### Editor's Note

In "Overfishing: A Global Perspective," Viet H. Nguyen addresses a pertinent topic that isn't necessarily at the forefront of American's concerns despite its significance. What is a food crisis? In informing readers of the factors contributing to this predicament, Nguyen cites a wide variety of sources. Are they clearly introduced and fully explicated? What aspects or elements would you change in order to maximize the information brought in from outside texts? How would you do this? Are there any sources you would eliminate or change?

Because such a large number of outside sources were consulted for this essay, the author must deal with multiple ideas and frames of reference within the topic. Think about how the organization requires Nguyen to incorporate and address such large amounts of information. Do the connections the author makes consistently culminate to a larger point? How would you change the organization of the essay to keep the focus clear?

## Overfishing: A Global Perspective

**Viet H. Nguyen**

In the past, the bountiful ocean appeared to be a ceaseless supplier of food around the world. However, today, what seemed to be an unending supply of fish can no longer keep up with an exploding human population of almost seven billion. As the demand for fish exponentially increases, the fishing industry has to keep up; wild fish populations have become severely diminished. Not only does overfishing threaten the marine ecosystem, it has an almost direct adverse impact on land animals, extinction of some aquatic species, and daunting enough—global warming. Fortunately, humans' innovations aren't always about depleting Earth's resources; attempts to remedy the situation are becoming the main concern of some people, and one of the results is fish farming. The cultivation of aquatic organisms—aquaculture—represents a favorable approach to lighten the pressure on the wild fish stock today. Ocean Farm Technologies Inc. (OFT) has developed a unique containment system for marine aquaculture—AquaPods—suited for rough open ocean conditions and a diversity of species ("AquaPod"). Although aquaculture has been under constant scrutiny and criticism, AquaPods are a pioneering new way of saving wild fish while feeding the ever growing human population, and they will revolutionize the fish farming industry to meet the current fish-meat quality standards at lower costs.

According to the Food and Agriculture Organization (FAO) of the United Nations, the amount of food fish consumed on a global scale has increased from 45 million metric tons (mmt) in 1973 to over 90 mmt in 1997 (qtd. in Delgado et al.). In response, the fishing industry has developed its fisheries to the point where it yields dual effects that could bring some species to extinction. First, fishermen are catching more fish every day, which depletes wild fish stocks and makes fish even harder to catch. The scarcity of fish results in technological advancements that can make it easier for fishermen to overfish. Second, as they fish longer, harder, and farther away from their home ports, fishermen impose an immense strain on fish stocks that "leave fewer regions out of reach so that fish can reproduce unmolested, thus exacerbating the effects of over-harvesting" (Tidwell). Bluefin Tuna, for instance, "is near ecological and commercial extinction" (Lovgren). The International Commission for the Conservation of Atlantic Tuna (ICCAT) sets an annual quota that restricts tuna catches across the Mediterranean to 29,000 metric tons (Lovgren). However, the World Wildlife Fund (WWF), an organization for the conservation of the natural environment estimates that the quota is being violated by about 50 percent; "real catches of Bluefin Tuna are around 45,000 metric tons" (Lovgren). The incentive of good price that consumers are willing to pay to the fishermen because of their insatiable demand for seafood far outstrips any laws or quotas set by the ICCAT. With that said, fishing quotas are absolutely necessary; however, it is not the only approach that could prevent the hardworking fishermen from overfishing.

The notion that only specific species of fish being caught will suffer in the outset of overfishing is common, but in reality, various land animals and the entire aquatic ecosystem will deteriorate too. "In the West African nation of Ghana, olive baboons ransacked crops and terrorized villagers" because of overfishing ("National"). They were searching for food because their population was also increasing. The baboons were not competing against fishermen (although they do eat fish), but there was not enough food in the wild for them. Baboon populations were once kept under control by large predators like lions and leopards, but due to an increase in bushmeat (meat for human consumption derived from wild animals) trading, numerous animals (including baboons' source of food) and large predators are being hunted to sell in the market of Ghana ("National"). After "delving into dusty archives where decades of animal population records lie hidden" in Ghana, Justin Bashares, a biologist at UC Berkeley, and his team of scientists found that "hunting pressure on Ghana's large animals increases in direct proportion to fish supplies" ("National"). Like many developing nations, fish is a vital source of food in Ghana. As the fish supply depleted, African people had to hunt for bushmeat instead. The outcomes have been dreadful to all nearby land animals and the African people themselves.

While the harmful consequences are evident on land, the effects are even worse under water. Every living organism depends on each other in the complex web of the ecological relationships to flourish. All it takes to offset the equilibrium of the marine ecosystem is an absence or deficiency of just one group of any species. A good example is the influence of algal bloom on other animals. Algal bloom is the case when large algae populations reproduce, accumulate, and die-off rapidly. Is it an essential part of nature; however, too many blooms can deplete the oxygen level in the water. Algae, like plants, produce oxygen in the process of photosynthesis during daytime whenever sunlight is present, and consume oxygen in the absence of sunlight for cell respiration. The oxygen produced is usually higher than the oxygen consumed by algae. However, when large populations of short-lived algae bloom near the water surface, they block most of the sunlight from reaching to aquatic plants, making these plants use oxygen instead of producing it. In addition to oxygen depletion, mass algae die-off will induce decomposers to use up even more oxygen to decompose dead algae. The exhaustion of oxygen in the water can asphyxiate numerous marine life forms. Algal bloom is due to "warmer water temperature and nutrient enrichment of water, especially phosphates and nitrogen, which is often the result of pollution from nonpoint sources" ("What"). This phenomenon has a detrimental effect on the various aquatic organisms, and chemistry of the ocean water.

Another plausible cause of increasing problems with algal bloom is the overfishing of sardines. Sardines are small and silvery fish that feed mainly on algae. Since "sardines are not as commercially important as other species, the government is not interested in them," making them susceptible to being overfished (Dean). As more sardines are being processed in the fisheries, less of them are available in the ocean to keep down algae population; copious amount of "algae survive uneaten, only to sink to the bottom, decompose and produce methane and hydrogen sulfide gas that rise to the surface in giant clouds" (Ocean). The presence of sardines draws an almost inverse relationship to the amount of organic matter of dead algae. The more organic matter of dead algae could change the water chemistry, as this article of NASA explains:

> Amounts of organic matter fall to the sea floor, where they are oxidized, and the bottomwaters [water level right above the seafloor] are frequently hypoxic (with low oxygen concentrations) or anoxic (zero oxygen concentrations). These conditions allow anaerobic bacteria [another kind of decomposers that produce Hydrogen sulfide and Methane as they digest the organic matter using little or no oxygen] to do their work. Over time, enough Hydrogen sulfide and methane builds up in the

> sediments to form a large enough volume of gas to release from the sea floor and rise to the surface (Ocean).

Hydrogen sulfide has a "rotten egg smell" reputation, can "strip oxygen from water as it rises to the surface," and is mainly responsible for poisoning fish and other animals in the ocean (Dean). Methane, which "pound for pound traps 21 times as much heat as carbon dioxide," is an extremely potent greenhouse gas that in large eruptions from the ocean together with manmade pollution can cause global warming ("Lice"). The consequences of overfishing are beyond the conservative idea that only fish suffer; effects of global warming encompasses all living things on the surface of the earth.

However serious the effects of overfishing are for our planet, the rising demand for fish will never stop; there has to be a way to increase supply. Like raising livestock, aquaculture can produce large quantities of food that can satisfy the needs of consumers. As fish are being raised in a constrained area until they can be harvested, a guaranteed quantity of mass number of fish will hit the market. In great number, farmed fish can ease the demand of wild fish, thus leaving fishermen less incentive to overfish. Currently, farmed fish amount to about 40 percent of the total fish sold in American markets (Tidwell). By 2030, it is estimated by the Food and Agriculture Organization that over 50 percent of food fish will be farm raised (Tidwell). Although growing rapidly, fish farming has been under various denigrations and criticisms that have put a negative connotation on farmed food fish because existing fish farming methods are not absolutely environmentally safe.

Fish farmers have to set up topless mesh cages, which also function as feedlots, to keep fish from fleeing, so they're limited to shallow water. Most fish farms are situated near coastal areas and "shallow holding ponds connected to rivers and estuaries or in partitioned areas of mangrove habitats" (Osmura). This suggests many ecological problems: mangroves habitats must have been destroyed for the cause of fish farming, water flow from various rivers to the sea are being congested, and many other animals can be trapped in the mesh as they swim along the river to the sea. Expensive coastal water for fish farmers would mean that they have to pack even more fish in a small area. As more fish reside in close vicinity in shallow water, the water current would be too slow to flush out their fecal matter, creating more pollution and a breeding ground for harmful parasites and sea lice. Sea lice can infest and spread out easily throughout the farmed fish. They can also "prey on juvenile wild salmon when they swim past the pens on their way from inland rivers to the ocean" ("Lice"). Salmon can produce a lot of waste, "a farm of 200,000 salmon can flush nitrogen and phosphorus into the water at levels equivalent to the sewage from 20,000 people" ("Waste"). Accordingly, fish farm-

ing not only has a damaging impact on the environment, it's also affecting wild species as well. According to the Farmed Salmon Exposed Organization:

> The crowded conditions of salmon farming pens provide ideal conditions for the outbreak of disease and parasites. In open net-cages there are no barriers to prevent the transfer of diseases and parasites between farmed and wild salmon; these pathogens are transferred to wild fish as they swim past the farmed salmon pens ("The Problem").

Salmons having diseases and being infested with parasites are definitely not a good source of food for consumers. If farmed fish can have a healthy environment to live in, their meat will be very healthy.

Almost all of the problems arise from the tight living spaces of farmed fish. The crisis can be resolved however if fish are grown in the open ocean where strong currents can sweep away their fecal matter. Developed in late 2005 by Ocean Farm Technologies, AquaPod Net Pens could be the solution to the aquaculture industry regarding fish farming pollution. AquaPods are "constructed of individual triangular net panels fastened together in a spheroid shape" ("AquaPod"). With a spherical cage, fish could be enclosed inside and grown offshore—where strong current flows thousands of cubic tons of fresh water through the cage every day. The cage could be "50 ft high and 80 feet at its widest point. The company's largest cage has an inner volume of more than 100,000 cubic feet, enough spacious room for tens of thousands of fish" (Mann). In the AquaPods, farmed fish will no longer have to gobble up food and water that are full of feces and pathogens; they would live in the ocean just like any other wild fish, except in a cage. Obviously, the "open ocean fish-meat" quality would much better than the fish-meat of near shore farms. Offering scores of advantages may make the new technology seem expensive, but it's not; "The AquaPod containment system costs significantly less than currently available submersible net pens on a cubic meter of containment basis" ("AquaPod"). The AquaPod technology can even help fish farmers reduce the cost of feeding fish; "the rigid exoskeleton of the AquaPod allows easy attachment of any number of feeding ports and secures feed pipe installation at any location on the exterior of the pen" ("AquaPod"). This could mean that feeding can be done automatically or remotely; the operator can be hundreds of miles back on shore controlling the feeding mechanism. By contrast, conventional fish farming requires more than one person to roam about the fish farm and deliver food to fish cage by cage. With all their health benefits and cost effectiveness, AquaPods are the future of fish farming.

Surprisingly, cars' exhausts are not the only cause of global warming—overfishing is, too. Although aquaculture might ease off overfishing, it presents even more dilemmas to the environment and wild fish. While the innovation of AquaPods might

not match Nobel Prize-winning sophistication of the 21st century, it could be the redeemer of the aquaculture industry. Even more, it could be the rescuer of wild fish, the earth, and ultimately, the overpopulated and problematic humans.

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*Viet H. Nguyen is an aerospace engineering major.*