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# The Atlantic Bluefin Tuna: A Tragedy of the Commons on the High Seas

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## Abstract:

Considered the biggest threat to marine ecosystems today, it is estimated that three fourths of the world's fish stocks are being harvested faster than they can reproduce. Because the ocean is not subject to defined property rights, there exists a "race to the bottom" encouraged by the rise of industrial fishing, as well as a voracious global demand. The Atlantic bluefin tuna provides a glaring example of an overfished species on the brink of extinction due to its popularity in the Japanese market. Its rarity and esteem have made it the most expensive fish in the sea and policy has so far failed to hinder the hunt for this profitable species. As a top predator in the marine food chain its viability poses a potential threat to maintaining balance in the ocean's ecosystem and tuna ranching largely perceived as a sustainable solution has only served to exacerbate that problem by jeopardizing the ocean's natural processes. Additionally, the intrinsic value of bluefin tuna and fish species in general has created little sympathy among consumers. For real change to happen, in the form of bluefin tuna being able to successfully replenish itself and reproduce, consumer awareness, international cooperation, and adherence to sustainable fishing will be required.

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## Introduction:

Although it is clear today that the ocean is a limited resource, there exists a pervasive mentality of disillusioned exploitation. Even as we face the unavoidable reality of a crippled marine ecosystem, economic profit is valued over wildlife and the benefits of a healthy environment. Comprehensively, marine ecosystems are experiencing anthropocentric pressures on several fronts, from pollution to habitat loss. These causes are essentially all effects of man's unrestrained growth and continual expansion upon nature's bounty. The greatest example of this tragedy is overfishing, which has spiraled out of control in the last half a century due to the rise of industrial fishing and an explosive demand for fish. Without designated property rights and effective regulation, the ocean has historically been perceived as a free for all, one in which several countries quickly capitalized upon by increasing fleet capacity and highly efficient technology. Formerly unexploited, marine environments are no longer capable of eluding man's ever-progressive hunt to empty the sea of all useable life. And as the world population continues to grow and fish becomes a staple of many diets, the resources of the sea are unable to keep up with this insatiable demand. Currently, the ocean faces a grim future with catch data predicting the collapse of all world fisheries by 2048 if the way fishing occurs today does not change. Real change however would clearly require uncharacteristic cooperation and dedication by many nations.[1]

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[1] Worm et Al. "Impacts of Biodiversity loss on Ocean Ecosystem Services." *Science* 314, 787 (2006). DOI: 10.1126/science.1132294

Perhaps the most commercially exploited fish today, Atlantic bluefin tuna present a case study to explore the effects of overfishing upon one species whose lucrative flesh has inspired a gold rush in the sea. Its popularity in the Japanese market and scarcity today has inspired prices exceeding $150,000 dollars, making it the most valuable fish in the sea. Going beyond the bluefin being served as a delicacy in pricey restaurants around the world, the actual fish is a stunning example of evolutionary prowess and impressive design. It is an unusual predator, warm-blooded for maximum efficiency to migrate long distances while capable of growing ten feet and more than a thousand pounds.[2] Although considered a fish, many authors compare the bluefin to shark and even whale species, both, deserving of protection due to their top predator status and slow maturation. One journalist even proclaimed, "dining on a 500-pound tuna is the seafood equivalent of driving a hummer," giving unprecedented value to a fish that is perceived by most consumers as something they have an indisputable right to eat.[3] The bluefin exhibit similar qualities to other species at the pinnacle of the marine food pyramid, and as bluefin is fished out, there is expected instability in the entire ecosystem. Although three types of bluefin species exist and all three of them face extinction**,** including the Pacific bluefin Tuna and the Southern bluefin Tuna, this thesis will focus solely on the Atlantic bluefin Tuna, who represent the most endangered member of the tuna species. As the slowest growing of the tunas, Atlantic bluefin populations have drastically declined as the key reproductive spawners have been targeted in what is an incredibly unsustainable method of fishing. Once an abundant species in the 1960s, the replacement of poling with purse seine fishing has decimated the bluefin population by drastic proportions and their

[2] Ellis, Richard. Tuna: A Love Story. New York: Alfred A. Knopf, 2008. Print.
[3] Greenberg, Paul. *Four Fish: The Future of the Last Wild Food*. New York: Penguin, 2010. Print.

dwindling stock has no chance against the many who hunt it. Furthermore, Atlantic bluefin pose a dynamic problem because unlike salmon and cod, their population is not contained and spans most of ocean as they migrate through the territorial waters of multiple nations. Although some rehabilitation efforts have taken root through the formation of the International Commission for the Conservation of Atlantic Tunas (ICCAT**),** such efforts have been criticized by environmentalists as beholden to serve corporate interests.

To fully understand the impact of overfishing upon the ocean, natural science data will be implemented in order to emphasize bluefin tuna's imperative role in their environment. In this section, I will also be emphasizing the important part each fish plays in maintaining a balanced habitat that directly correlates with ecosystem services and ecological economics. Additionally, I will examine the relatively recent historical demand for bluefin tuna in Japan as well as sushi's incredible growth that has caused such a global preference for fish around the world. This will highlight the importance of altering consumption habits if fish like the bluefin have any chance of survival in the future. I will also use economics theory to further consider the tragedy of the commons phenomenon that occurs with common resources while investigating economic factors such as subsidies that encourage overfishing. The perception of fish as a commodity versus a functioning member of wildlife in an ecosystem will also be questioned as I develop practical recommendations to protect the bluefin, which are not motivated by profit maximizing behavior. Furthermore, I will apply the discipline of politics and law to address policies that have failed in their endeavors to maintain a sustainable bluefin population by choosing profit over planet. I will also elaborate on the issue of illegal

fishing and sub-standard regulation that makes international agreements so elusive. Finally, building on my previous analysis, I will formulate a multi faceted policy that incorporates the ecological and intrinsic value of bluefin to find a sustainable solution while suggesting practical changes to current fishery management. I will also illustrate how the rapid rise of "tuna ranching" cannot be considered a sustainable solution as it is highly inefficient for predator species and cannot replace the ecosystem services provided by wildlife.

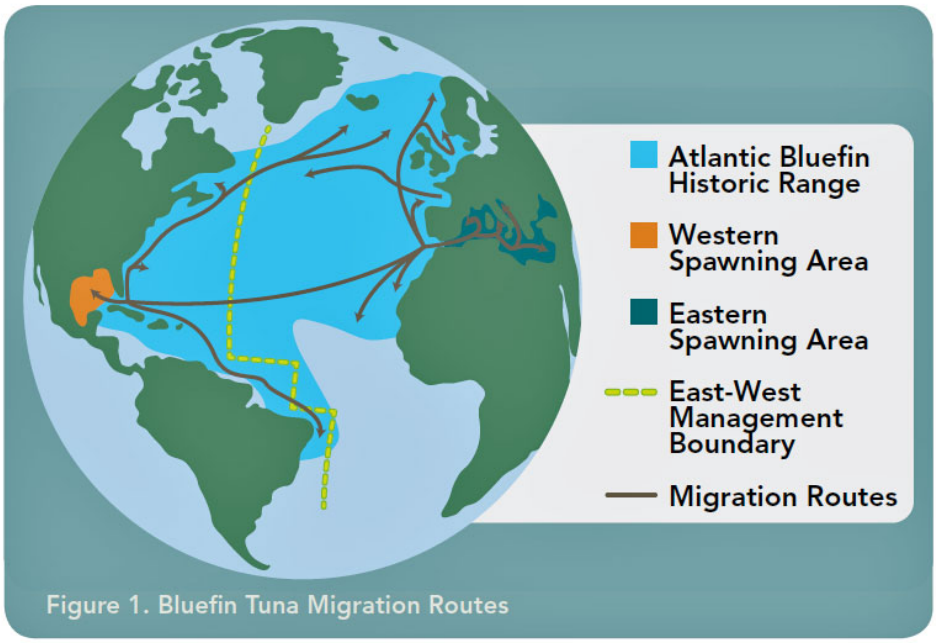

Figure 1. Bluefin Tuna Migration Routes

## Chapter 1: A Unique Species

Atlantic bluefin tuna are highly migratory and opportunistic predators specific to the Atlantic Ocean. The species comprises of two distinct stocks, the West Atlantic bluefin tuna, which spawns in the Gulf of Mexico and the East Atlantic tuna, which spawns in the Mediterranean Sea (shown in Figure.1). Both species interact on a limited basis and are capable of making transatlantic crossings in short time periods. Without

interruption, Atlantic bluefin are capable of living up to forty years while growing to an immense ten feet and one thousand pounds. As a long-lived species, bluefin develop slowly, with the Western stock reaching maturation at age nine, while the Eastern stock matures more quickly by age four. Although a female bluefin lays millions of eggs, few actually make it to adulthood, making this species even more vulnerable to the pressures of overfishing.[4]

Bluefin tuna are biologically astonishing creatures. Evolutionary adaptation has equipped these superior predators with strategic tools for efficiency and success. Considered to be one of the fastest fishes of the ocean, bluefin tuna are capable of swimming up to 55 miles per hour for hundreds and even thousands of miles. With such speed and endurance, bluefin have garnered admiration for being unlike any other fish in the ocean. This has piqued unusual interest and research into the biological factors that make bluefin tuna a hallmark ocean predator. To the untrained in marine biology, a shocking discovery is the warm-blooded physiology of bluefin. A feature adapted solely by bluefin, billfish and lamnid sharks, the ability to elevate body temperature in cold waters allows bluefin to explore the deeper ocean depths in three thousand feet dives. One advantage of this heating mechanism is that the warmth increases delivery of oxygen to the myoglobin of the fish's muscles, making the fish more powerful and capable of catching its prey. Additionally, this warming technique aids in rapid digestion so the predator can feed frequently in cases of prey abundance, while its capacity to warm its brain simultaneously leads to better vision. Comparable to the heating and cooling system

[4] Ellis, Richard. Chapter 2: A Celebration of Tuna (pg 21)

of a refrigerator, bluefin has this prime modification that has allowed it to thrive and function on a higher level than all other fishes.[5]

A truly winning package of natural adaptations, the enviable mechanics of this top predator culminate in an ideal bodily design. Every component of the bluefin is intended to make it a stronger and more formidable hunter. Its sleek conical frame allows for maximum efficiency while maintaining a rigid body structure that concludes in a double-jointed tail providing 90% of the locomotive power.[6] Its first dorsal fin and side pectorals expertly fold into the body in order to reduce drag, thereby creating an intelligent streamline effect to meet less resistance. The bluefin is not just a fish nor should be it limited by that categorization. It is an animal capable of weighing up to 1,500 pounds with the height of a full-grown man and a heart ten times the size of other fishes. As environmentalist Carl Safina wrote in describing his experience with bluefin, "Close your eyes. Think fish. Do you envision a half a ton of laminated muscle rocketing through the sea as fast as you drive your automobile? Do you envision a peaceful warrior capable of killing you unintentionally with one whack of its tail? These giant tuna strain the concept of fish."[7] The profound awe of bluefin tuna has been shared by many, from Aristotle to Ernest Hemmingway. It is a being that warrants interest beyond its culinary significance when we consider that it reigns as king of the fishes in the sea.

There is a wide consensus that bluefin tuna deserve protection on the basis of their intrinsic value. It is true that we cannot idly admire the beauty of bluefin in the same way

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[5] Whynot, Douglas. *Giant Bluefin*. New York: Farrar Straus Giroux, 1995. Print.
[6] Whynot, Douglas. (65)
[7] Safina, Carl. *Song for the Blue Ocean: Encounters along the World's Coasts and beneath the Seas*. New York: Henry Holt, 1999. Print. (9)

that we can with cuddly and cute pandas or impressive rhinoceroses. Indeed, if we allow a great species to die into extinction because we seldom witness the fish in the flesh, we will be committing a great tragedy. Bluefin unto itself is a species worth preservation, deserving the same protection as whales and dolphins. It is necessary that we change the way that these "fish" are perceived within society's supply chains. They are not just food, but rather complex organisms with fascinating characteristics. Bluefin tuna should be regarded as the ultimate fish that is capable of surviving and adapting to almost anything, except man**.**

To express a particular bias towards bluefin tuna is perhaps unfair as all marine life act as complementary elements of a functional ecosystem. When one species is driven to extinction, it undoubtedly affects the overall health and resilience of the community. In the past, fishery management has been based on the trends of a single fish and it often failed in that endeavor. An increasingly popular approach is to regard fisheries management through the lens of an entire ecosystem.[8] This would require us to perceive the Atlantic bluefin tuna not as an individual agent, but as a member of a specific environment with complex interactions and roles. Unfortunately, it is clear today that there is not enough information to fully understand the dynamics of marine ecosystems, though there is much information that has been inferred.

One such study illustrated the potential impact of biodiversity loss on ocean ecosystem services, concluding that species richness enhances ecosystem productivity and stability. The study found that a number of experiments in diet mixing displayed the importance of diverse food sources for secondary production and the channeling of that

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[8] Pauly, D., and J. L. Maclean. *In a Perfect Ocean: The State of Fisheries and Ecosystems in the North Atlantic Ocean*. Washington: Island, 2003. Print.

energy to higher levels in the food web.[9] This gives evidence to the roles that each species plays in creating a healthy ecosystem, and especially the bluefin tuna as an apex predator, with a role to regulate and maintain balance. Predators are important in every environment as they create a vital stability that if threatened, can lead to overpopulation by a particularly reproductive species. Bluefin tuna are incredibly voracious predators that often feed on anything in order to store energy for their migratory journeys. Therefore it is apparent that their extinction would cause disparity in the lower trophic levels. An additional study titled, "Tracking apex marine predator movements in a dynamic ocean" found that top predators exploit their environments in predictable ways that contribute to the foundation of multispecies hotspots in which significant biodiversity is contained. The study goes on to suggest that regions with high productivity are linked to the migration routes of top predators, which could imply the importance of predators in creating a top down structure.[10]

The ecosystems of the sea may be invisible to us, however they are not easy to ignore. The collapse of one fish can directly lead to the collapse of another, but with so many pressures today it can be difficult to find absolute causation. From pollution to trophic exploitation it is fairly well recognized that marine ecosystems face unprecedented stress today that effects its ability to provide ecosystem services. Much of the world relies on the ocean for its provisioning, regulating, supporting and cultural services, however we continue to abuse the ocean's abundant resources.

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[9] Worm et Al.

[10] Block et Al. "Tracking apex marine predator movements in a dynamic ocean." Nature 475. (2011). doi:10.1038/nature10082

In the case of fish, there has been a continual tendency to drive one species to extinction and move onto the next available and abundant species in a boom and bust cycle. It appears we cannot seem to learn our lesson, as this trend is called "fishing down marine food webs" and is widely acknowledged as a severe problem. As one author puts it, "the food webs of the North Atlantic have been drastically shortened, and the whole pyramid of sea life squashed down, forcing us to compete with seals for the few remaining forage fish".[11] Contrary to historical "fact" the sea has limitations that we are rapidly encroaching on as demand exceeds supply. To that end authors Daniel Pauly and Jay Maclean, authors of *In a Perfect Ocean,* give evidence to the fact that total biomass in the sea is declining and that larger fish at the top of the marine web have been steadily decreasing. According to the text, the catch composition of smaller fish indicates changes in abundance in the underlying ecosystem and therefore reflects the collapse of large populations. This in turn forces the fisheries to focus on the lower trophic levels and reduce the food base for predators even further thereby ensuring their demise. The predator tracking study gave a clearer indication of this possibility stating, "a failure to manage marine resources effectively in the Atlantic has led to a decline of pelagic species such as the Atlantic bluefin tuna and the porbeagle shark, and has brought demersal fish, such as cod, to the brink of ecological extinction".[12]

The study goes onto show that the removal of shark and tuna in several habitats has directly correlated with a decline in large fish. A comprehensive analysis suggests that the extinction of bluefin tuna would result in the fishing of the next largest species while lower species in the first trophic level would have exploding populations. This

[11] Pauly, D., and J. L. Maclean. (46).
[12] Block et Al. (4)

unsustainable cycle will clearly result in a sea full of jellyfish and invasive species if the balance between predator and prey is not carefully maintained.

Altering the tropic levels in an ecosystem creates instability and change. It effectively shrinks the food web by reducing a long food chain to a short one, making a community weaker and more vulnerable to environmental fluctuations. Biodiversity allows a community to be much more resilient to unpredictable change so that there is higher chance of recovery afterwards. Climate change also poses incredible challenges to the future of all ecosystems, but it stands much more likely that healthy and thriving ecosystems will be able to adapt. In the face of unpredictability, it is paramount that we allow marine ecosystems to function properly, otherwise all of the potential changes of climate change could decimate entire populations and biomes. Weather patterns, storms, and water temperature are all serious factors that affect marine life's reproductive abilities and potential for survival. One study explored the possible effects of a warming ocean due to acidification and that direct impact upon bluefin tuna's highly specialized spawning behavior.[13] Because bluefin seek out warm water to increase the chances of viability, a change in water temperature due to climate change will effect speed up typical routines and cause changes in the spawning season, location and migratory behavior, therefore leaving them vulnerable to a decrease in reproductive capacity.

Many fish species have adaptations specific to their habitat that confine them to a certain body of water, however a change in water temperature will challenge their normal behavior. A healthy ecosystem is paramount for survival especially as new species that

[13] Muhling, B. A., Lee, S-K., Lamkin, J. T., and Liu, Y. "Predicting the effects of climate change on bluefin tuna (Thunnus thynnus) spawning habitat in the Gulf of Mexico". – ICES Journal of Marine Science, doi:10.109/icesjms/fsr008.

are potentially invasive expand into new territory. The study also points out that if overfishing has reduced the genetic diversity of bluefin tuna then the ability of the species to adapt may be compromised. This illustrates the importance of combating overfishing in order for recovery to occur so that marine ecosystems can remain robust and resilient.

A flourishing ecosystem is also essential when it comes to unexpected pressures instigated by human catastrophe as in the case of the BP crude oil spill. A recent study connects the 2010 environmental disaster to heart abnormalities in large predator species creating future health problems that threaten the mortality rates of an already struggling population. Coauthor of the study, Nat Scholz indicates that although the effects may not be apparent now upon bluefin, fish will be ultimately lost from adult spawning populations.[14] This crippling spill has irreversibly impacted the surrounding ecosystem, but in an area with such high biodiversity**,** there is some hope that recovery is possible. An analysis of the spill one year later shows how much the Gulf has absorbed the spill, but it is also apparent that long-term effects contain unknown variables.[15] With the prediction that the bluefin population will decrease directly because of the spill, it has never been more important to protect this endangered species. If the bluefin's food source is also deminished, it will create even more risks to the survival of spawn that biologically is at a disadvantage due to slow maturation. The species faces attack on all fronts and it is somewhat unimaginable how their disappearance in the Gulf spawning grounds will damage the ecosystem even more than has already been done. Robust and resilient populations are necessary to combat unexpected scenarios like the BP spill,

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[14] Incardona et al. "Deepwater Horizon crude oil impacts the developing hearts large predatory pelagic fish." PNAS 2014 : 1320950111v1-201320950. (2014).

[15] Biello, David. "How long will the Gulf of Mexico Oil spill last?" *Scientific American Global RSS* (2010)

which could be significantly more destructive on a weak ecosystem that is incapable of adapting to change. Inability to recover from the Gulf spill will also pose profound economic woes to a community that thrives off the sea's local abundance.

Industrial fishing has irreversibly damaged many marine ecosystems. Trawlers have turned rich and productive zones into wastelands while bycatch has decimated numerous aquatic populations. The pursuit for an ever-dwindling supply of fish is impacting all members of an ecosystem that is hidden to the human eye, carefully deflecting us away from the guilt we feel with the destruction of the Amazon forest or the precarious status of the Black Rhino. The ocean has largely been denied the consumer awareness that factory farming and Genetically Modified Organisms inspire. It is easy to see why, namely, because both of these environmentally destructive practices are tangible and directly impact our land, whereas the ocean is a far away imagining for many. However, if one takes a closer look at the ocean's vast waters, it becomes apparent just how much these complex basins do for human wellbeing.

For marine ecosystems around the globe, the term "precautionary principle" is becoming increasingly significant as more and more people embrace the uncertainty of the effects of overfishing. The principle states, "that where there is significant risk of damage to the environment, users must take precautionary action to limit the potential risk of damage even where scientific evidence is inconclusive."[16] This is a necessary step, as bluefin's potential extinction will have unpredictable effects upon its ecosystem, but

[16] Berrill, Michael. *The Plundered Seas: Can the World's Fish Be Saved?* San Francisco, CA: Sierra Club, 1997. Print. (54)

by adhering to the precautionary principle there is the opportunity to prevent dire consequences.

## Chapter 2: "The King of Sushi"

Atlantic bluefin tuna was once an integral aspect of Mediterranean culture and tradition, however today the majority of bluefin are exported to Japan where the taste for "toro" sashimi has created a voracious demand for the fatty bluefin flesh. In the past, tuna fishing represented the primary source of income for Mediterranean countries, while today few fisheries are left due to the dwindling stocks of bluefin and market laws that make it an unprofitable venture. Once a traditional way of life for Mediterranean people, the trap fisheries that operated for centuries have been forced out with the explosive popularity of bluefin and the industrialized methods to obtain this golden fish. A once sustainable and localized business has transformed into a massive gold rush inspired by global capitalism. While Mediterranean countries regarded bluefin with great esteem, with one author writing, "the bluefin were to ancient Mediterranean people what the buffalo were to the American Plains Indian," bluefin was originally perceived by other countries as a food fit only for cats and dogs.[17] It was quite literally utilized as pet food, as the Japanese thought the fatty taste of bluefin to be unappetizing while preferring white lean fish.[18] And yet the convergence of a few fortuitous elements would ultimately turn bluefin into the most desired fish of the sea.

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[17] Ellis, Richard (112)

[18] Issenberg, Sasha. *The Sushi Economy: Globalization and the Making of a Modern Delicacy*. New York, NY: Gotham, 2007. Print

After the devastation of World War II, Japanese fishermen sought to secure a stable food supply for domestic demand. Because western occupation in Japan introduced the Japanese palette to greasy fatty foods including beef, there was now an interest and desire for bluefin that hadn't existed before.[19] As Japan worked to recover its post-war economy, an export boom to America ensued in which manufactured goods were being shipped by plane to the US, but returned to Japan empty**,** creating an expensive issue. Businessmen sought out a solution to satisfy Japanese consumer demands and found it in the rise of sport fishing in Canada and on the East Coast. Giant bluefin were being caught solely for recreational purposes and then were discarded as trash. Japanese companies found they could buy the bluefin from these anglers for as little as five cents a pound and export them back to Japan.[20] This only became possible due to the invention of deep freeze technology that allowed the fish to be preserved much longer than the normal rate of decay. The concurrent nature of these events elevated bluefin to a gourmet delicacy that rapidly changed the value of this once pedestrian fish. Richard Ellis, the author of *Tuna: A Love Story* wrote "the ability to catch and freeze large tuna coincided with the unprecedented popularity and price of maguro (Japanese for tuna), which has changed the way the world thinks about bluefin tuna."[21] The taste for fat adopted by sushi's great enthusiasts and the simultaneous effect of prodigious availability was as another author put it "the almost instantaneous invention of value they triggered in a natural resource has little parallel in history."[22]

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[19] Issenberg, Sasha (75)
[20] Greenberg, Paul (203)
[21] Ellis, Richard (143)
[22] Issenberg, Sasha. (Intro xii)


Figure 2.

In only a few years the value of bluefin rose astronomically and so did the number of fishermen seeking their fortune through the meat of this elusive fish. From 1971 to 1988, bluefin went from fetching 40 cents a pound to an astounding 14 dollars per pound making each one of these predators worth thousands of dollars.[23] With a preference for gourmet food and a rise in disposable income, bluefin was regarded with the highest esteem on the raw market. In the seventies, sushi was also finding a niche in Los Angeles as a result of Japanese immigrants and an exposure to this dining ingenuity. Los Angeles was a city of tastemakers and sushi found success in its uniqueness. Its exotic nature gave it appeal, while health conscious individuals perceived it as dietetic option. In essence, sushi in America was born in Los Angeles and its popularity spread to the rest of the country.[24]

Today sushi restaurants can be found almost everywhere, showing just how much this once foreign food has become apart of our culture, as well as a symbol of status. As Ellis illustrates, "consumption is increasing in the United States, Taiwan and

[23] Whynott (86)
[24] Issenberg, Sasha (81)

China…Americans now eat 100,000 tons of tuna as sashimi a year."[25] The more expensive the fish is the more our society clamors to eat it even though its price is clearly an indication of rarity. When Sweden submitted a proposal in 1991 to list bluefin as endangered, Japan and the United States immediately voted it down showing just how far America's interest in bluefin has come.[26] Bluefin is undoubtedly a controversial staple of the most expensive restaurants in the United States including the several Nobu's that span the globe. Considered to be one of the most prominent celebrity sushi chefs in the world Nobu Matsuhisa currently faces ire for his refusal to stop serving bluefin in his fine dining restaurants. However, he did partially bow to pressure and now stipulates on his menu that bluefin is considered "environmentally endangered" showing the power of protest.[27] As minor a success as it is, chefs like Nobu can be instrumental in creating consumer awareness to stop the demand that inspires the exploitation of bluefin.

The history of Atlantic bluefin tuna clearly illustrates a tragedy of the commons. Its considerable value created a free for all that encouraged its current demise. At its most abundant in the 1960s, bluefin catches peaked at 35,000 metric tons, while falling to 20,000 tons in 1964, and even more shocking, to 6,100 tons in 1978.[28] It was a drastic and immediate decline due to the enormous amount of pressure placed on this fish by overcapacity and modernization. It was an era of industrialization for all commercial fisheries who shifted to more efficient techniques and capitalized on spotter planes for accuracy. Japanese long liners consisting of nets spanning miles and reaching hundreds

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[25] Ellis, Richard (142)
[2626] Ellis, Richard. (61)
[27] Clover, Charles. *The End of the Line: How Overfishing Is Changing the World and What We Eat*. New York: New, 2006. Print. (189)

[28] Ellis, Richard (63)

of feet below were capable of catching anything even if it was not the intended species. Using advanced GPS systems and sonar screens, enormous trawlers compete with one another to locate and capture their treasure before another nation or boat can. The popular method of catching bluefin through purse seine fishing is so effective that bluefin numbers have no chance of survival against such ruthless tactics. Additionally, the awareness of bluefin's spawning location rapidly decimated the population as they became easy to catch. It is estimated that North Atlantic breeding populations have fallen an astonishing 90 percent in the last twenty years.[29] Even as the greatest predators of the sea, bluefin could never elude the technology of man or remain untouched by the unquenchable appetite of so many.

The gradual decline of bluefin stock after the pinnacle of abundance in the sixties encouraged fishermen to explore solutions as consumer demand remained unchanged by bluefin's precipitous status. Perhaps this was due to a lack of consumer awareness or the industries desire to do anything in order to keep themselves in business. The solution to the predicament was to find a steady supply, thus rendering, tuna ranching, the answer rather than reducing fishing efforts immediately. The first commercial operation in the Mediterranean was in 1979 where huge fish traps spanning miles of nets would capture juvenile bluefins trying to leave their spawning ground as the season was over in July.[30] In many candid texts, tuna farming is referred to as tuna fattening operations and unlike typical aquaculture methods, young wild tuna are captured and then raised at sea until they are robust and ready for auction. Atlantic bluefin are primarily raised in the Mediterranean where they are easily trapped due to the enclosed elements that delineate

[29] Ellis, Richard (62)
[30] Ellis, Richard (164)

the structure of the sea. Although tuna farming has been economically successful, it is truly detrimental to the environment and has placed further stress on the bluefin population. For example, there are virtually no regulations, restricting the catch of bluefin for farming, as they do not bring their haul into port so they can potentially catch as much as they like. It has been suggested that up to 50 percent of the Mediterranean's bluefin catch is illegal because fish intended for fattening are not included in internationally set quotas.[31] Ellis wrote, "There is better than fifty-fifty chance that people enjoying maguro in Japan are eating fish fattened in pens in the Mediterranean." Additionally, it is a highly inefficient system as tuna are carnivorous and require 10 to 25 kilograms of baitfish to produce only one kg of tuna.[32] This causes fishermen to prey on fish protein that is truly needed to feed a world that relies on these fish for food rather than profit. It only encourages an unfair system that serves to weaken ocean ecosystems as a whole. Furthermore, tuna pens create tremendous amounts of waste as they pollute coastal zones and cause an accumulation of mercury that could be harmful to human health.

With such rapid growth it appears that tuna ranching is now a worldwide industry, but it will only bring extinction to tuna as it an unsustainable system to catch juvenile fish before they are capable of breeding. Already, catches are suffering as so many nations have capitalized on this business and companies are now working on breeding tuna in captivity. The future of bluefin tuna is in serious jeopardy and I find it appalling that instead of immediately instating a moratorium on the fishing of bluefin, humans are trying to breed bluefin in captivity by experimenting with advanced technology. If this continues it means that one day our children will not know wild bluefin tuna, but a man

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[31] Ellis, Richard (64)
[32] Ellis, Richard (64)

made construct of what it once was and they will know an emptier, incomplete ocean and the unimaginable consequences that will accompany this.

## Chapter 3: Unethical Economics

Garret Hardin wrote in his legendary essay "The Tragedy of the Commons," that each man is locked into a system that compels him to increase his herd without limit--in a world that is limited."[33] According to Hardin, individuals will act in a manner that maximizes their own self-interest and because of this common resources will inevitably be destroyed. The basis for this resides upon undefined property rights that encourage depletion of natural resources that are contrary to the whole group's long-term best interests. The ocean is a prime example of Hardin's theory as historically it has been perceived as an inexhaustible resource that because of open access encourages overfishing.

It is a predictable cycle of boom and bust that fisheries all around the world have experienced today. Many nations refuse to recognize the tragedy before them in order to maintain economic prosperity, but there is widespread consensus that open access fisheries are inherently self-destructive. The rapid industrialization of the fishing industry in the last century has given way to superior technology and overcapacity that severely impedes the natural rate of replenishment. The root of this issue is the enormous world population whose appetite for fish has continually increased creating an out of control demand.

Atlantic bluefin tuna pose a special problem because unlike many other fish they are a distinctly migratory species that travel great distances across the Atlantic basin and

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[33] Hardin, G. 1968. "The Tragedy of the Commons". Science 162: 1243-1248 (1968) (2)

the Mediterranean. It is a global fishery shared amongst several nations making international cooperation and effective management difficult. Regulation is also challenging due to the high occurrence of illegal fishing in open waters that are not policed regularly and underreporting quotas creates unreliability. As the most valuable fish in the sea, bluefin tuna are subject to intensive overexploitation as fishermen seek their fortune in the high waters. Bluefin tuna's incredibly competitive and dwindling numbers have only caused a more demanding race for the last fish in a situation that can only spell the extinction of bluefin. In 2001, an enormous bluefin was sold at the Tsukiji fish market in Japan for a record making $173, 600, with each pound costing an astounding $391.[34] It is a proverbial gold rush inspired solely by profit that dismally only speaks to the gourmet palette, rather than food for the many who rely on fish as a major protein source. It is a highly inequitable system that favors capitalist market-based principles to an absurd degree. The ocean is perhaps the final frontier where this unrestrained free for all has allowed wealthy nations to take primary advantage of the sea in order to feed a select few.

The Atlantic and Mediterranean bluefin tuna fisheries are multi-billion dollar industries, fueled by antiquated subsidies and large companies. Despite reports of diminishing catches and higher fuel costs, fishing still exists largely unrestrained in the Atlantic. This is largely in part due to the $50 billion that is globally doled out in subsidies to the fishing industry each year in order to keep fishing commercially viable. Although intended to bolster economic growth, it promotes exploitation and it creates market distortions. *Fish, Markets, and Economics* notes, "by reducing the prices of

[34] Ellis, Richard (140)

natural resources such as fish populations, subsidies discourage their efficient use" as most boats would probably close from poor profits due to a lack of fish.[35] Unfortunately these subsidies create artificial stability that allows for overcapacity and therefore is an incentive for overfishing. It is bad economic policy that governments perceive as an investment in the fishing industry, but rather results in an imbalance that if left to standard market devices, the number of fishermen would stabilize to an allowable figure. There are currently too many boats chasing too little fish and if this continues the entire bluefin industry will collapse. It is paramount that subsidies be scaled back in order to slash the estimated four million fishing vessels that amount to double then what is needed to fish the ocean sustainably.[36] Subsidies have only caused the fishing industry to expand their capacity to fish rather than creating effective policies to limit fishing and therefore ensure an industry that can sustain itself.

It is beyond evident today that we cannot fish in a manner that suggests the ocean is still so abundant, but poor policies only encourage a tragedy of the commons rather than curbing it through proper taxes. The difficulty is that without regulation, economic incentives to stop overfishing are ineffectual. If a tax were to replace a subsidy and stringent oversight was enforced then fishermen and consumer would have to bear the true externalities of catching fish. In this way the environmental effects of catching fish could be internalized to prevent overfishing and extreme prices in the market place would potentially deter consumers from bluefin. Unfortunately, when it comes to bluefin it appears that consumers will pay just about anything to eat this luxury item. It may be

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[35] Iudicello, Suzanne, Michael Weber, and Robert Wieland. *Fish, Markets, and Fishermen: The Economics of Overfishing*. Washington, D.C.: Island, 1999. Print. (60)

[36] Montaigne, Fen. "Global Fisheries Crisis." *National Geographic*. April 2007.

more pragmatic to appeal to a consumer's integrity than their wallet, as although the price of wild bluefin increases the demand does not fall in the way of classical economics. A new approach is required that fuses environmental ethics with economics so that bluefin is perceived as more than just a gourmet food item, but first and foremost as wildlife deserving of intrinsic value.

Fisheries management by ICCAT has been to adopt a total allowable catch (TAC), which seeks to ensure the stability of bluefin populations while maintaining economic prosperity. TAC are quotas that try and place a limit on fishing boats in order to prevent complete open access. The intention is to allocate fish resources to different member states and therefore control the amount of fish that is removed each year. It is a common market intervention implemented since the 1950s by fisheries around the globe, so it not surprising that ICCAT would perceive this as an effective strategy when Atlantic bluefin stocks were first recorded as diminishing. However, faulty science based on models of high recruitment led to optimistically large quotas that did nothing to rehabilitate the bluefin population. The purpose of maximum sustainable yield is to maintain population size at the point of maximum growth rate by harvesting individuals that would be normally added to the population. This theory, inspired by Michael Graham, argues that a fishery is sustainable if removed fish can be replaced by stock production each year. This method of management has found much criticism amongst conservation biologists, who believe that a simple calculation fails to take into account key factors including the size and age of the fish taken.[37]

[37] "Fishing to the Limits: The trouble with maximum sustainable yield and the need for target and limit reference points". *Pew Environment Group*. November 2012.

The management of bluefin is largely regarded as a failure because too many holes make it inadequate. If fish populations are to grow catches should be lowered to take into account errors and variability (See Figure 3). In traditional economics, quotas are found to be more politically attractive than taxes, which can perhaps explain their regrettable prevalence in fisheries management. MSY appears to fall under the category of environmental economics as maximizing profit is still an essential goal of the equation. In An Epitaph For Sustained Maximum Yield Larkin summed it up best, "Here lies the concept MSY. It advocated yields too high, and didn't spell out how to slice the pie. We bury it with best of wishes, especially on behalf of fishes. We don't know yet what will take its place, but hope its good for the human race."[38]

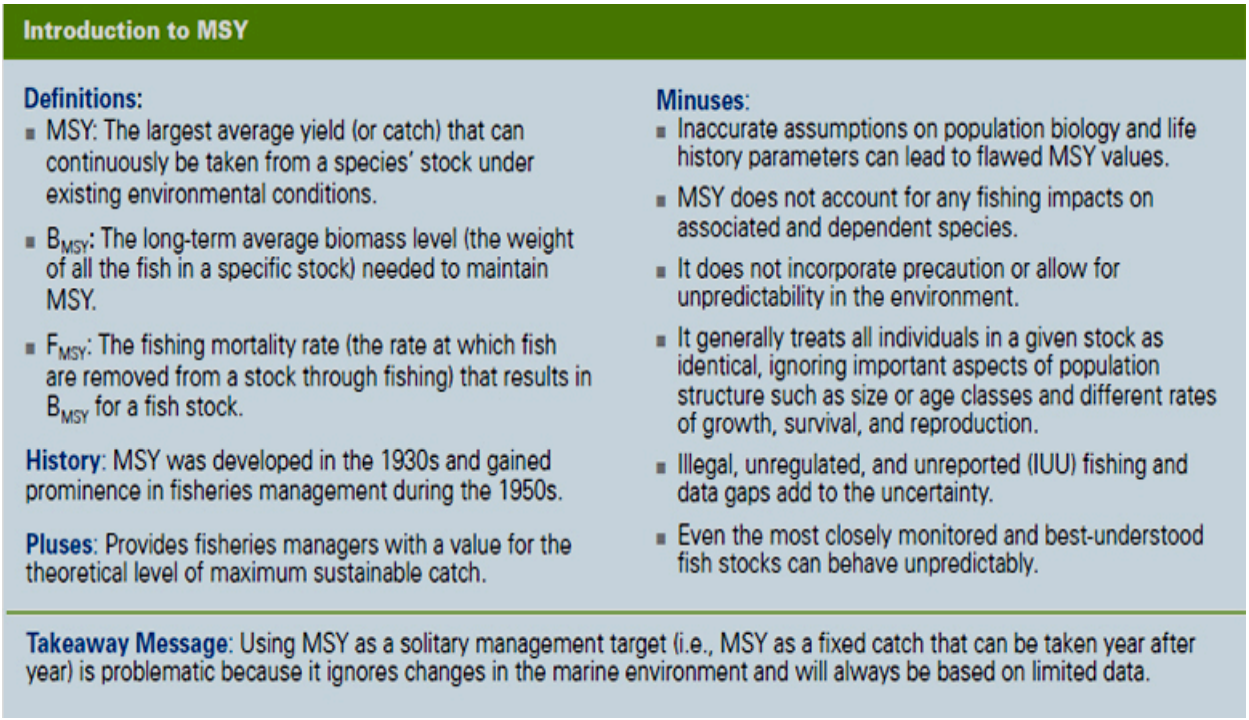


Figure 3.

[38] P. A. Larkin (1977) An Epitaph for the Concept of Maximum Sustained Yield, Transactions of the American Fisheries Society, Vol. 106, Iss. 1, 1997

Ethics have been primarily avoided in favor of economic buoyancy. Regulations and penalties attempting to enforce fishery management have often been flaunted as fishermen seek to maximize their profit in fear of another boat beating them to it. This makes cooperation extremely difficult as self-interested fishermen act only for their own financial good. This mode of thinking has allowed illegal fishing to run rampant as fishermen will underreport quotas, fish during closed seasons and use spotter plans even though they are legally banned.

According to a study by Pew Initiative, the amount of eastern Atlantic bluefin tuna sold on the market was 141% above the legal quota illustrating that policy will always be flawed if cooperation cannot be established.[39] Bluefin is so difficult to protect because no one owns the waters that they circulate through thus policing is mandatory if policy were to be successful. Additionally, the use of surface long lines and other environmentally destructive gear have plagued Atlantic bluefin as well as marlin, sailfish and sharks who are unintentionally caught by the thousands each year. This has been a problem since the 1960s as baited hooks are suspended from lines that stretch miles and kills up to eighty percent of unintended species.[40] The instance of bycatch is an ethical dilemma because it is incredibly wasteful and unfair to deplete precious resources and not catalyzes the depletion of precious resources without the utilization of the protein. Millions of people struggle with hunger everyday and good fish are being thrown out needlessly with completely illogical rationality. It is unethical to threaten the viability of

[39] Bregazzi, Roberto. "Mind the Gap: An analysis of gap between Meditteranean bluefin quotas and international trade figures." *The Pew Environment Group.* October 2011.
[40] Bard, Dave. "Surface Longline fishing in the Gulf of Mexico." *The Pew Charitable Trusts*. 2012.

marine populations when their deaths could so easily be avoided by adopting selective low impact gear.

Currently, fisheries management rely on single species methodology to conceive a biological maximum sustainable yield. It relies on scientific data to project the amount of fish that can be caught each year without reducing the size of next year's stock of reproducing individuals. This is considered to be a sustainable method, yet it is failing radically due to a multitude of variables. Most importantly, time has shown it to be ineffective as populations continue to dwindle and therefore there is a greater interest in approaching overfishing through ecosystem management. This would be replacing traditional economic variables with the comprehensive mode of ecological economics. Ecological economics seeks to preserve the natural capital resources of an environment and addresses the interdependence of human economies and ecosystems. It also perceives natural capital as something that is irreplaceable, which differs from environmental economists who believe that our descendents will discover substitutes for depleted resources. This may be applicable to some resources, but the elements of the ocean cannot be replicated and the unique role that bluefin plays in its ecosystems cannot be supplanted. By focusing on regional large marine ecosystems the preservation is aimed at all species and the complex interactions that sustain their communities.

Engaging in economic valuation, ecological economist Robert Costanzo estimated that marine systems are worth $20.9 trillion a year in the ecosystem services they provide including everything from carbon sequestration to filtration.[41] Ecological economics perceives the entire ecosystem as intrinsically valuable rather then only focusing on the

[41] Costanza et Al. "The value of the world's ecosystem services and natural capital." *Nature*. Vol 387. May 1997.

monetary worth of bluefin. It makes leaving bluefin in the water a higher priority than taking it out and therefore diminishing the quality of an ecosystem. The restoration of ecosystems and the rehabilitation of the bluefin population show a clear advantage for future generations who will be able to maintain a strong fishing economy while receiving the benefits of healthy ecosystems. If we discount the ecosystem services that the ocean provides then we are risking the survival of mankind as our world continues to change.

Ecological economics also incorporates an ethical framework that doesn't just regard bluefin as a commodity or resource, but as a living wild animal who is a valuable member of the earth. Today our consumption of fish is widely out of touch with its source. We do not perceive fish as wildlife, but as food for consumption. The majority of people do not experience a guilty conscience when indulging in fish, but when it comes to meat our morality kicks in. In my view, one of the issues, is that we are disconnected from the ocean because of its lack of visibility. We are disengaged with the process that takes a fish out of the sea and transforms it into an appetizing square on our plate. There is no indication of the being that once pulsed with life rather we have carved up its very essence and made it unrecognizable. A resounding theme of the documentary *Earthlings* is that we are all species of one planet. We share this world and do not have a god given right to empty the ocean of all its life. The imminent extinction of bluefin is only a most prominent symbol for what is happening all around the globe.

The approach taken towards fisheries management echoes the sentiments of the planetary management view. The implementation of a maximum sustainable yield that is translated into total allowable catches suggests that we can somehow manage fish stocks to recovery and abundance. In this way fisheries seek to control nature and manage

stocks only for human benefit. It essentially puts the needs of humans above nature and excludes the value of ecosystem services and the environments intrinsic value. It unfortunately lacks respect for nature and admiration for ecosystems unto themselves. In the case of tuna ranching the goal is to tame nature's complex processes in order to create a continual supply of bluefin tuna rather than to save a majestic wild species. Tuna ranching is inspired by profit hungry individuals who actually hurt the bluefin population and environment more while being able to label their product as a sustainable solution. Planetary management only allows for a gradual death of nature by playing on the belief that technology can replace anything, but the impressive bluefin is hardly expendable.

## Chapter 4: A History of Bad Policy

Atlantic bluefin tuna pose a particularly complex issue when it comes to establishing an international law of rights to this transnational creature. Because it is not local to any one region, this valuable fish isn't entitled to any specific country although there has been considerable conflict inspired by that very desire. The Law of the Sea, the first international law ratified by a multitude of countries was able to establish exclusive economic zones (EEZ) for coastal countries. This was an important step in privatization of a common resource, however there was no specific consensus reached about tuna. But, Article 63 of the Law of the Sea calls for cooperation amongst nations over shared stocks of highly mobile species, which would be applicable to tuna. Unfortunately, countries have interpreted this to mean that tuna belongs to know one and EEZ's have been disregarded in the lawless hunt for tuna.

Established in 1969 the International Commission for the Conservation of Atlantic Tunas (ICCAT) was inspired by the inescapable evidence of decreased catches.

Managing up to thirty species, Atlantic bluefin tuna is its priority as the most valuable and desired fish of the sea. According to their website, ICCAT is an inter-governmental fishery organization responsible for the conservation of tuna in the Atlantic Ocean while also expressively stating science as the basis of their management decisions. This is an interesting point as ICCAT has received much criticism over the years for implementing high quotas that do not adhere to scientist's recommendations. This trend has garnered the nickname International Conspiracy to Catch all the Tunas as ICCAT has largely been ineffectual in rehabilitating Atlantic bluefin stock.[42] The most recent estimates put the western population of Atlantic bluefin at just 36% of its 1970s level and the eastern population is considered 75% below healthy levels.[43] Many believe this to be a result of strong commercial interests who have successfully lobbied for poor laws in order to continue overfishing this extravagantly priced fish. The meager amount of Atlantic bluefin remaining in the ocean seems to give that theory validation, but it has also been the work of illegal fishers and unintended bycatch. ICCAT's quotas fail to take into account how much these numbers affect the recruitment rate of fish as recently it was found that one in five fish are caught illegally amounting to a $23 billion black market.

Yet, conservationist Carl Safina claims that ICCAT has generally had exemplary science, however maintaining cooperation by member states has been the problem. He informs us that the structure of ICCAT has stock assessments and scientific analyses being completed by delegates who are assigned by member countries and these so called managers make recommendations for intended implementation. The key issue is that

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[42] Clover, Charles (33)

[43] Bard, David. ICCAT Takes Positive Action to Rebuild Atlantic Bluefin Tuna Populations, End Illegal Fishing, but Ignores Sharks. Pew Initiative. November 25, 2013.

compliance is voluntary so many countries have failed to act in accordance with policy recommendations and therefore the population of Atlantic bluefin has been unable to recover. Because ICCAT is essentially run by the nations who are extensively fishing bluefin it makes sense that they would be reluctant to restrict their fishing, but it allows the issue to continue unhindered. In some sense they are using ICCAT as a front for greenwashing. Safina quotes an opponent of ICCAT as saying, "although science is supposed to be impartial and objective…even at the scientific level, national agendas and industry objectives are paramount and…color the analyses and interpretations of the results".[44] Factual evidence shows that in 1981 the Commission's Standing Committee on Research and Statistics found that Western Atlantic bluefin were severely depleted and recommended that catches be reduced to as near zero as possible, but the managers set a 1,116 metric ton quota and doubled it to 2,660 the next year from political pressure. This is a profound complication as effective management is impossible without objective oversight that keeps members to their word.

Another additional obstacle is that ICCAT separates the Atlantic bluefin population into two distinct stocks in an effort to separate countries quotas based on region. However, studies have shown that the stocks are prone to mixing and tagging data has revealed that as much as 43-63 percent of the bluefin collected in the west originated in the east.[45] This serves as another barrier to preserving bluefin as higher quotas are often implemented with what is perceived as healthier stock even if it is only because the eastern stock is actually being caught in the West. Using MSY in their policy also did not

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[44] Safina, Carl. "Tuna Conservation." *Tuna: Physiology, Ecology, and Evolution*. Academic Press: London. (2001) (445)
[45] Clover, Charles (35)

take into account the majority of fishermen who targeted only the largest species, which for bluefin is like a death sentence as the large fish have birth rates with the lowest mortality. Because bluefin spawn have a naturally high rate of mortality, MSY predicts far too optimistic levels for population re-growth. Law has historically not been in favor of Atlantic bluefin tuna's survival.

Legal enforcement of quotas has also been difficult to implement as a lack of regulatory resources and commitment to punitive measures has allowed illegal fishing to run rampant. Powerful companies that make up large portions of the fishing industry flaunt quotas and misreport catches. This has become especially prominent with the introduction of the tuna ranching business that allows boats to catch at sea and avoid reporting numbers at landing since they are directly transported to cages for fattening. Fishermen don't face any serious legal action so they continue to do it even though ICCAT is aware of their transgressions. An investigation by International Consortium of Investigative Journalists found that cheating occurs on all levels of the supply chain led by predominantly by the French, Spanish and Italians while the fish are directly sold to the Japanese market. The black market had an estimated revenue of 4 billion between 1998 and 2007 illustrating just how pervasive illegal fishing has become. The biggest issue is that everyone is breaking the rules so accountability is very difficult to enforce as just about everyone is cheating the system. Jean-Marc Fromenti, a marine biologist and member of ICCAT's scientific body said of the situation, "there was no political will to enforce the rules, most notably the quota…until 2008, there was no enforcement. No one declared. There was general cheating." During this time period catches jumped to 60,000

tons, almost double the typical ICCAT quota of 30,000 tons and what is considered to be three times in excess of what ICCAT scientists deemed sustainable.

The report goes on to show that government officials encouraged this system by "fixing" national numbers. For example**,** in 2007 France declared its real catch of 10,000 tons, which was nearly double their ICCAT quota and so triggered a criminal investigation. Unfortunately, the Japanese market who accepts undocumented catches to satisfy the voracious demand for bluefin fuels the real cause of this impulse to cheat the system. Valued at $500 million, the Atlantic bluefin market in Japan is an intricate web of brokers, wholesalers and retailers with the corporate giant Mitsubishi at the top. Controlling over 40 percent of the bluefin market in Japan, Mitsubishi has been implicated in illegal laundering schemes to keep up with demand, yet they have never faced legal penalization. The lack of cooperation expressed by many of ICCAT's member countries explains the difficulty in protecting bluefin as the system makes it easy to cheat and there is no real fear of criminal charges. It cannot be law if breaking it doesn't come with consequences.[46]

[46] Guevara et al. "Overview: The black market in bluefin". *International Consortium of Investigative journalists.* Web. 2012.

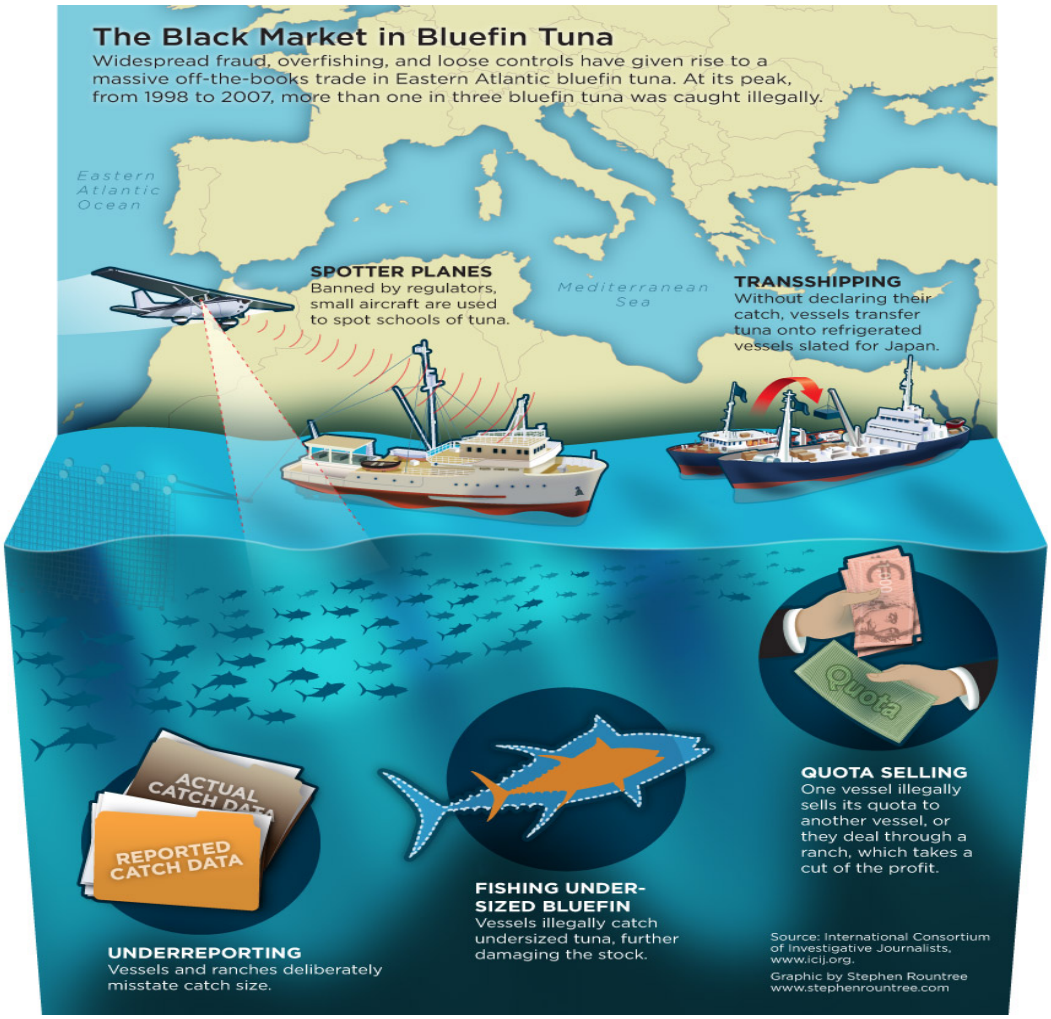


Figure 4. www.publicintegrity.org

As soon as environmental organizations got involved in Atlantic bluefin tuna conservation in the 1990s, they brought outside attention to ICCAT's poor management. During this time the National Audubon Society petitioned the US government to list Atlantic bluefin tuna under the Convention on International Trade in Endangered Species (CITES), which would have prohibited the trade of bluefin. According to Safina, the United States declined the proposal after the U.S fishing industry and their congressional representatives voiced opposition. As mentioned before Sweden also sought to petition to list the species as endangered, but were pressured to withdrawal their proposal by the US

and Japan.[47] Listing bluefin tuna under CITES would guarantee this species the protection it deserves, but because bluefin is so valuable that protection is denied. In 2008 a report commissioned by independent auditors to review ICCAT's performance condemned ICCAT for having, "failed to abide by their legal obligations…failed to conserve bluefin tuna and failed in the eyes of the international community." They called for the immediate closure of bluefin fishing and ranching, but this was unsurprisingly ignored. Yet, the result was that ICCAT did launch a new system called the Bluefin Tuna Document Scheme (BCD) that has sought to bring complete traceability and transparency to the trade. Under the system, vessels are given an individual number for each catch, which follows the fish to ranch, through harvest and then to market. At each point along the supply chain players are supposed to provide detailed information about the catch and the final handwritten report will be submitted into the ICCAT database. But this endeavor has had mediocre successes as the system has been found to have incomplete information and discrepancies that prevent regulators from following the fish from vessel to market.

ICCAT continues to be a façade for an industry that is unwilling to change its behavior even if cooperation means a future for the bluefin fisheries. Otherwise the general consensus to continue breaking the rules and staying profitable in the short term will continue to deplete bluefin stocks until the ocean is empty of their majestic presence and the industry will be forced to close as they will no longer have a commodity to sell. Although this year has finally brought news of ICCAT quotas that adhere to scientific recommendations it is unclear if the quotas are capable of doing anything with illegal fishing as extensive as it is. Pew Initiative also found that the failure to adopt an

[47] Safina, Carl. (448)

electronic bluefin catch system only leaves bluefin susceptible to illegal fishing thus it is clear that ICCAT is still unable to take definitive steps to ensure Atlantic bluefin tuna's full recovery. It is an organization content with doing the bare minimum to satisfy commercial interests rather than the bluefin tuna's interest. A tragic reality as its supposed duty is to protect the bluefin population from extinction, but their methods only encourage further decimation of a population that should be considered endangered. Policy has really only served to fail bluefin tuna as it has done little to curb overfishing while seemingly turning international law into a doctrine of accountability.

## Conclusion: Policy Recommendations

Currently, the future of Atlantic bluefin tuna is undeniably bleak. If policy and consumption habits remain unchanged, commercial and biological extinction are imminent. Existing research indicates that the demand for bluefin tuna is the most significant problem. In my view, if consumers explicitly understand their personal impact upon the marine ecosystem by indulging in bluefin they might otherwise refrain from eating it. The issue is that consumers are simply not aware of the endangered status of bluefin because it appears readily available and its gourmet price makes it an appealing luxury. Japan is a country where officials unfortunately appear to have little regard for natural resources as they continue to hunt whales and even dolphins. It would be a difficult task to persuade Japan to embark on a consumer awareness campaign especially when they unabashedly engage in whale hunting despite a whale moratorium.

Consumer behavior is unlikely to change towards bluefin as the majority of people aren't ethically minded when it comes to seafood. A study on seafood awareness campaigns found that very few Asian consumers discriminate between products in the

context of environmental issues illustrating that sustainably sourced fish isn't a priority in these countries.[48] At a global level, everyone is at fault for consuming seafood without a guilty conscience because it is perceived as food rather than wildlife. Consumer perception towards seafood will take years to evolve and by the time this occurs, wild bluefin may exist no longer.

The most appealing solution to the decimation of Atlantic bluefin tuna is to list it as an endangered species under CITES and call for an international moratorium to bluefin fishing. This is perhaps the only way that bluefin could stand a chance of repopulating. Unfortunately, this proposal is economically impractical and would face opposition by many countries rendering any legislation ineffective. I mention this recommendation only because it is probably the most effective way to rehabilitate the bluefin population, but as long as bluefin fetches such monumental prices there will be no impetus to stop aggressively fishing. Once catches become alarming enough to frighten the fishing community it is likely this policy will be adopted, otherwise they will consciously allow the collapse of the resource they depend upon for income.

The most practical recommendation is a reduction in quotas that more clearly aligns with scientific advice. The reduction would need to be below what is conceived as the maximum sustainable yield to take into account the slow maturation of bluefin as well as environmental factors that hinder population growth. This would be most preferable and accessible for the fishing industry, however it is clear that legal policy is ineffective when regulation is not enforced. If action is to be taken legally ICCAT would need to be replaced by an independent committee that does not take orders from the commercial

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[48] Jacquet, Jennifer and Pauly, Daniel. "The Rise of Seafood campaigns in an era of collapsing fisheries." *Science Direct.* 2006. Web.

fishing industry. If ICCAT cannot be disbanded it needs to be restructured in a manner that will hold it accountable if bluefin stocks do not show recovery in the next ten years. There needs to be some form of checks and balances that keeps ICCAT responsible for progress. Right now ICCAT is incapable of enforcing its quotas on the scale it needs to be and this is an enormous obstacle to cooperation. If ICCAT were capable of enforcing immaculate regulation then they could prevent illegal fishing and demand cooperation rather than ask for it voluntarily. However their history suggests that this is unfeasible and unlikely as they are too susceptible to commercial interests.

I also recommend that fishing subsidies be immediately repealed. Subsidies serve only to create an imbalance that leads to over capacity and therefore overfishing. There are quite literally too many boats chasing too little fish. If subsidies were abolished the industry wouldn't be able to support that overcapacity and companies would be forced to exit as it would be unprofitable to remain. This is naturally what should occur, but subsidies are a crutch that allow fishermen to stay in business when the market can't actually support it. The end of subsidies will alleviate the pressure on bluefin significantly, but considering the severely threatened status of bluefin there needs to an incentive to drastically impede fishing efforts. Although quotas are preferable to taxes, they are not efficient for policy when members do not cooperate and cheat the system. Unless punitive regulation is implemented to hold nations accountable when they transgress quotas this will never be a fully viable option to prevent overfishing. Because of this, landing taxes should be invoked that gradually rise with higher catches so there is an incentive to catch less. Revenue generated by taxes could be used by ICCAT to create sanctuaries for the Atlantic bluefin where they could be protected from the constant hunt.

Sanctuaries predominantly in coastal zones where spawning occurs would allow juvenile populations to mature without threat of tuna ranchers taking fish prematurely. Marine sanctuaries have been shown to be extremely effective in restoring fish populations to healthy levels and in coastal areas they provide enormous benefits for ecotourism. The Gulf of Mexico is sorely in need of economic revitalization after the BP disaster and therefore a designated sanctuary there could be an opportunity for ecotourism and new jobs.

The most essential strategy is to implement environmental education in our classrooms. This should be a priority, as it will equip the next generations with an ethical framework that gives value to our ecosystem. Environmental education emphasizes nature as an entity that we apart of, rather than separate from and it teaches people to perceive nature without monetary lenses. Consumer awareness has the potential to save Atlantic bluefin tuna and if a conscious mindset that relies on environmental wisdom is developed at a young age consumers can't feign ignorance or indifference. If consumers understand their impact upon the environment then they will have to make a morally informed decision and this would probably result in choosing to forgo consuming endangered species. This mindset can only grow by encouraging an education that includes an understanding of our environment and our relationship to it. It is important to show that we are not stewards or managers of the environment, but connected members of the environment that rely upon this planet to exist. Not all hope is lost for bluefin tuna as there is a choice to continue the extinction of this species or to change our ways and make sure this incredible species is saved. If we teach the next generations of this world to perceive food as more than just sustenance for humans, but as apart of nature and a

complicated ecosystem then a new mindset can be developed. Consumer awareness and environmental education are the best strategies to ensure the survival of bluefin as once demand goes down there won't be a market for this fish and than conservation efforts can take place to rehabilitate what is left of the beautiful wild bluefin.

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