local members of the Storyteller's Guild. These characters, called 'tellers,' made their livings by making people remember things. I told stories about polar bears and climate change, ozone depletion and DNA; topics that depress, annoy or bore people to tears, but the tellers listened, and so did the group. At that point I decided that whatever it was I ended up doing, it would involve the sharing of stories – calling on words to change histories, change minds, and change the future. The ocean is one of the most powerful forces on the planet, but words are stronger still. Perhaps words – good words, the right words – can remind people of the ocean, and its importance.

So when Kate and our classmate Françoise started chatting to each other about their shared experiences at Shoals Marine Lab, I paid close attention. For some reason, they were convinced that Shoals was just what I needed, and for some reason, I believed them.

Shoals sounded unbelievably perfect, probably too good to be true. I had forgotten about the ocean for a while, but I felt a wordless call. It sounded like a story waiting to unfold.

More stories need to be told of environmental concerns, and the story of marine biological depletion is a vital one. The Millennium Ecosystem Report estimated from the years 2001 to 2005 that "at least one quarter of marine fish stocks are overharvested," meaning that the fish populations are at one quarter of their original, unfished population (Millenium Ecosystem Report [MER], pg. 11, 2005). The Pew Oceans Commission Report, published in 2003, cites that "thirty percent of the [global] fish populations that have been assessed are overfished or are being fished unsustainably", implying that some fish stocks are in immediate danger of being overharvested (Pew Oceans Commission [POC], pg. vi, 2003).

These stories need to be explored in further depth. Their reality needs to be brought home to the segments of the population who make commercial and political decisions. As a child, I did not think that the tidepools I played in were empty; I thought that it was an awesome event to find one crab in a whole day's absorbed search. It never occurred to me that those same tidepools were once home to large ecosystems of mussels, fish of varying sizes, starfish, and assorted crustaceans. Perhaps if we knew more of the losses we have suffered, we would be less hasty to deplete these stocks of natural diversity.

One of the most obvious concerns with marine depletion is that wild fish will no longer be available as a food source for humans. The Millennium Ecosystem Report (2005, p. 13) claims that "we have gone past the point where nature can replenish the stock" although "[human] demand has never been greater and will continue to rise". These fish are not just intrinsically valuable in themselves as a unique living resource; an estimated

one billion humans depend on fish as a sole protein source, and more will do so in the future (Michael Chambers, personal communication, 2007).

Before addressing the causes of marine depletion, it is vital to understand that fish stocks are not a resource that is solely exploited and influenced by humanity. While humans are the most indiscriminate harvesters in the marine environment, we are not solely responsible for the increases and decreases of fish populations. The number of fish in the sea is shaped by almost infinite variables, including the availability of plankton, food web interactions, climate change, life histories, and reproductive biology. These combine to make it difficult, if not impossible, to predict the response of fish stocks to human-induced changes in the marine environment. The complications of this issue will become more apparent when we focus on important human-directed projects such as marine reserves and aquaculture.

The Pew Oceans Commission cites some major issues that cause marine depletion: bycatch, habitat loss, and overfishing (POC, 2005, p 36). Bycatch is the accidental catching of animals in gear deployed to harvest different animals. For example, a fisherman may catch sea turtles in a shrimp net, which usually results in the death of the turtle. Dolphins can be caught in nets and drown - entanglement is a significant threat facing marine mammals. An estimated one quarter of the world's fishery catch is thrown away as bycatch (POC, pg 42, 2005). Indiscriminate fishing gear and practices have often made it difficult for endangered species to recover.

Commercial fishing and coastal development are responsible for a major portion of the loss of marine habitat. The most cited example is the common fishing practice known as trawling, in which a weighted net is dragged by a boat along the bottom of the ocean

floor, scaring fish from the bottom and scooping them up. Protective gear can be fitted to nets to prevent them from being shredded by debris on the ocean floor. Objects like rubber tires are used to allow the bottom of the net to scrape the floor while rolling over obstacles. While this gear saves the fishermen the time and effort of constantly repairing ruined nets, it also damages the habitat of the ocean floor, destroying the features of the environment and giving it the appearance of being criss-crossed by all-terrain vehicles (JB Heiser, personal communication, 2007). Dredging, similar to trawling, is used for less mobile creatures like shellfish; dredges drag along the seafloor, scooping up slow-moving scallops and causing significant damage to the habitat.

In tropical regions, trawling and dredging damage coral reefs, which provide a valuable habitat for the very fish that are being sought after. In the New England area, the sediments of the ocean floor provide a home and feeding for the invertebrates on which fish feed. Continuing swipes of a trawl net further hinder the ability of the environment to recover; the Pew Oceans Commission (2005, p 42) states that "areas of New England's Georges Bank are trawled three to four times per year". With the habitat gone, that area of the ocean floor remains empty. The situation is worse when the razed area was a breeding or nursery ground for native fish.

Overfishing is the most obvious cause of marine depletion. "The principal problem is that we catch too many fish, and far too quickly, for nature to replace" (POC, 2005, p 35). Human overfishing is a global concern, which makes it one of the most difficult issues to address. Commercial fishing provides a worldwide industry, a major portion of many economies, an important part of many cultural heritages, a large source of employment, and protein for millions. Fishermen have spent centuries perfecting technology and

techniques to catch as many fish as possible. Now, it appears, they are simply *too* efficient, "outstripping natural obstacles and the ability of fish to replenish" (POC, 2005, p 40). And the fishermen are not willing to stop, after they have invested so much into their boats and equipment; as Peter Weber (1993, p 48) states, "Once invested, fishers will only pull out of an area if they can find new fishing grounds where they can use their equipment; otherwise they will stick with the overfished grounds until forced out of business." If the fishermen continue to use practices and gear that maximize their catch, they will soon fish themselves out of a job, ultimately destroying their livelihoods and any chance of long-term recovery. If the fishermen switch to less efficient gear or stop fishing altogether, they will have greater long-term benefits, but will lose their current livelihoods. Neither is a choice they wish to make. Are the economies of families, towns, states and countries worth the survival and diversity of mere fish?

Obviously, some kind of balance must be struck to create sustainable, productive fisheries. The goal is to ensure employment, protein, profit and promise for humans, and to ensure healthy, stable and diverse populations of fish. When conservationists forget the human element in these stories, they quickly lose sympathy among the very people who will become most affected by their ideas. Likewise, fishermen would benefit from viewing the ecological "big picture," which dwarfs human endeavor in its complexity.

Thankfully, fishermen and conservationists are working together to create solutions to the causes of marine depletion. Many endeavors, such as aquaculture and marine reserves, are being explored as possible ways to reduce pressure on marine species while turning a profit for humans. Other solutions such as gear restrictions and modifications

are inconvenient for humans, but may reduce overfishing, bycatch, habitat loss, and marine mammal entanglement.

Aquaculture is the development of domesticated fish stocks that are kept isolated from the open ocean. These “fish farms” are composed of large cages in the ocean that pen schools of fish for easy feeding and harvesting. Fish farmers can simply remove the domestic fish from the cages when they large enough to sell, at minimum impact to the populations of wild fish. This allows the public to have large quantities of big fat fish while the wild fish are left in peace. However, aquaculture poses some risks to the marine environment the farms are placed in. Aquaculture creates waste, and there is a risk of domestic fish escaping into the wild population. The Open Ocean Aquaculture Project, operating in the Gulf of Maine, is approaching these issues from different angles, using experimental feeding techniques, cage design, and monitoring technology to reduce the environmental impacts of aquaculture. (Michael Chambers, personal communication, 2007).

Many people feel that the development of marine reserves will positively impact the populations of wild fish. Marine reserves are areas of the ocean that cannot be fished commercially; they are, in effect, national parks of the ocean. Proponents of marine reserves believe that setting aside an area for fish to live in, unmolested by commercial fishing, will improve marine habitats, increase species diversity, and provide a place for breeding females to grow and nest. This, in turn, will lead to larger, healthier, more diverse fish populations, which will surely be appreciated by the commercial fishermen and the conservationists alike.

Marine reserves preserve the habitats necessary for wild fish to thrive. Commercial fishing practices like trawling and dredging disrupt ocean habitats, which affect the life histories of local marine populations. Fish use portions of their habitats as breeding or nursery grounds; if these are destroyed, the fish may not be able to breed or grow in the area. This obviously has some effect on the overall fish population.

Marine reserves may also increase diversity. It is hoped that by setting aside an area of habitat that cannot be trawled or dredged, the populations of herbivorous fish will increase. This, in turn, will provide a stable food source for the larger fish that prey on these fish, and the bigger fish that eat those fish, until the marine reserve has a selection of fish of varying sizes and value.

Marine reserves may also improve the health and size of the fish population. Big fat fish are worth the most on a dinner plate, so fishermen prefer to take the largest, heftiest and oldest fish they can. These mature, healthy fish are often breeding females. As female fish age, they become more and more fecund, producing more eggs every year. Older fish also produce much higher-quality eggs than young mothers. It is apparent that these big females are very valuable in the fish population, but they also commercially valuable fish, and fishermen will not be convinced to throw them back. Marine reserves would allow young female fish a safe place to grow big and old. They would not be harvested too early, and they would produce greater amounts of quality eggs. Existing older female fish could undergo several reproductive cycles and produce several batches of these eggs, increasing the fish stock and improving the quality of the population.

However, fishermen are not as enthusiastic about the idea. They dislike the idea of having traditional fishing grounds suddenly closed to them. Proponents of marine

reserves wish for the areas to remain open for some uses, such as research, education, or eco-tourism. Fishermen will lose their rights over their fishing grounds to outside scientists and tourists, as well as losing all the fish they had been depending on in the reserved area.

Finally, there is no guarantee that marine reserves will bring back the desired fish stocks to healthy, commercially viable levels. Recall that the populations of wild fish are controlled by many variables; human predation is only one of them. Factors like climate change and food availability will continue to influence their populations, whether or not the fish have reserved breeding grounds and nurseries.

Halweil (2006) states that "Evidence shows that fish populations recover rapidly in such [marine] reserves and that nearby fish catches and fish sizes increase dramatically after the reserves are set up," but scientists still cannot show the fishermen that they will definitely benefit from marine reserves in the long term. The short-term costs are more immediately obvious, and marine reserves still look like a very poor deal to the fishermen. The tantalizing hauls produced by the scallop reserves are very attractive, but they are not proof that the sacrifice will pay off. Fishermen will have to give up the big fish they have now for the vague promise of more, bigger fish in the future. It's a difficult choice for them to make, and the decision cannot be made without their endorsement. Scientists cannot take the sea from the fishermen, even if it is 'for their own good.'

Gear restrictions and modifications allow fishermen to use specific gear that is designed to minimize bycatch and habitat destruction. One example of gear restriction is the replacement of sinking lines with floating lines. Lobstermen prefer to tie their lobsterpots together with brightly colored nylon rope, which floats near the surface of the

water, making the traps more accessible. Unfortunately, whales are easily entangled in floating ropes. Sinking ropes, made of white cotton that is easily waterlogged, pose less of a hazard to marine mammals, but they are more expensive and less convenient. The use of floating ropes is now prohibited in the state of Massachusetts.

One type of gear modification is the Turtle Exclusion Device, or TED, which is used to reduce the incidental catching of endangered sea turtles in the shrimping industry. The TED is a metal cage with a trapdoor, set in the middle of a shrimping net, so that when the net scoops up a sea turtle, it falls against the TED. The thrashing turtle can nose the trapdoor open and escape, but the tiny shrimp pass right through the metal bars and into the end of the net.

Fishermen do not like gear restriction and modification because it is expensive and annoying. Often, they dislike the regulations that are mounted without their input, and they are resentful of scientists telling them how and what to fish. It is, after all, *their* livelihood, which cannot be ignored.

Given this information, it may seem that all of these measures are meager. While fishermen and conservationists are reaching some agreements, it seems that neither side is happy with the outcomes. Any future solutions will require even greater cooperation between fishermen, scientists, and lawmakers.

And if it is the future we are looking towards, we must recall that greater forces than commercial fishing affect wild marine populations as well. Factors beyond our control, like the abovementioned life histories and food web interactions, direct the birth, growth and development of these populations. Humans cannot change the way fish breed or how

many eggs each female produces. We only know that our actions can affect these populations; we cannot always know how.

That leads us to one of the greatest threats facing global marine ecosystems now – a threat that makes the daily problems faced by the fishermen of Maine seem insignificant. Global climate change can no longer be ignored. It is certain now that human influences have changed the climate that we live in, and that even if we stop producing greenhouse gases today, there will be no reversing these effects. These are factors that are no longer in our control, but the changes they will cause in the ocean environment are predicted to affect all levels of marine life.

Human consumption of fossil fuels has released greenhouse gases into the atmosphere, insulating the planet and creating a global warming trend. This has significant effects on the global marine environment.

For example, variability in the atmosphere can be statistically linked to variability in right whale calves. Right whales feed on tiny zooplankton, called copepods, which cannot swim against the current. These microscopic creatures are pushed around at the mercy of atmospheric conditions, drifting in certain areas depending on the whim of the current, their neutral buoyancy allowing them to hang suspended in the water column. The fifty-foot whales must follow and consume these concentrated pools in order to gain enough calories every day. Global warming is affecting the weather patterns responsible for ocean warming and cooling, which in turn affect the currents and density. Now, it seems, right whales are unable to find enough food during particularly warm years, and they do not produce many calves. The past twenty years have seen tremendous – and unhealthy – variation in right whale calves, which appears to correlate with the recent

weather extremes caused by global climate change. Thus, the recent warming trends may contribute to the slowed recovery of endangered species (Robert Kenney, personal communication, 2007).

Multiple causes lead to the loss of marine diversity and population health. With time and understanding, we can begin to eliminate the problems caused by overfishing and habitat loss. Gear modification can reduce bycatch and mammal entanglement, and marine reserves will allow fish populations to rebuild. Scientists and fishermen are beginning to listen to and understand each other's stories, which will be necessary to achieve their common goals.

But the situation is changing now, and we must change to suit it; greenhouse gases are changing the climate of our planet, wreaking unpredictable consequences on the marine environment. We have evolved so far in our understanding of marine creatures, their relation to their environments, and their ability to give us what we need from them. In the years to come, we must evolve faster, keeping up with the global trends that will set the pace for our future.

I am only a student now, and not yet a very good storyteller. But one day I will be a scientist, and a mother or teacher as well. If my grandparents had learned the story of marine depletion sooner, I could have held sea stars in my hands, could have had childhood dreams of dense shoals of fish. I do not want my future to have empty seas.

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Note: Summary of the causes of marine depletion and environmental issues, with an emphasis on anthropogenic causes of these problems and possible solutions.